U.S. Consumer Product Safety Commission
LOG OF MEETING

Subject: Meeting with Dr. Arlene Blum on Flame Retardant Chemicals

Date of Meeting: November 13, 2007

Log Entry Source: Dale R. Ray, Project Manager, Upholstered Furniture Flammability, Directorate for Economic Analysis, (301) 504-7704

Date of Log Entry: December 10, 2007

Meeting Location: CPSC Headquarter, Bethesda, MD

CPSC Attendees:
Dale Ray (Project Mgr., Furniture), Directorate for Economic Analysis
Michael Babich, Directorate for Health Sciences
Treye Thomas, Directorate for Health Sciences
Marilyn Wind, Directorate for Health Sciences
Patty Adair, Directorate for Engineering Sciences
Allyson Tenney (Project Mgr., Mattresses), Directorate for Engineering Sciences
Robert Franklin, Directorate for Economic Analysis
Chuck Smith, Directorate for Economic Analysis
Gregory Rodgers, Directorate for Economic Analysis
Russ Roegner, Directorate for Epidemiology
Kathleen Stralka, Directorate for Epidemiology
Joel Recht, Directorate for Laboratory Sciences
Patty Pollitzer, Office of the General Counsel

Non-CPSC Attendees:
Arlene Blum University of California, Berkeley
Len Sweet, Chemrisk, Inc.
Helen Sullivan, In House Communications
Russ Batson, American Home Furnishings Alliance
Keith Hughes, Chemtura Corp.
Ron Dombrowski, Tech Tex Solutions, Inc.
Steven Valentine, K&L Gates law firm (rep. Supresta, Inc.)
Chrys Lemon, McIntyre Law Firm (rep. Polyurethane Foam Ass'n.)
Phil Wakelyn, National Cotton Council
Laura Ruiz, Albemarle Chemical Co.
Barbara Little, Albemarle Chemical Co.

Summary of Meeting:

Dr. Blum requested this meeting to give a presentation to the CPSC staff entitled "The FR Dilemma," and to discuss her concerns about potential environmental safety and health impacts associated with the use of certain flame retardant (FR) chemicals in upholstered furniture and other products. An outline of Dr. Blum's talk and a copy of her PowerPoint slide presentation are attached.

Dr. Blum stated her views on a variety of issues related primarily to the CPSC staff's 2005 draft standard for upholstered furniture; this draft standard contained open flame ignition requirements for upholstery materials that would likely be met with FR additives in polyurethane foam and other fillings. She questioned whether the available fire loss data could demonstrate the effectiveness of California's furniture regulation (TB-117), and therefore questioned the efficacy of polyurethane foam FRs used to meet that regulation. She expressed particular concern about chlorinated tris phosphate chemicals, one of which was identified in the CPSC staff's upholstered furniture risk assessment as posing a potential cancer risk. She also expressed concern about the lack of toxicity and exposure data on many FRs, including a leading bromine- and phosphorus-containing mixture that replaced a recently-discontinued bromine compound. She presented a memo, from the Global Development and Environmental Institute of Tufts University, that criticized the CPSC staff's preliminary regulatory analysis for not including estimates of monetary damages associated with the use of FR materials. This memo is also attached.

Dr. Blum said that with the likely increase in prevalence of reduced ignition propensity cigarettes and the increasing incidence of fire sprinklers in residences, there are ways to reduce fire risks without potentially toxic chemicals.

Dr. Blum's policy recommendations were that:

- all FR chemicals should be required to be shown safe for human health and the environment before they chemicals are allowed to be used in products;
- more research and development resources should be devoted to developing non-toxic, "green chemistry" FRs; and
- a moratorium should be imposed on new flammability regulations until new "green" FRs are developed or existing FRs are demonstrated to be safe.

In discussing a potential furniture regulation, Dr. Blum expressed support for a furniture industry recommendation that CPSC consider adopting the voluntary UFAC guidelines as a smoldering ignition standard, on the basis that this option would not require FR fabrics or filling materials. Mr. Ray asked Dr. Blum whether she had similar concerns about the use of inherently FR fiber barriers such as those used in mattresses to comply with the recent CPSC mattress rule. Dr. Blum responded that she was not particularly concerned about those barrier products, although she said she would like to know more about end-of-life-cycle issues like potential effects on landfills and other aspects of environmental quality.

The staff and the outside meeting participants discussed all of these topics with Dr. Blum, and questioned some of her assumptions and conclusions. Mr. Ray assured Dr. Blum that the staff would consider the issues she raised in the development of possible regulatory alternatives for upholstered furniture.

Fire Retardant Dilemma Briefing, November 13, 2007

New flammability regulations are likely to have negative impacts on the health of Americans and their environment

There is lack of scientific information on the human and animal health and environmental impacts of the potentially toxic chemicals that are being used as fire retardants in furniture and other consumer products. The chemicals being used to meet the California furniture flammability standard either have no health data or data suggesting harm. The Polyurethane Foam Association estimates 17 to 70 million additional pounds of potentially toxic chemicals would be used to meet the current Consumer Product Safety Commission draft standard.

The same tris that was removed from children's pajamas in 1977 is now used in furniture.

After Tris fire retardants used to treat children's sleepwear were found to be mutagens, possible human carcinogens, and to leach from sleepwear into children's bodies, these chemicals were removed from use in children's sleepwear. The same chlorinated tris that was removed from children's sleepwear 30 years ago is currently the second most-used fire retardant in foam in furniture in the US, used in levels up to 5% of the weight of the foam. Tris is a mutagen and a carcinogen and recent CPSC studies predict up to 300 cases of cancer per million people exposed to tris in furniture for a lifetime. The estimated cancer risk in children from two years of exposure to chlorinated Tris-containing furniture is 20 per million. **If tris were used across the US, the CPSC risk analysis predicts up to 1,200 additional cases of cancer annually from exposure.**

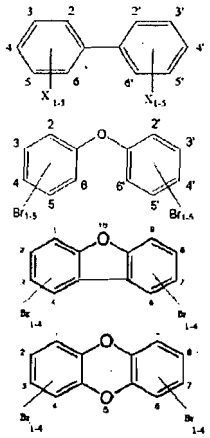
A. Blum and B.N. Ames, *Flame retardant additives as possible cancer hazards: The main flame retardant in children's pajamas is a mutagen and should not be used.* Science 195, 17 (1977).
M.D. Gold, A. Blum, B.N. Ames, et al, *Children Absorb Tris-BP Flame Retardant from Sleepwear: Urine Contains the Mutagenic Metabolite, 2,3-Dibromopropanol.* Science 201, 1020 (1978).
M. D. Gold, A. Blum, and B.N. Ames (*Another Flame Retardant, Tris- (1,3-Dichloro-2- Propyl)-Phosphate, and Its Expected Metabolites and Mutagens.* Science 200, 785 (1978)
Dec 21, 2006 CPSC report by Michael Babich
see http://www.cpsc.gov/library/foia/foia07/brief/ufurn2.pdf page 5

We continue to move from one toxic fire retardant chemical to another

Toxic PBDEs were used to treat furniture foam from the early 1980s until they were banned by the CA legislature and the manufacturer ceased production in 2004. They were replaced by chlorinated tris, a known toxicant, and also unknown proprietary mixtures containing chemical cousins such as chloroalkyl phosphates, halogenated aryl esters, and tetrabromophthalate diol diester. **The most recent EPA study shows areas of concern large data gaps for human health and environmental safety information for all of the fire retardant chemicals currently used in furniture.**
Furniture Flame Retardancy Partnership: Environmental Profiles of Chemical Flame-Retardant Alternatives for Low-Density Polyurethane Foam, EPA 742-R-05-002A, September 2005 p. 4-2 to 4-5.

PBDEs are similar in structure to PBBs, PCBs, and Dioxins.

Many of the same adverse health effects and proposed mechanisms found in animal and humans from the known toxicants PCBs. PBBs, dioxins and furans are found in animals exposed to PBDEs.



PBBs
X=Br
PCBs
X=Cl

PBDEs

Brominated
Furans

Brominated
Dioxins

The average US woman's body burden of PBDEs is approaching levels that cause reproductive and neurological impacts in animals.

PentaBDEs disassociates from foam and migrates into the indoor air and household dust. **PBDE levels in CA, both in the most polluted part of Richmond and in pristine Bolinas, are 3 to 10 times higher than other states. US levels are ten times higher than European levels.**

For US women, the highest five percent have PBDE tissue concentrations equal to those that cause reproductive changes in the offspring of pregnant experimental animals and within a factor of ten of the level that causes neurological changes. The **mean PBDE tissue concentrations found in US woman are one third the level that cause reproductive impacts, and three percent of the level that cause adverse neurological effects in animal studies.**

Thomas A. McDonald, Polybrominated Diphenylether Levels among United States Residents: Daily Intake and Risk of Harm to the Developing Brain and Reproductive Organs, Integrated Environmental Assessment and Management, Volume 1, Number 4, pp. 343–354

Human epidemiology studies are beginning to be carried out on PBDEs and other FRs.

Dozens of scientific studies are under way looking at **the relationship of other fire retardant chemicals to birth defects, autism, hyperactivity, reduced fertility and sperm counts and other neurological and reproductive conditions.**

A study at Copenhagen University Hospital **associates cryptorchidism, a condition in which one or both testicles fail to descend into the scrotum, with higher concentrations of PBDEs in breast milk.** In 2006, Swedish researchers **linked early-onset testicular cancer with higher levels of maternal PBDEs.**

PBDE autism connection being studied by Irva Hertz-Picciotto at the Mind Institute at UC Davis and also at the US EPA.

So far in 2007, there are more than 120 published peer reviewed studies on health impacts and bioaccumulation of PBDEs alone

PCBs, Tris, Halon, Asbestos, PBDEs are all fire retardant materials which are turning out to have a seriously long term negative effect on our health and/or environment. Once millions of pounds of toxic fire retardant materials **such as** these enter the global environment, it is impossible to recall them. Increasing the use of such flame retardants without testing them in advance is questionable.

EPA and CPSC do not have the authority to protect the public from toxic chemicals in consumer products. Chemical producers are not required to provide health and safety information before their chemicals are licensed and usually do not.

Manufactures are only required to submit minimal toxicity data for new chemicals. **Out of an estimated 62,000 old chemicals in commerce, only five chemicals have been regulated by TSCA.** No old chemicals have been regulated since 1990 when the regulation of asbestos was reversed in a lawsuit against the EPA.

Hundreds of peer reviewed journal articles show that brominated fire retardant chemicals are accumulating in humans and their environment and cause health problems in animal studies. Some examples are below

Linda S. Birnbaum and Elaine A. Cohen Hubal, *Brominated flame-retardants: Cause for concern?* Environmental Health Perspectives, Volume 112(2004).

P. Eriksson, E. Jakobsson, A. Fredriksson, *Brominated flame-retardants: a novel class of developmental neurotoxicants in our environment?* Environmental Health Perspectives, Volume 109, No. 9, pp 903-908(2001).

Henrik Viberg, Anders Fredriksson, et. al, *Neurobehavioral derangement in adult mice receiving decabrominated diphenyl ether (PBDE 209) during a defined period of neonatal brain development*, Toxicological Sciences, Volume 76, pp 112-120(2003).

American Public Health Association, October 27, 1993 9304: Recognizing and Addressing the Environmental and Occupational Health Problems Posed by Chlorinated Organic Chemicals

M.M. Schantz, S.A. Wise, *Polybrominated diphenyl ethers in house dust and clothes dryer lint.* Environmental Science and Technology, 39, (4), 925-931(2005).

Matthew Lorber,. *Review: Exposure of Americans to polybrominated diphenyl ethers,* Journal of Exposure Science and Environmental Epidemiology advance online publication 11 April 2007;

Arnold Schecter, Olaf Päpke, T. Robert Harris, K.C. Tung, Alice Musumba, James Olson, and Linda Birnbaum, *Polybrominated Diphenyl Ether (PBDE) Levels in an Expanded Market Basket Survey of U.S. Food and Estimated PBDE Dietary Intake by Age and Sex,* Environmental Health Perspectives • Volume 114, Number 10(October 2006)

Peter S. Ross, Fireproof Killer Whales (Orcinus orca): Flame Retardant Chemicals and the Conservation Imperative in the Charismatic Icon of British Columbia, Canada. Journal of Fisheries and Aquatic Sciences, Volume 63, Number 1, pp. 224-234 (11) (January 2006).

A. Schecter, M.P. Vuk, O Papke, J.J. Ryan, L. Birnbaum, R. Rosen., Polybrominated diphenyl ethers (PBDEs) in US mothers' milk. Environmental Health Perspectives 111, (14), 1723-1729(2003)

K. Thuresson, P. Hoglund, L. Hagmar, A. Sjodin, A. Bergman, K. Jakobsson, Apparent half-lives of hepta- to decabrominated diphenyl ethers in human serum as determined in occupationally exposed workers. Environmental Health Perspectives, 114, (2), 176-181(2006).
Voorspoels, A. Covaci, P. Lepom, S. Escutenaire, P. Schepens, Remarkable findings concerning PBDEs in the terrestrial top-predator red fox (Vulpes vulpes). Environmental Science & Technology 40, (9), 2937-2943(2006),.
J.R.Christensen, M. Macduffee, R.W. Macdonald, M. Whiticar, P.S. Ross,, Persistent organic pollutants in British Columbia grizzly bears: Consequence of divergent diets. Environmental Science & Technology 39, (18), 6952-6960(2005).
Johnson-Restrepo, K. Kannan, R. Addink, D.H. Adams, Polybrominated diphenyl ethers and polychlorinated biphenyls in a marine foodweb of coastal Florida. Environmental Science & Technology, 39, (21), 8243-8250(2005).
A. Schecter, et al, Polybrominated Diphenyl Ether Flame Retardants in the U.S. Population: Current Levels, Temporal Trends, and Comparison With Dioxins, Dibenzofurans, and Polychlorinated Biphenyls Journal of Occupational and Environmental Medicine, Volume 47, Number 3, March 2005
M.M. Schantz, S.A. Wise, Polybrominated diphenyl ethers in house dust and clothes dryer lint. Environmental Science and Technology, 39, (4), 925-931(2005).
N. Wu, T. Herrmann, et al. "Human exposure to PBDEs: associations of PBDE body burdens with food consumption and house dust concentrations." Environmental Science and Technology 41(5): 1584-9(2007).
D. Fischer, K. Hooper, M. Athanasiadou, I. Athanassiadis, A. Bergman,, Children show highest levels of polybrominated diphenyl ethers in a California family of four: A case study. Environmental Health Perspectives, 114, (10), 1581-1584(2006).
Brominated Flame Retardants: Rising Levels of Concern
SARAH JANSSEN, M.D., PHD, M.P.H, JUNE 2005, Health Care Without Harm white paper
http://www.noharm.org/us/bfr/issue
U. Gill, I. Chu, J.J. Ryan J, M. Feeley.Polybrominated Diphenylether Levels among United States Residents: Daily Intake and Risk of Harm to the Developing Brain and Reproductive Organs, Integrated Environmental Assessment and Management Volume 1, pp. 343–354,(2005)
U. Gill, I. Chu, J.J. Ryan J, M. Feeley. Polybrominated diphenyl ethers: human tissue levels and toxicology. Rev Environ Contam Toxico 183:55-97(2004).
T, Colborn, Neurodevelopment and endocrine disruption. Environmental Health Perspect. 112(9):944-9(June 2004).
Grandjean P.,. Landrigan PJ, Developmental neurotoxicity of industrial chemicals., Lancet. 2006, Dec 16;368(9553):2167-78.
L,T.Van der Ven, A. Verhoef, et al, 28-day oral dose toxicity study enhanced to detect endocrine effects of hexabromocyclododecane in Wistar rats. ., Toxicology Science. 2006 Dec;94(2):281-92(December 2006). Epub 2006 Sep 19.
Lunder S, Sharp R. 2003. Mothers' Milk: Record levels of toxic fire retardants found in American mothers' breast milk. Environmental Working Group. www.ewg.org/reports/mothersmilk/
Schecter, A.; Vuk, M. P.; Papke, O.; Ryan, J. J.; Birnbaum, L.; Rosen, R., Polybrominated diphenyl ethers (PBDEs) in US mothers' milk. Environmental Health Perspectives 2003, 111, (14), 1723-1729
WWF Detox Campaign, Results of WWF's European Family Biomonitoring Survey, Brussels, Belgium, 2005
B. Fangstrom, L. Hovander, et al"Concentrations of polybrominated diphenyl ethers, polychlonnated biphenyls, and polychlorobiphenylols in serum from pregnant Faroese women and their children 7 years later." Environ Science and Technology 39(24): 9457-63. (2005).
J.A. Dye, M. Venier, C.R. Ward, L.Y. Zhu, R.A. Hites, L.S. Birnbaum: Pet Cats In The U.S. Have High Polybrominated Diphenyl Ether (PBDE) Serum Levels. Society of Toxicology2007 meeting Abstract number 853
Timo Hamers,et al, **In Vitro Profiling of the Endocrine-Disrupting Potency of Brominated Flame Retardants** TOXICOLOGICAL SCIENCES 92(1), 157–173 (2006),Advance Access publication April 6, 2006, doi:10.1093/toxsci/kfj187

Only CA currently has a furniture flammability standard. After 26 years of use, fire data is not precise enough to show whether or not lives

have been saved from this standard. This implies that the impact on fire deaths is nost likely small

From 1980 to 1999, states that didn't regulate furniture flammability experienced declines in fire death rates similar to that seen in California.

5 Year Averages of Fire Deaths
1980-1984 Compared to 1995-1999

• California,	down 32%	• Pennsylvania,	down 30%
• Texas,	down 33%	• Illinois,	down 39%
• New York,	down 40%	• Ohio,	down 39%
• Florida;	down 31%	• Michigan,	down 30%

Source John R. Hall Jr, June 2006, U.S. Unintentional Fire Death Rates By State, Fire Analysis and Research Division, National Fire Protection Association

Reduced Ignition Propensity (RIP) cigarettes appear to reduce fire deaths by 50 to 66% and are the law for over half the US population

Laws in 22 U.S. states and Canada require cigarettes to be constructed so that they will self-extinguish if left unattended, and the other states are considering such regulations. Early estimates fom New York State suggest RIP cigarettes could lead to a half to two thirds reduction in fire deaths and reduce the need for fire retardant chemicals in consumer products. RJReynolds Tobacco Co, (35% of the market) has announced that it will phase in RIP cigarettes for all its brands, with full distribution to be completed within two years. Phillip Morris will likely follow suit in the near future..

Second International Conference on Fire "Safer" Cigarettes, Sponsored by: Harvard School of Public Health, December 11-12, 2006 http://www.hsph.harvard.edu/tobacco/agenda.html

The CPSC draft standard would increase FR usage levels

- **According to the CPSC, their estimated 3-7% increase in FR usage [compared to California standard] to meet CPSC staff's 2005 revised draft.**

Only a relatively small number fires addressed by the added chemical fire retardants

The chemicals are primarily added to meet an open flame standard. There were an estimated 20 deaths in open flame fires in which upholstered furniture was the first item ignited nationally and 220 such upholstered furniture fire deaths with unknown origins in 2003, according to the CPSC as below

ESTIMATED RESIDENTIAL STRUCTURE FIRE DEATHS
By Item First Ignited

Product	1999	2000	2001	2002	2003

Upholstered Furniture	**430**	**580**	**620**	**460**	**560**
Smoking Material Ignition	330	340	380	200	310
Open Flame Ignition	30	120	50	30	20
Other	70	120	190	230	220

Source: U.S. Consumer Product Safety Commission/EPHA, from data obtained from the U.S. Fire Administration and NFPA

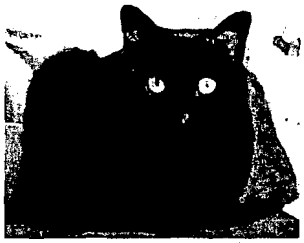
California has current legislation, (AB706), to alter their furniture flammability standard due to serious human health and environmental concerns.

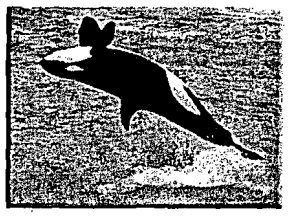
It is prudent to take a precautionary or "better safe than sorry" approach when introducing potentially toxic materials into consumer products
Women who were highly exposed to DDT before the age of 14 have a five times greater risk of breast cancer before the age of fifty than populations with low exposure. It has taken up to fifty years since the exposure to obtain this evidence of cancer causation.
DDT and Breast Cancer in Young Women: New Data on the Significance of Age at Exposure
Barbara A. Cohn,1 Mary S. Wolff,2 Piera M. Cirillo,1 and Robert I. Sholtz1
VOLUME 115 | NUMBER 10 | October 2007 • Environmental Health Perspectives

Introducing potentially toxic chemicals into our environment without adequate human health and environmental information is like carrying out a study of cancer, reproductive and neurological effects with our population as the test subjects

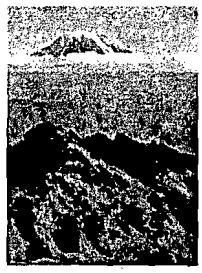
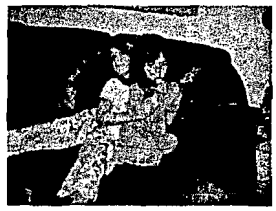
Policy Recommendations

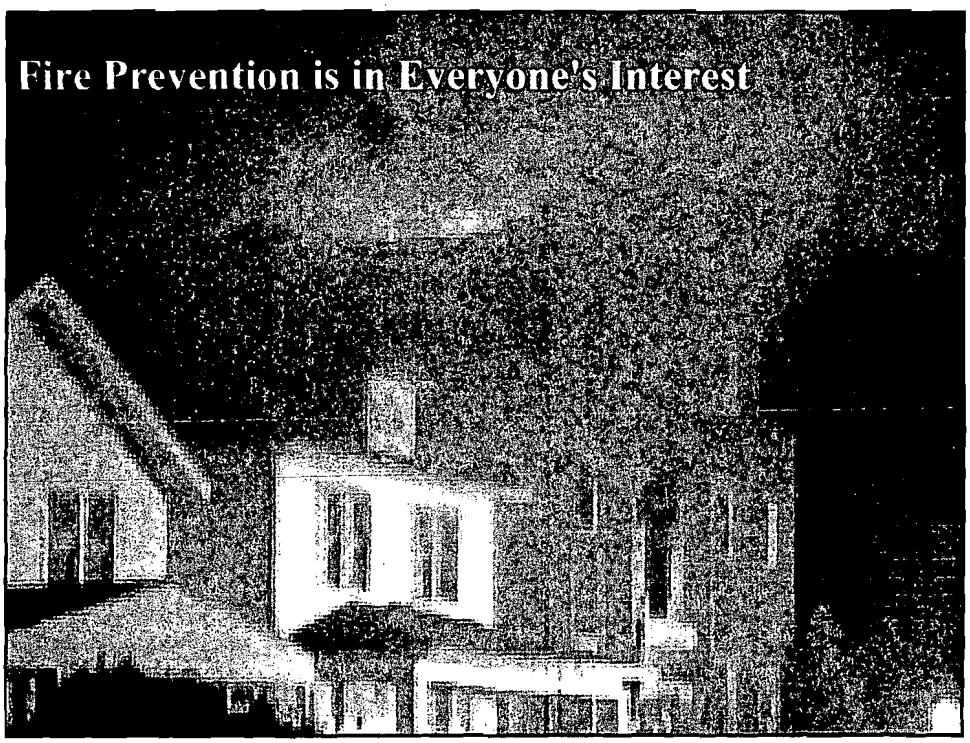
- All fire retardant chemicals must be shown to be safe for human health and environment before use in consumer products.
- R&D money is needed to design and produce non-toxic fire retardants using green chemistry.
- There should be a moratorium on new regulations that would be met by the use of additional fire retardant chemicals until new green fire retardants have been developed or current chemicals have been show to be safe.





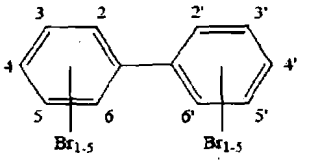
The Fire Retardant Dilemma



Past Hazardous Chemicals and Materials that contributed to Fire Safety

- **PBBs**
- **PCBs**
- **Brominated Tris**
- **Halon**
- **Asbestos**
- **PBDEs**



Polybrominated Biphenyls (PBBs)

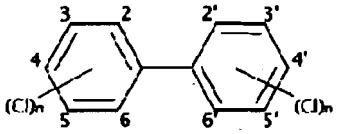
209 theoretically possible congeners

Divided into ten homolog groups, mono to decabromo

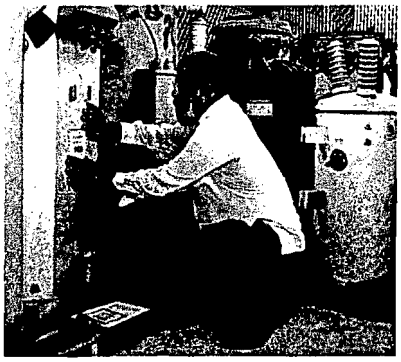
In Michigan PBBs were accidentally mixed with livestock feed in 1973. 1.5 million chickens, 30,000 cattle, 6,000 pigs, and 1,500 sheep that ate the feed had to be destroyed.

PBBs can cause nervous, immune systems liver, kidneys, and thyroid gland disease in animals.

PBBs are anticipated to be human carcinogens.



209 theoretically possible congeners
Divided into ten homolog groups,
Mono to decaPCB



PCBs banned in 1977

PCBs cause cancer and serious adverse health effects on the immune, nervous, reproductive, and endocrine system's of animals.
PCBs are probable human carcinogens. **US EPA**

Tris-BP Flame Retardant

Tris (2,3-dibromopropyl) phosphate

- Used to treat children's sleepwear from 1975 to 1977 in the US
- Up to 10% of the weight
- Padded on to fabric, not attached
- Impurity is 0.05% DBCP or (1,2,dibromo-3-chloropropane)
- Metabolite is 2,3-dibromopropanol
- DBCP and 2,3-dibromopropanol found to be carcinogens in 1973.

Science, January 7, 1977

Flame-Retardant Additives as Possible Cancer Hazards

The main flame retardant in children's pajamas is a mutagen and should not be used.

Arlene Blum and Bruce N. Ames

Thousands of chemicals to which humans have been exposed have been introduced into the environment without adequate toxicological testing.

Some chemical flame retardants provide a good example of a technological innovation where adverse environmental effects may outweigh some of the benefits.

Until recently, little attention was paid to the long-term biological effects of these flame-retardant compounds. The main organic chemicals used in flame retardants contain bromine or chlorine or they are phosphate esters. Some have chemical structures (discussed below) that are closely related to compounds known to cause cancer or to be toxic to animals. Several compounds previously used as flame retardants have been shown to be teratogenic, carcinogenic, mutagenic, or highly toxic (4).

CPSC Bans TRIS-Treated Children's Garments

FOR IMMEDIATE RELEASE

April 7, 1977

Release # 77-030

Table 1. Morning urine samples were obtained from a 7-year-old child. On days 1 and 2 and 8 to 12 the child was wearing repeatedly washed sleepwear that may have been tris-BP–treated; on days 3 to 7 she was wearing new tris-BP–treated pajamas.

Day	New treated pajamas	Dibromopropanol (mg/ml)
1	No	0.4
2	No	0.4
3	Yes	11
4	Yes	29
5	Yes	*
6	Yes	21
7	Yes	18
8	No	9
9	No	14
10	No	6
11	No	6
12	No	8

*The urine was lost.

Children Absorb Tris-BP Flame Retardant from Sleepwear: Urine Contains the Mutagenic Metabolite, 2,3-Dibromopropanol

Abstract. *The flame retardant, tris(2,3-dibromopropyl)phosphate (tris-BP), which is a mutagen and causes cancer and sterility in animals is absorbed from fabric by people. 2,3-Dibromopropanol, a metabolite of tris-BP and a mutagen itself, has been found in the urine samples of ten children who were wearing or who had worn tris-BP–treated sleepwear. Eight of these children were wearing well-washed sleepwear and the possibility of absorption of tris-BP from well-washed sleepwear is discussed. 2,3-Dibromopropanol was not found in the urines of one child and one adult who had never worn tris-BP–treated garments.*

Science

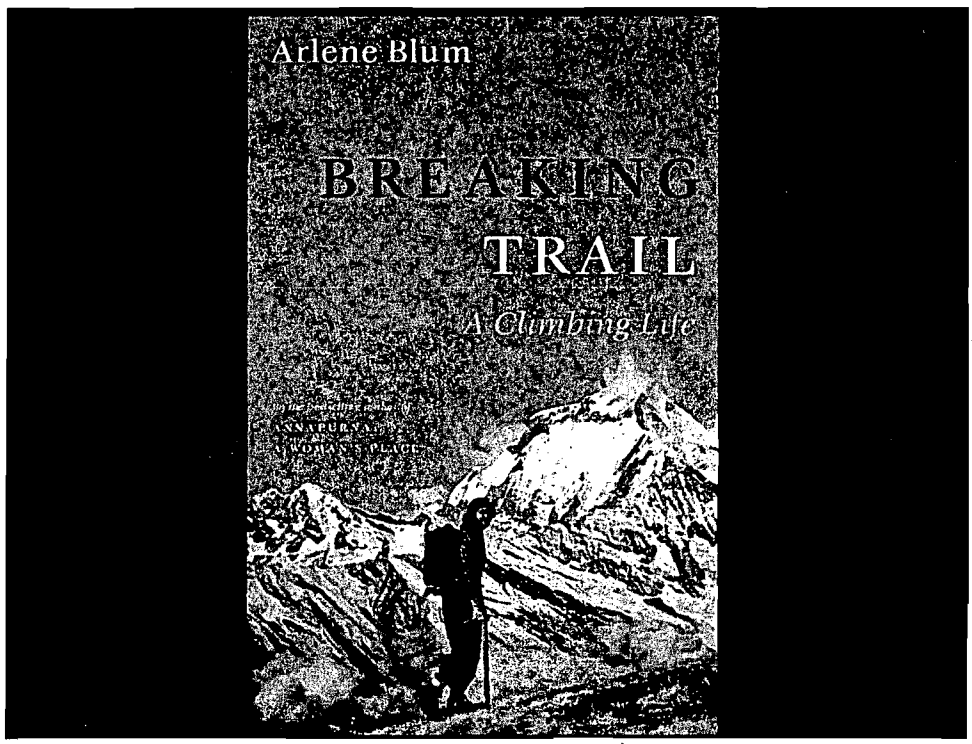
Brominated Tris replaced by Chlorinated Tris

In stores six months after the 1977 Tris ban:
34% contains tris (2,3-dibromopropyl) phosphate
18% contains tris (1,3-dichloro-2-propyl) phosphate

Another Flame Retardant, Tris-(1,3-Dichloro-2-Propyl)-Phosphate, and Its Expected Metabolites Are Mutagens

Abstract. *A flame retardant used in children's sleepwear, tris-(1,3-dichloro-2-propyl)phosphate (Fyrol FR2) is a mutagen in the Salmonella-mammalian tissue homogenate test after it has been activated by mouse or rat liver homogenate. The expected enzymatic hydrolysis product, 1,3-dichloro-2-propanol, is similarly a mutagen after activation by liver homogenate. A proposed metabolite of the flame retardant, 1,3-dichloro-2-propanone, is a potent mutagen in the absence of such activation. A flame retardant with similar structure, tris-(2,3-dibromopropyl)phosphate (tris-BP), was shown previously to be a mutagen, to cause sterility in animals, to be a carcinogen, and to be absorbed through human skin. These and other flame retardants have characteristic nuclear magnetic resonance spectra that can be used to determine which flame retardant is present in commercially purchased sleepwear. Sleepwear treated with tris-BP, Fyrol FR2, and other chemical additives was being sold in late 1977.*

Science, 1978



Past Hazardous Chemicals and Materials that contributed to Fire Safety

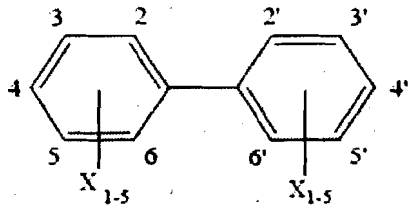
- **PCBs**
- **PBBs**
- **Brominated Tris**
- **Halon**
- **Asbestos**
- **PBDEs**

BUREAU OF HOME FURNISHINGS AND THERMAL INSULATION

California Upholstered Furniture Flammability Standard Technical Bulletin 117 (TB117) requires polyurethane foam in furniture foam sold in California to withstand a 12-second exposure to a small open flame.

PentaBDE was added to foam in amounts up to 10% of the weight of the foam beginning in the 1980's in furniture sold in California.
No flammability requirement enforced for fabric

Structure of PBBs, PCBs, & PBDE

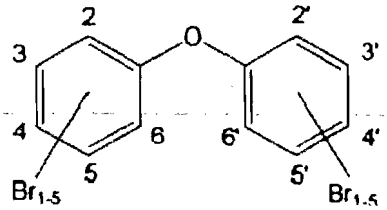


PBBs

X=Br

PCBs

X=Cl



PBDEs

209 theoretically possible congeners
Divided into ten homolog groups, mono to decabromo

Emerging Chemicals In the News: FLAME RETARDANTS

th Buffkus: Family woes fed his desire.

NFL Week 3

'Rarest of athletes'

Titans defender's life growing up shapes game ■ 1C

USA TODAY

NO. 1 IN THE USA

Listen up!

Dave Matthews, left, goes solo; Gloria Estefan returns; and Nickelback is no slug ■ CD reviews, 1: 6D

esday, September 23, 2003

Newsline

Dollar slides – and stocks follow, 1, 5B

	Close	Change
Jones industrial average	9535.47	▼ 109.43
dag composite	1874.62	▼ 31.08
ind, 30-year yield	5.14%	▼ .007
TODAY Internet 50	100.04	▼ 1.65

Flame retardant found in breast milk

U.S. levels highest in the world, study says

By Elizabeth Weise
USA TODAY

A toxic chemical used to make furniture foam and electronics fire resistant is turning up in high amounts in the breast milk of women in the USA.

Two studies, one out today, found that all of the women tested were contaminated with polybrominated diphenyl ethers. Their PBDE levels were the highest in the world, 10 to 20 times higher than ... in Europe, where the chemicals are being phased out.

The Environmental Working Group, a nonprofit environmental research organization, tested the milk of 20 women. It found levels ranging from 9.5 to 4,019 parts per billion. The women were recruited via EWG's Web site.

It is not yet known how this chemical affects people; no ... have been done on what a ... el would be. But "this is a wake-up call," says Linda Birnbaum, director of the Environmental Protection Agency's ... mental toxicology lab. ... PBDEs in humans are doubling every two to five years, the ... A University of Texas ...

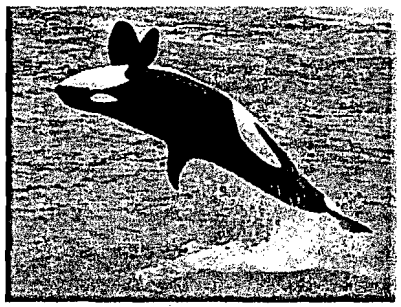
What are PBDEs?

Polybrominated diphenyl ethers are among the most common flame retardants in the USA. Scientist ... study by Arnold Schecter, professor of environmental sciences, and Birnbaum found levels in breast milk from 5 to 418 parts per billion in 47 American women. It was published last month in *Environmental Health Perspectives*. Breast milk is tested because it's the least invasive way to test fat, where toughest flame retardancy standards, 3,000 people die in fires each year. The Chemical Manufacturers Association estimates the number would be up to 960 higher without such flame retardants.

PBDEs may enter the environment during manufacturing or when products break down.

Mothers' Milk

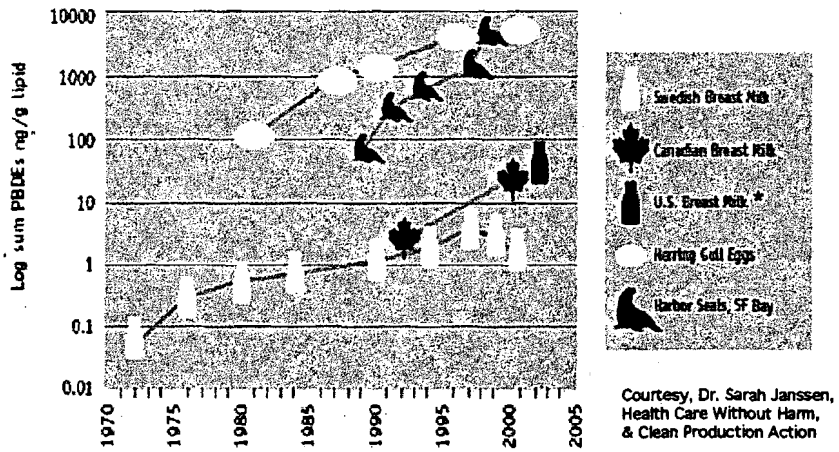
Record levels of toxic fire retardants found in American mothers' breast milk



- Very high concentrations of PCB and PBDEs fire retardants are found in marine mammals
- Puget Sound orcas carry the highest PCB levels of any marine mammal in the world, almost 150 parts per million on average
- PCB levels starting to go down thirty years after ban; PBDE levels rapidly going up.

From Peter S. Ross, **Fireproof Killer Whales** (Orcinus orca): Flame Retardant Chemicals and the Conservation Imperative, Canadian J. of Fisheries and Aquatic Sciences, Volume 63, Number 1, pp. 224-234 (11) (January 2006).

Selected Human and Wildlife levels of PBDEs



Courtesy, Dr. Sarah Janssen, Health Care Without Harm, & Clean Production Action

**US Breast Milk is the average of medians of four studies in 2003, 2004*

Routes of Fire PBDE Retardant Exposure

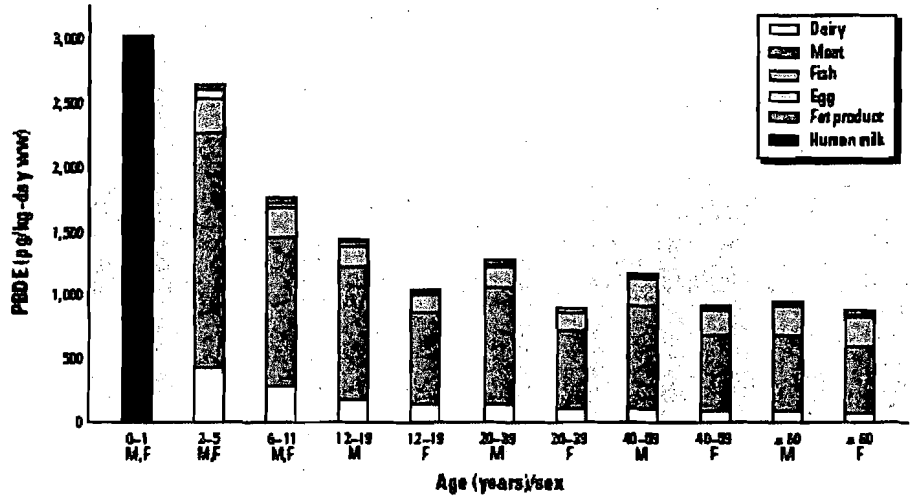
- Found in house dust and dryer lint --82 % of dose from inhalation of contaminated dust particles.

  Matthew Lorber, *Review: Exposure of Americans to polybrominated diphenyl ethers,* Journal of Exposure Science and Environmental Epidemiology 11 April 2007

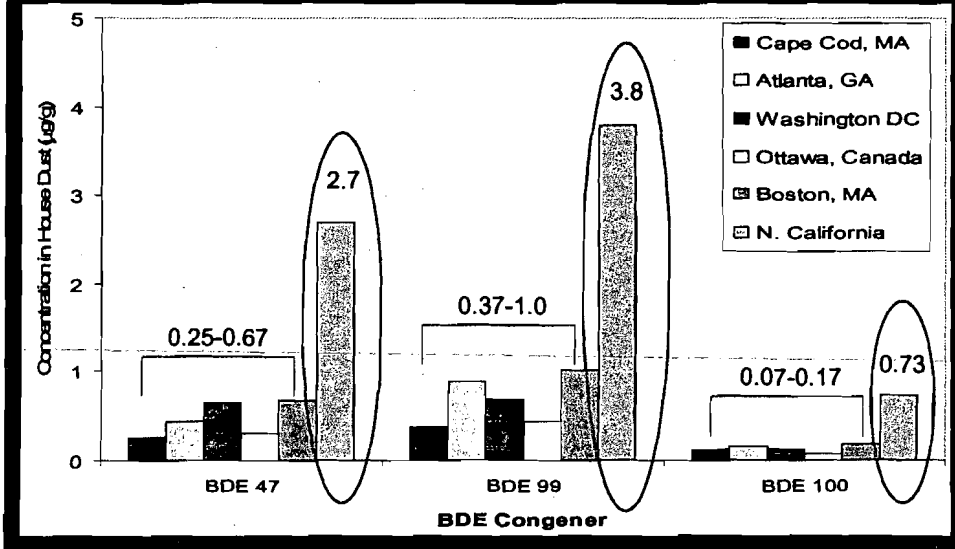
- Ingestion from food, especially meat and fish

- For fetuses and infants, absorption across the placenta or ingestion from breast milk.

Daily PBDE dietary intake of U.S. population by age and food group (pg/kg body weight)



Median PBDE fire retardant concentrations in household dust in 6 regions in North America



From: Zota et al., 2007 ISEA annual meeting.
Silent Spring Institute

PentaBDE used to meet TB117

- 95% of global production of the fire retardant PBDE was in the USA, primarily to comply with the California furniture standard.
- American body burdens exceed those of Europeans and others by factors of 10 or more.

Reproductive Effects of PBDEs in Rodents

- Penta-BDE exposure causes abnormal gonadal development in rats. The number of ovarian follicles are reduced in female rat and sperm count decreased in males.
- Exposure delays the onset of puberty in males and females rats.
- Deca-BDE exposure is associated with abnormal sperm and increased pregnancy resorption rates.

Neurobehavioral Impacts from **PBDEs**

- Exposure to PBDE fire retardants during brain development results in neurological deficits including decreased memory, learning deficits,and altered motor behavior.
- Penta-BDE exposure in utero is associated with hyperactivity.

Interference with Thyroid Hormone Action

• PBDEs fire retardants bind to thyroid hormone receptors.

•PBDE exposures correlated with decreased thyroid hormone levels (serum T4) in mice, rats, kestrals, and frogs.

•One study of manufacturing workers exposed to PBDEs and PBBs found an increased incidence of hypothyroidism

Potential Human Health Risk

For US women, the highest five percent have concentration of the fire retardant PBDE in tissue and breast milk equal to a level that causes reproductive changes in experimental animals and within a factor of ten of a level that causes neurological changes.

Possible Human Health Impacts

- Exposure to PBDEs in utero was significantly associated with adverse birth outcomes such as decreased birth weight, length, and chest circumference.

  Chao et al, 2006

- Chryptorchidism or undescended testicles increases with maternal PBDE exposure.

  Main et al, 2007

Human health studies of PBDEs and conditions such as autism, hyperactivity, reduced fertility, etc. are underway with more results expected in 2008.

DDT and Breast Cancer in Young Women:

New Data on the Significance of Age at Exposure

- Women who were highly exposed to DDT before the age of 14 have a five times greater risk of breast cancer before the age of fifty than populations with low exposure.
- **It has taken up to fifty years since the exposure to obtain this evidence of cancer causation.**

Barbara A. Cohn,1 Mary S. Wolff,2 Piera M. Cirillo,1 and Robert I. Sholtz1 VOLUME 115, NUMBER 10 | October 2007 • Environmental Health Perspectives

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- U. Gill, I. Chu, J.J. Ryan J, M. Feeley.**Polybrominated Diphenylether Levels among United States Residents: Daily Intake and Risk of Harm to the Developing Brain and Reproductive Organs,** Integrated Environmental Assessment and Management Volume 1, pp. 343–354,(2005)
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- J.A. Dye, M. Venier, C.R. Ward, L.Y. Zhu, R.A. Hites, L.S. Birnbaum: **Pet Cats In The U.S. Have High Polybrominated Diphenyl Ether (PBDE) Serum Levels.** Society of Toxicology2007 meeting Abstract number 853

127 listings on PBDEs to date in 2007 in Pub Med

August 9, 2003

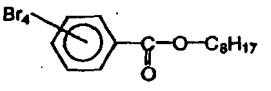
California Bans Penta and Octa-PBDEs

November 3, 2003

Great Lakes Chemical Corporation, annouces they will voluntarily cease Penta-PBDE production. The replacement is Firemaster® 550

PentaBDE replacements

1. Firemaster 550, is the most commonly used. The major component is Octyl tetrabromobenzoate (OTB)



OTB

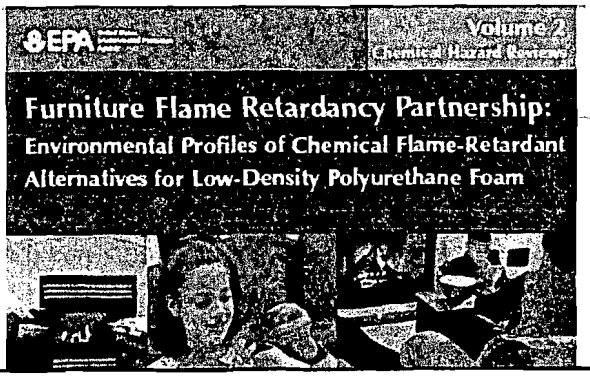
Occurrence and Bioaccumulation — **No information**

Toxicity

'**Insufficient toxicity data on OTB** or related compounds were available to assess whether OTB could present a hazard to consumers. Basic toxicity data, physico-chemical data, and additional exposure data are needed to assess whether OTB may be hazardous to consumers.'

Consumer Product Safety Commission Preliminary Risk Assessment of Flame Retardant Chemicals in Upholstered Furniture Foam (2006):

According to Great Lakes:
"The voluntary phase-out of penta and octa follows the EPA's assessment that the penta replacement has a favorable environmental profile, in that it is not persistent, bioaccumulative or eco-toxic."



Proprietary H: Halogenated aryl ester
Existing Data Summary Table – Human Health Endpoints

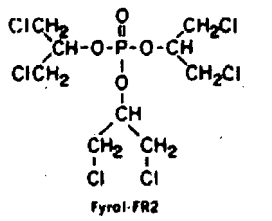
✓ = Endpoint characterized by existing data • = Data available but not adequate X = Endpoint not applicable
As noted in this key, a check mark indicates that an endpoint was adequately characterized by existing studies. It does not indicate a positive or negative result for that particular endpoint.

Acute Toxicity	
Oral	✓
Dermal	
Inhalation	
Eye irritation	
Dermal irritation	
Skin sensitization	
Subchronic Toxicity	
28-Day oral	
90-Day oral	
Combined repeated dose with reproduction/ developmental toxicity screen	
21/28-Day dermal	
90-Day dermal	
90-Day inhalation	
Reproductive Toxicity	
Reproduction/ developmental toxicity screen	
Combined repeated dose with reproduction/ developmental toxicity screen	

Developmental Toxicity	
Reproduction/ developmental toxicity screen	
Combined repeated dose with reproduction/ developmental toxicity screen	
Prenatal developmental	
Chronic Toxicity	
Chronic toxicity (two species)	
Combined chronic toxicity/ carcinogenicity	
Carcinogenicity	
Carcinogenicity (rat and mouse)	
Combined chronic toxicity/ carcinogenicity	

Neurotoxicity	
Acute and 28-day delayed neurotoxicity of organophosphorus substances (hen)	
Neurotoxicity screening battery (adult)	
Developmental neurotoxicity	
Additional neurotoxicity studies	
Immunotoxicity	
Immunotoxicity	
Genotoxicity	
Gene mutation in vitro	
Gene mutation in vivo	
Chromosomal aberrations in vitro	
Chromosomal aberrations in vivo	
DNA damage and repair	
Other	

PentaBDE replacements
2. TDCP
or Chlorinated Tris



Fyrol-FR2

Tris-(1, 3-dichloro-2-propyl) phosphate

<u>Maximum Estimated Cancer risk from Furniture</u>

Lifetime exposure up to 300 cancer cases /million

Two-years of exposure (children) up to 20 per million

Annual increase in cancer up to 1,200 cases

Tris also shows liver, kidney, and testicular toxicity

CPSC Report, Michael Babich, Dec 21, 2006

The U.S. Toxic Substances Control Act

- 62,000 chemicals "grandfathered" in 1979. These chemicals are 95% of chemical production today.
- EPA has restricted five of these chemicals since 1979.
- Burden of proof on EPA,
- No health or environmental data required for the 20,000 new chemicals introduced since 1979 (85% have no health data; 67% no data at all)
- Inadequate information to regulate

Courtesy of Michael Wilson
Green Chemistry in California: A Framework for Leadership in Chemicals Policy and Innovation
http://coeh.berkeley.edu/news/06_wilson_policy.htm.

Chemicals Effectively Regulated by the EPA since 1979 :

- PCBs
- Chloroflurorcarbons (halon)
- Dioxins
- Hexavalent Chromium
- Asbestos (reversed by court order)

DfE Partnership Approach Identifying and Promoting Less Toxic Alternative Fire Retardants

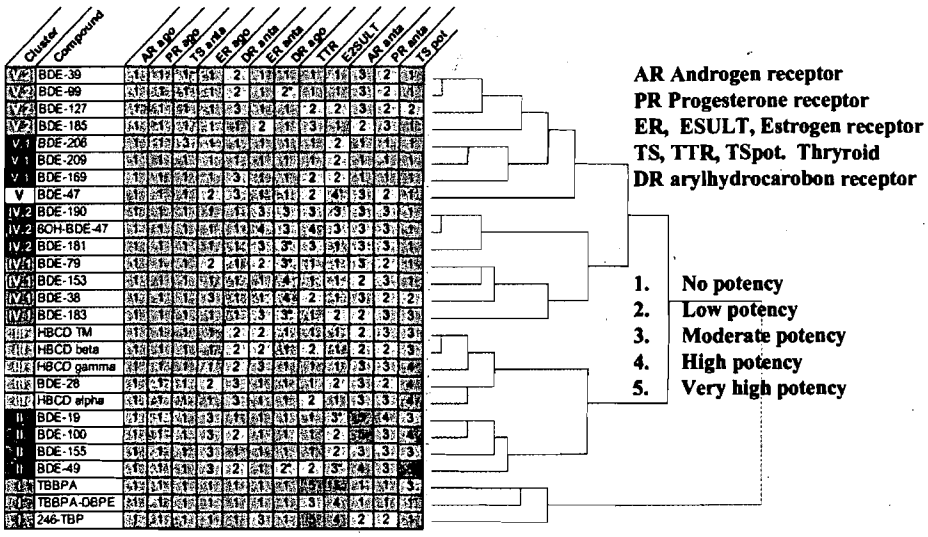
- Engages diverse stakeholders
- Provides needed information in a format that facilitates decision making
- Protects confidential business information through third party review and careful information presentation
- Uses EPA chemical information, models and new chemicals criteria
- Focuses on hazard and not risk

Impacts of fire retardant chemicals

*From the San Francisco Estuary Institute, based on EPA TSCA Inventory 2002

	Production Volume (lbs)*	Bioaccumulation	Persistence	EcoToxicity	Mammalian Toxicity
Tetrabromobisphenol A (TBBPA)	100-500M	Low	Moderate	High	High
Hexabromocyclododecane (HBCD)	10-500K	High	High	High	High
Decabromodiphenylethane (DBDPE)	?	Low	High?	?	?
1,2-Bis(2,4,6-tribromophenoxy)ethane (BTBPE)	1-10M	High?	Moderate?	?	?
Pentabromoethylbenzene (PBEB)	0	Moderate?	Moderate?	?	?
Dechlorane Plus (DP)	1-10M	Low	High	?	?
Tris(1,3-dichloro-2-propyl)phosphate (TDCPP)	10-50M	?	Moderate?	Moderate	High
Triphenylphosphate (TPP)	10-50M	High?	Low?	High	?
Octyl tetrabromobenzoate (OTB) (in Firemaster 550)	?	?	?	High?	?

Endocrine-Disrupting Potency of Brominated Flame Retardants

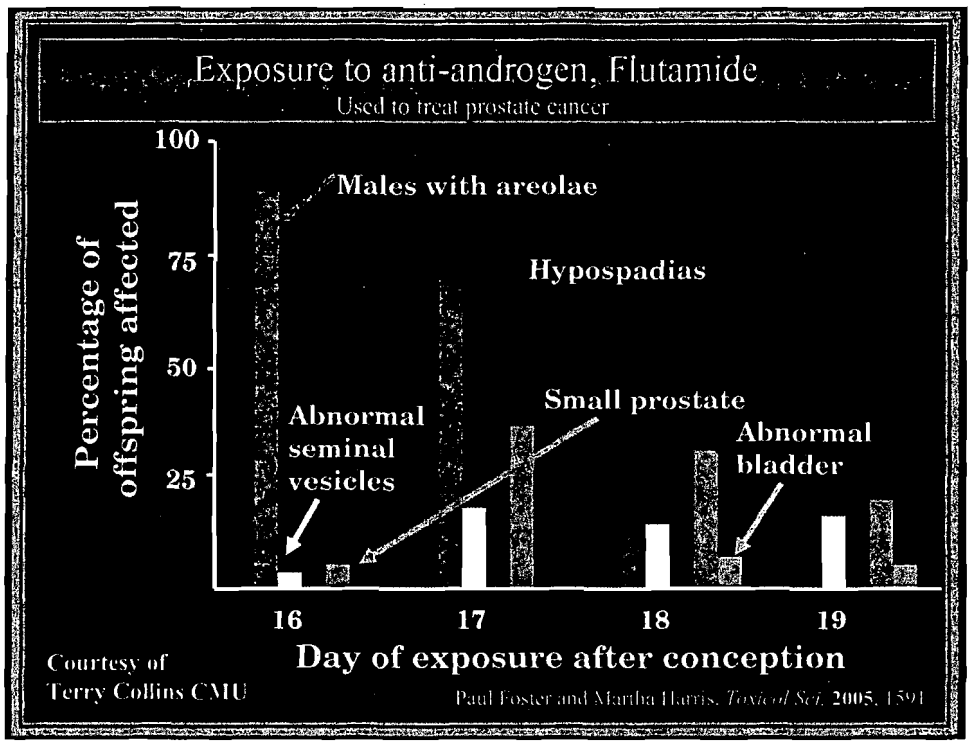


Timo Hamers,et al, TOXICOLOGICAL SCIENCES 92(1), 157–173 (2006), In Vitro Profiling of the Endocrine-Disrupting Potency of Brominated Flame Retardants, April 6, 2006, doi:10.1093/toxsci/kfj187

The Endocrine Disruptor Hypothesis

Postulates that endocrine disruptors, often at very low levels, can act like natural hormones and interfere with the endocrine systems of wildlife and humans. These systems are responsible for the reproduction, development, and behavior.

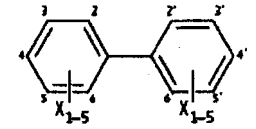
The timing of exposure during development can be extremely sensitive.



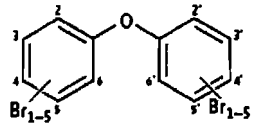
Most BFRs tested have high anti-androgenic activity

- BDE-100 has an anti-androgenic potency that is 13 times higher than that of the drug flutamide
- Exposure of fish and also rodents to anti-androgens has been associated with a decrease in testicular function and sperm production.
- Presence of BFRs in the aquatic environment could explain observed alterations in fish reproductive function.

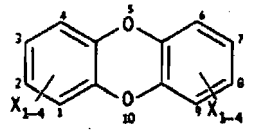
Timo Hamers,et al, TOXICOLOGICAL SCIENCES 92(1), 157–173 (2006), In Vitro Profiling of the Endocrine-Disrupting Potency of Brominated Flame Retardants, April 6, 2006, doi:10.1093/toxsci/kfj187



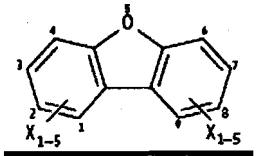
PCBs (X = Cl) and PBBs (X = Br)



PBDEs



Dioxins (X = Cl or Br)



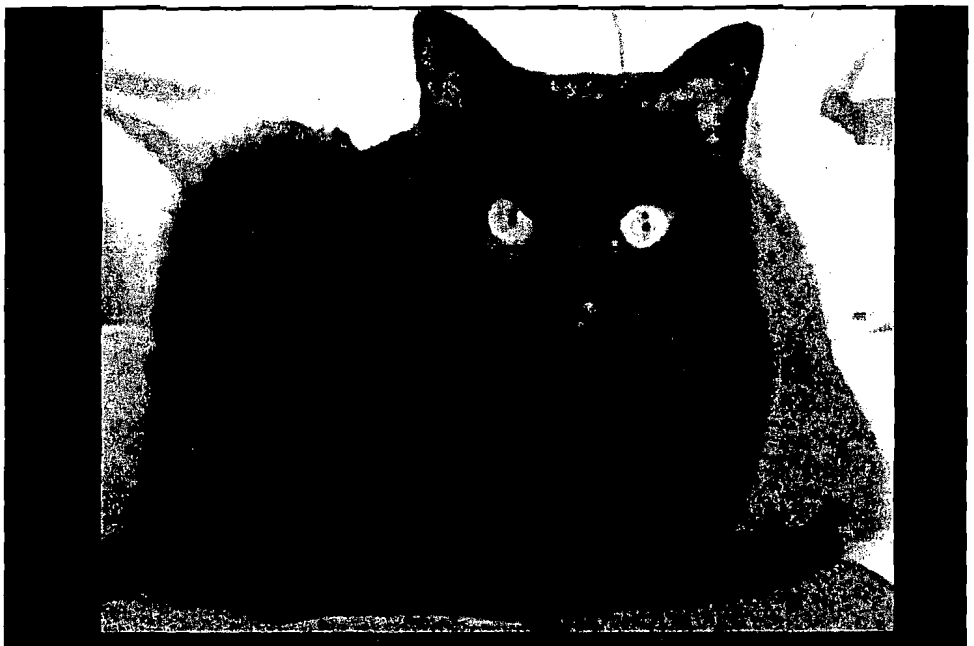
Furans (X = Cl or Br)

When PBDEs combust, how much dioxin and furan are produced?

Cancer risk among firefighters: a review and meta-analysis of 32 studies

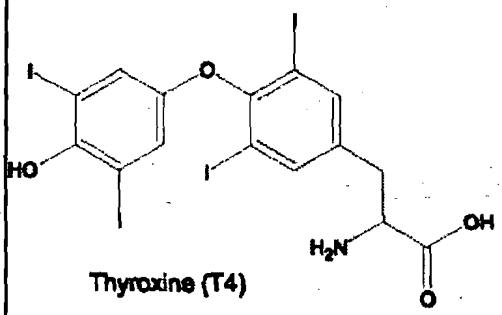
- Fire fighters have significantly elevated rates for four types of cancer: **multiple myeloma, non-Hodgkin's lymphoma, prostate, and testicular cancer.**
- Eight additional cancers including malignant melanoma and brain cancer were determined to have a possible association with firefighting

G.K. LeMasters, et al, Journal of Occupational and Environmental Medicine 48(11): 1189-202(2006).

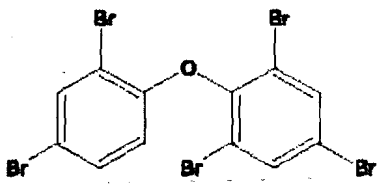


Hyperthyroidism is a Recent Disease of Cats

Thyroxine and pentaPBDE

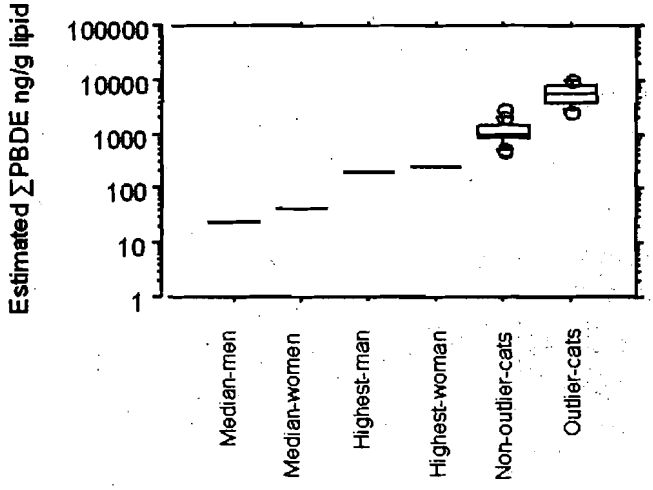


Thyroxine (T4)



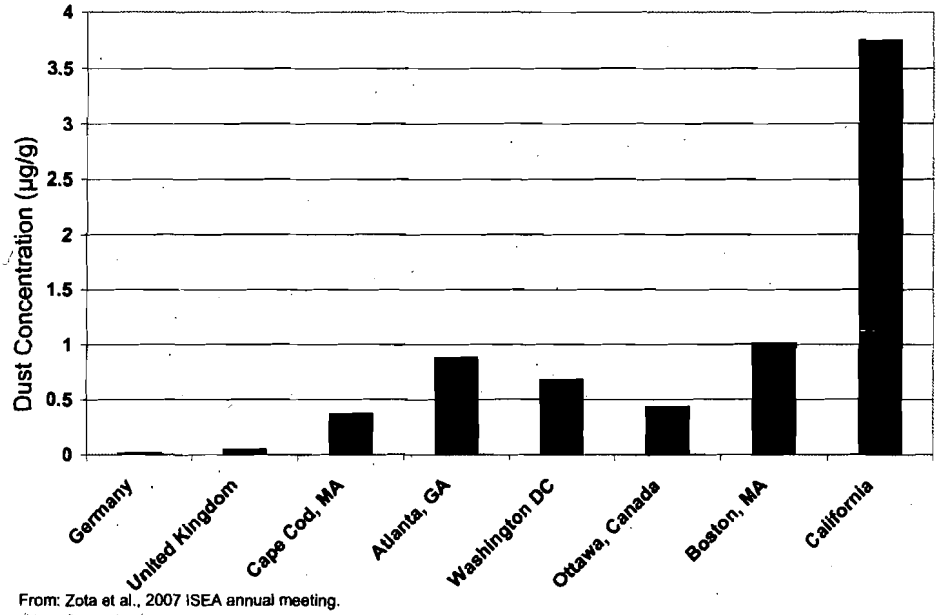
2,2',4,4',6-pentabromodiphenylether (PBDE-100)

Comparison of Cats to Humans.



Courtesy, Dr. Linda Birnbaum

Median of BDE-99 fire retardant concentration in household dust

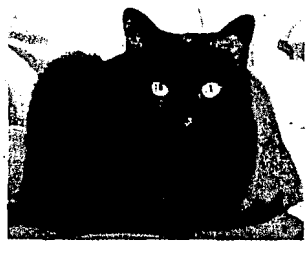


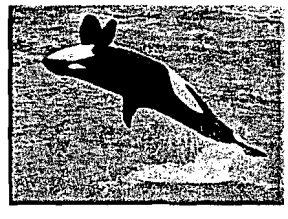
From: Zota et al., 2007 ISEA annual meeting.

Silent Spring Institute

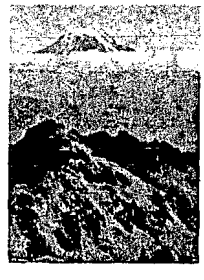
Biophysical chemist Arlene Blum, using an x-ray fluorescence analyzer, measures 5% bromine from the fire retardant in her couch foam.

SCIENCE, 12 OCTOBER 2007, VOL 318, p. 194





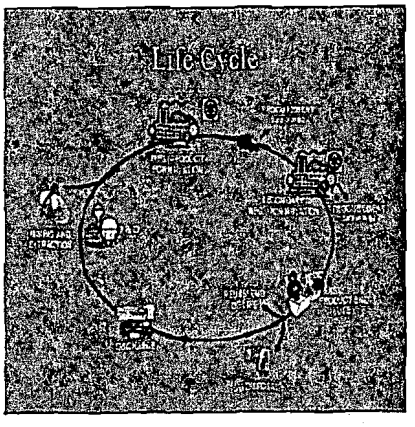
How can we can maintain fire safety and reduce toxics?


Challenge: Comparative Hazard Assessment and Life Cycle Thinking

Comparative Hazard Assessment

- Hazards associated with chemical exposure during manufacture
- Hazards associated with chemical exposure in consumer products
- Hazards associated with chemical at end of life when product is combusted, landfilled, composted, littered or recycled



GREEN CHEMISTRY

Green Chemistry Mission

To promote innovative chemical technologies that reduce or eliminate the use or generation of hazardous substances in the design, manufacture, use, and disposal of chemicals and chemical products

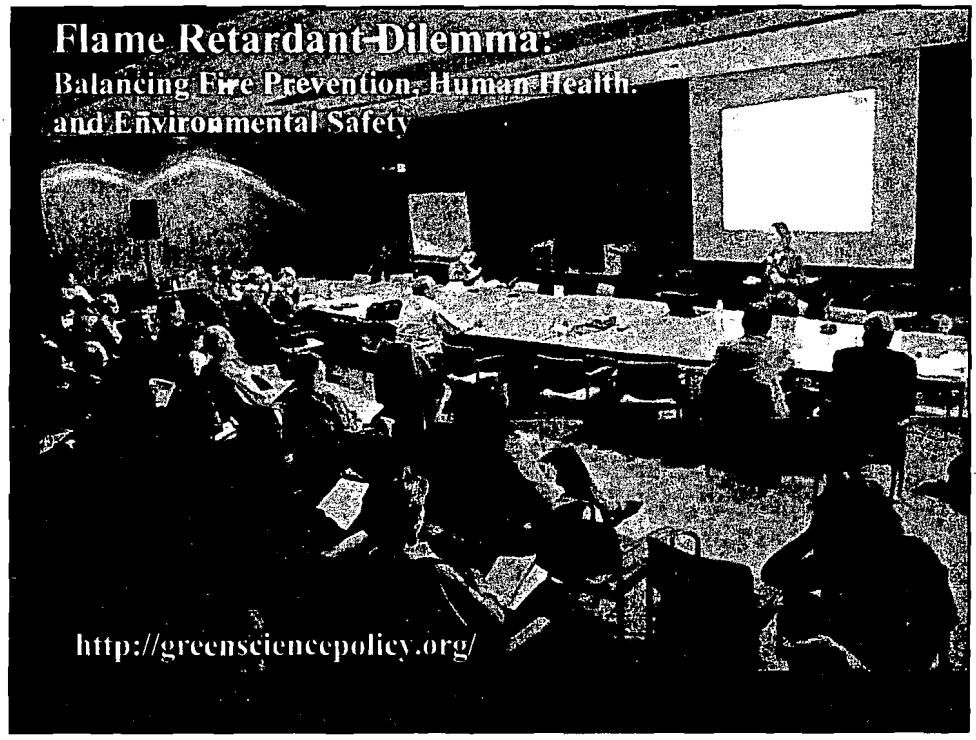
Manufacturers who Have Agreed to Phase-out Use of BFRs

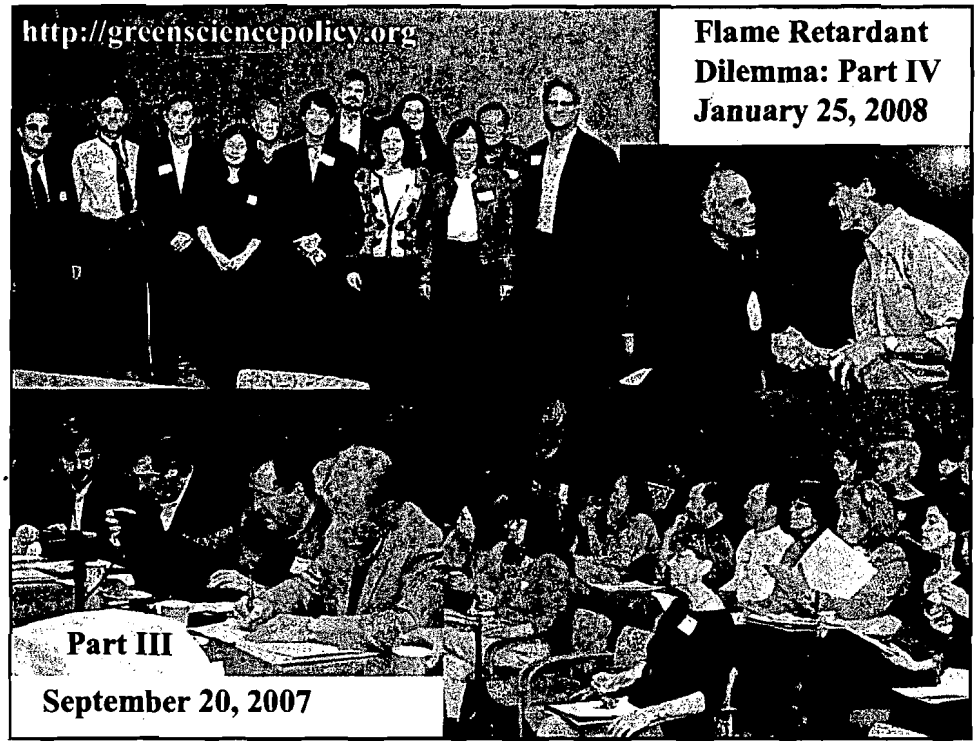
Electronics:

Apple	Panasonic
Ericsson	Phillips
IBM	Sony
Motorola	Toshiba
NEC	Dell
HP	

Furniture:

IKEA
Crate and Barrel
Eddie Bauer
Comfort Care





The Fire Retardant Dilemma

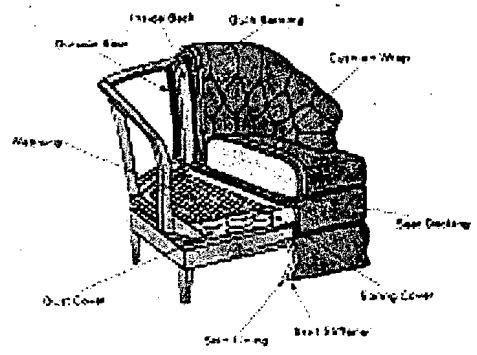
January 25, 2008, UC Berkeley

- David Epel, Ph.D,. Jane and Marshall Steel Jr. Professor of Marine and Biological Sciences, Stanford University **Embryo stability: Ancient Cellular Toxic Defense Meets A New World Of Chemicals**
- Myrto Petreas, Ph.D., MPH, Chief, Environmental Chemistry Branch, DTSC, **Where have all PBDEs gone? To people, wildlife, and waste streams everywhere. (When will we ever learn?)**
- Debbie Raphael, Toxics/Green Program Manager, Department of the Environment City & County of San Francisco **Making Decisions in the Face of Scientific Uncertainty: San Francisco and the Precautionary Principle**
- Heather Stapleton, Ph.D, Department of Environmental Chemistry, Duke University, **Human Exposure To Brominated Fire Retardants In Indoor Environments via Inhalation, Dust Exposure And Hand To Mouth Contact**
- Rachel Morello-Frosch, Ph.D., M.P.H., University of California, Berkeley, Dept. of Environmental Science, Policy and Management & School of Public Health , **Regional variation in levels of indoor PBDEs may reflect differences in fire safety regulations for consumer products**

A construction modification approach for superior furniture fire retardancy

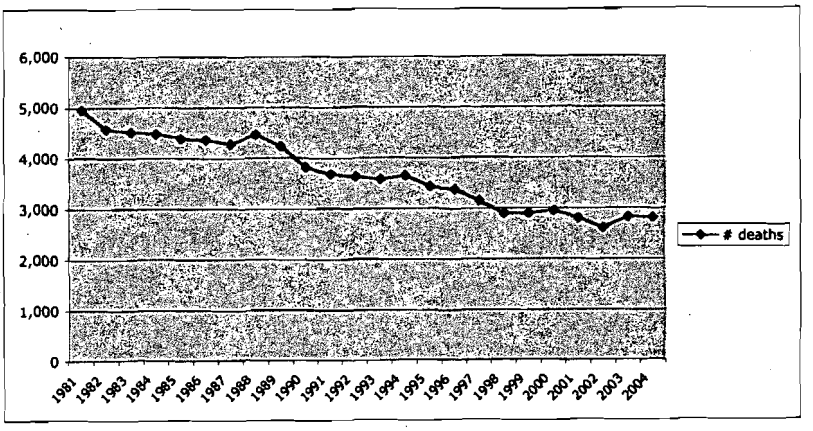
Replace all of part of batting (in red) with an inherently fire retardant fabric.

Use a thermally conductive welt cord



Good News About Fire Safety

Home Fire Deaths, USA, 1981-2004



1981 4,956 deaths 2004: 2,810 deaths

Source: National Center for Health Statistics

5 Year Averages of Fire Deaths

1980-1984 Compared to 1995-1999

National Fire Protection Association Report, June 2006

California	down 32%
Texas	33%
New York	40%
Florida	31%
Pennsylvania	30%
Illinois	39%
Ohio	39%
Michigan	30%

Blum and Ames, *Science*, January 7, 1977

Alternatives to Preventing Burns Without Chemical Additives

1) *Self-extinguishing cigarettes*. The major single cause, accounting for about one-third to one-half (*35*), of the approximately 12,000 fire deaths and $11 billion in losses in the United States each year (*36*) is tobacco-smoking materials (*35*). The most common fire death scenario was found to be the residential furnishing fire started by tobacco-smoking materials; alone it accounts for 27 percent of fire deaths. The next largest single cause was residential furnishing fires started by open flames, which accounted for 5 percent of the United States fire deaths. All other single causes were 4 percent or less.

New York is the first state to require RIP cigarettes, beginning in mid-2004.

Early data suggests fires and fire deaths are reduced by 1/3 or more

National Fire Protection Association
The authority on fire, electrical, and building safety

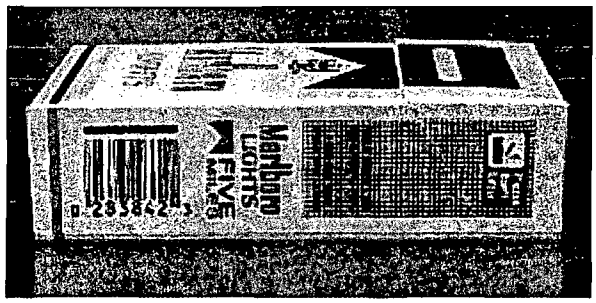
October 25, 2007

Reynolds American Inc. announces product-wide switch to fire-safe cigarettes.

"If cigarette manufacturers had begun producing only fire-safe cigarettes 20 years ago," said Jim Shannon, NFPA's president, **"an estimated 15,000 lives could have been saved** by now. '

An Environmentally Friendly Way to Reduce Fires

Universal fire safe cigarettes will greatly diminish fires, deaths, and injuries.



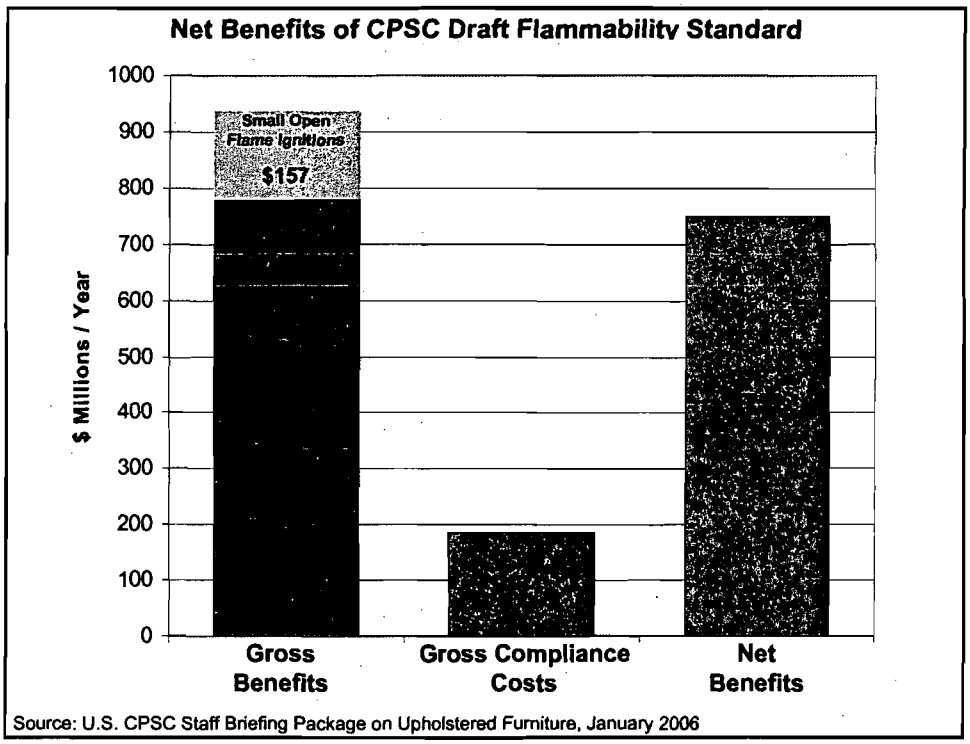
The value of adding potentially toxic fire retardant chemicals to consumer products needs to be reassessed.

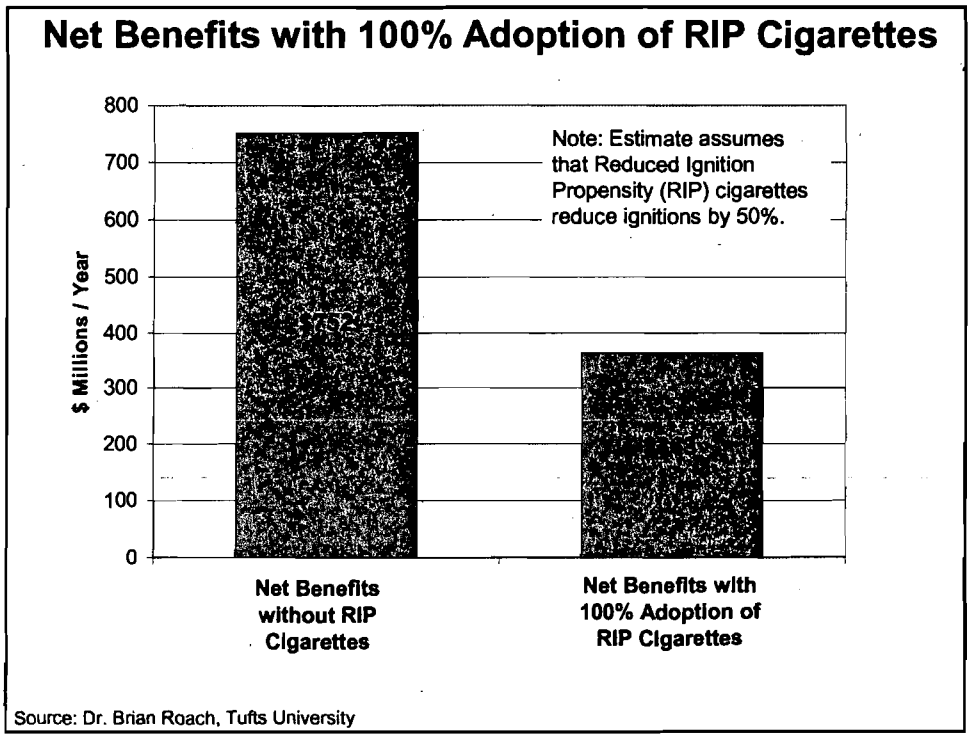
ESTIMATED FURNITURE FIRE DEATHS

By Item First Ignited

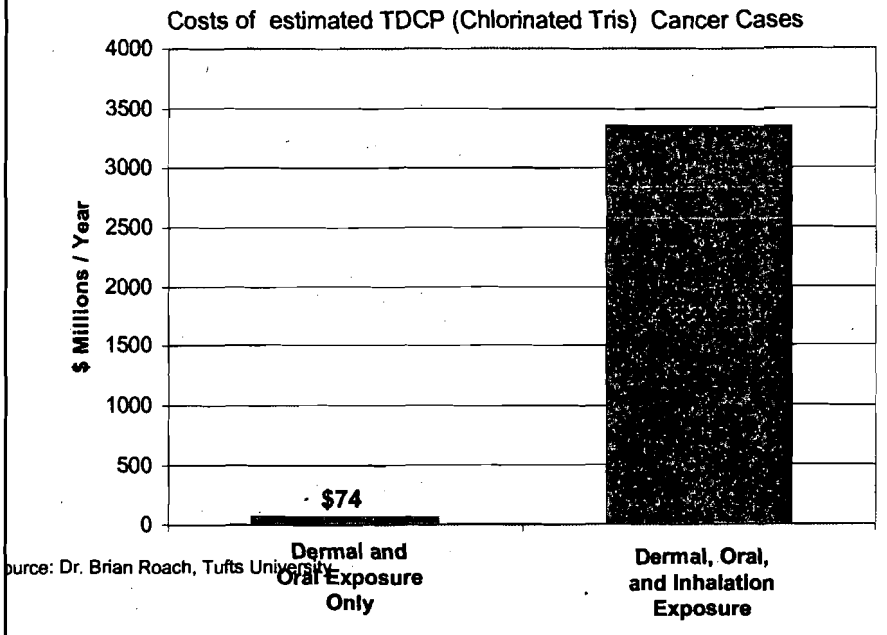
	1999	2000	01	02	03
Upholstered Furniture	**430**	**580**	**620**	**460**	**560**
Smoking Material Ignition	330	340	380	200	310
Open Flame Ignition	30	120	50	30	20
Other	70	120	190	230	220

Source: U.S. Consumer Product Safety Commission/EPHA, from data obtained from the U.S.Fire Administration and NFPA


Net Benefits of CPSC Draft Flammability Standard
$ Millions / Year
1000
900
800
700
600
500
400
300
200
100
0
Small Open Flame Ignitions
$157
Gross Benefits
Gross Compliance Costs
Net Benefits
Source: U.S. CPSC Staff Briefing Package on Upholstered Furniture, January 2006

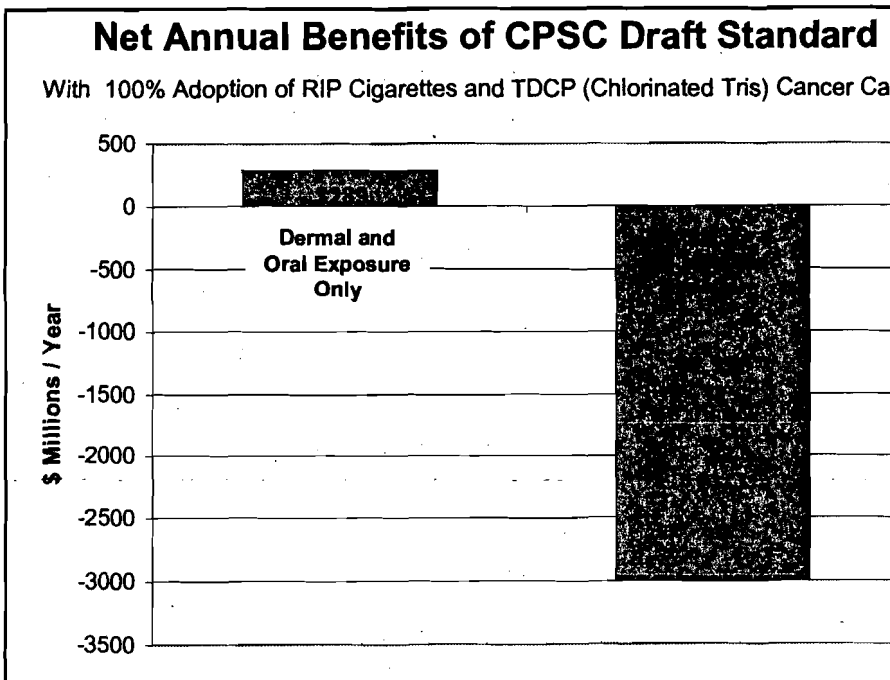

Net Benefits with 100% Adoption of RIP Cigarettes
$ Millions / Year
800
700
600
500
400
300
200
100
0
Note: Estimate assumes that Reduced Ignition Propensity (RIP) cigarettes reduce ignitions by 50%.
Net Benefits without RIP Cigarettes
Net Benefits with 100% Adoption of RIP Cigarettes
Source: Dr. Brian Roach, Tufts University

Health Costs of CPSC Draft Standard -



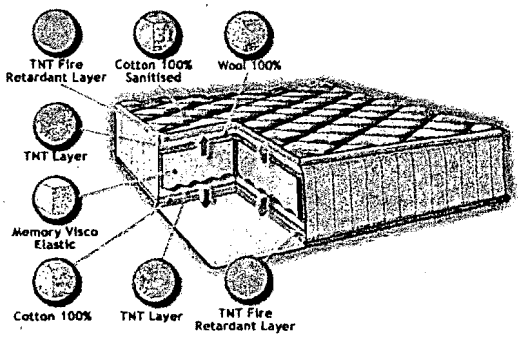
Source: Dr. Brian Roach, Tufts University

Net Annual Benefits of CPSC Draft Standard



Source: Dr. Brian Roach, Tufts University

Barrier technology used in meet national mattress flammability standard is effective and reducing flammability



ESTIMATED FIRE DEATHS
Prior to a Mattress Standard

By Item First Ignited

	1999	2000	01	02	03
Mattress, Bedding	330	410	330	440	380
Smoking Material Ignition	170	180	190	220	170
Open Flame Ignition	70	80	60	60	100
Unknown	90	150	80	160	110

Source: U.S. Consumer Product Safety Commission/EPHA, Data obtained from the U.S. Fire Administration and NFPA

CPSC predicted that a national mattress standard would reduce annual fire deaths from mattress fires by 69 to 78 %.

BUREAU OF HOME FURNISHINGS AND THERMAL INSULATION

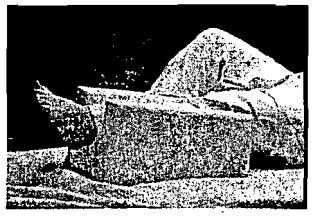
TB 604 Bed Clothing Standard

Met by:

- Inherently fire resistant fibers
- Chemicals added to foam?
- New technologies?

TB604 would require high levels of FR chemicals

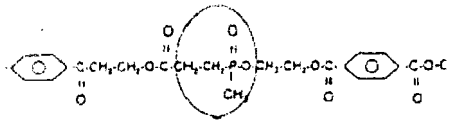
- Much more FR than used to meet TB117
- Lower density foam products typically require more FR additives than higher density foams and are common in items where load bearing requirements are minimal.



Inherently Fire Resistant (IFR) fibers

FRs added to backbone in melt spinning process

- e.g., phosphorous-based additives in polypropylene and polyester fibers



IFR Base Polymers

- Non-halogen: melamine, polyaramides, carbonized acrylic, & glass.
- Halogen: modacrylic and polyhaloalkenes.

Mixtures of IFR and less flame retardant fibers used to balance cost, comfort and fire safety goals.

Acrylonitrile

- carcinogenic in rat studies
- probable human carcinogen
- mutagenic in sister chromatid exchange
- chromosomal damage in mammalian cells in vitro

IARC (1999). IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Volume 71. Re-evaluation of some organic chemicals, hydrazine and hydrogen peroxide (Part One). IARC, Lyon. pp. 43-108.

Vinylidene Chloride,

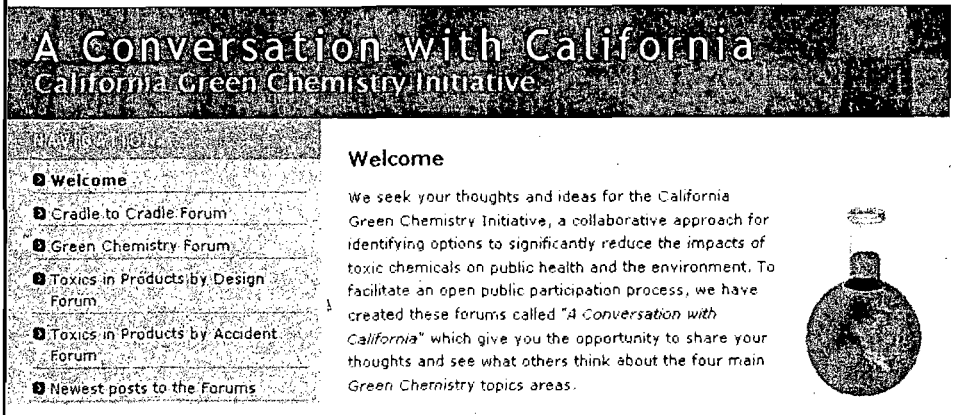
- potent hepatotoxin
- animal carcinogen
- shows suggestive evidence of human carcinogenicity by the inhalation route of exposure

U.S. EPA (2002). Toxicological Review of 1,1-Dichloroethylene (CAS No. 75-35-4). In support of summary information on the Integrated Risk Information System (IRIS). June 2002. U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/IRIS/toxreviews/0039-tr.pdf

Vinyl Chloride

- angiosarcoma of the liver in rats, mice, hamsters via inhalation and oral routes
- angiosarcoma of the liver in PVC workers
- hepatotoxin
- reproductive effects include testes damage and reduced fertility

U.S. EPA (2000). Toxicological Review of Vinyl Chloride (CAS No. 75-01-4). In support of summary information on the Integrated Risk Information System (IRIS). May 2000. EPA/635R-00/004. U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/iris/toxreviews/1001-tr.pdf



Monomers that comprise some inherent fibers

Mutagens, carcinogens and/or can cause neurological, developmental or reproductive impacts in animals.

Worker health and environmental impacts of manufacture and disposal should be considered in the cost analysis.

Some other questions

What about plasticizers?
Phthalates are often used to make polyvinylidene chloride, polyvinyl chloride soft and flexible. They are known endocrine disruptors and just have been banned from use in children's items in California.

How are fire retardant chemicals from in furniture and other consumer goods transported in the environment? What is their ultimate fate?

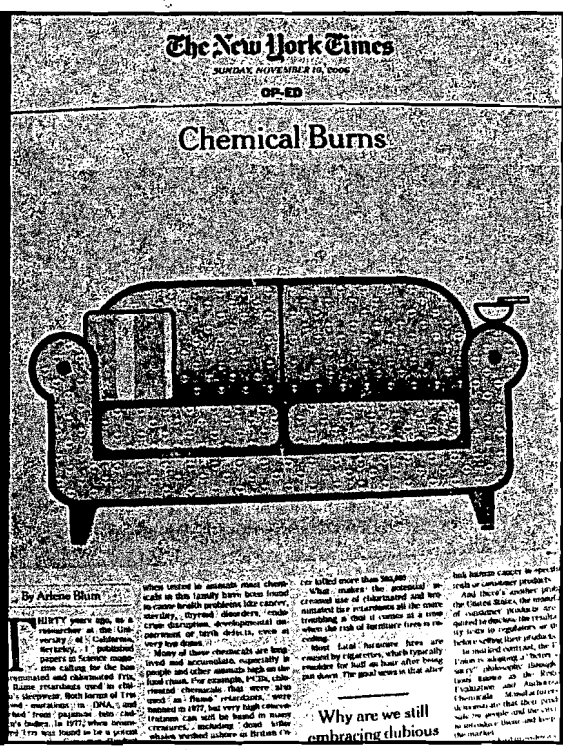
Will there will be incineration of these materials or inadvertant combustion?
When polyvinylidene chloride, polyvinyl chloride, or materials treated with brominated or chlorinated fire retardant chemicals burn, highly toxic dioxins and furans are produced.

BUREAU OF HOME FURNISHINGS AND THERMAL INSULATION

TB 604 Standard.

Health and environment should be considered as well as flammability in making new regulations for filled bedding products.

The Story of AB706



The New York Times

SUNDAY, NOVEMBER 19, 2006

OP-ED

Chemical Burns

By Arlene Blum

Why are we still embracing dubious

2007 UCSF-CHE Summit on Environmental Challenges to Reproductive Health and Fertility

January 28 -30, 2007 , UCSF Mission Bay Conference Center, San Francisco, CA

This groundbreaking conference covers the reproductive and developmental health impacts of exposures to environmental contaminants, including the fetal origins of adult disorders.

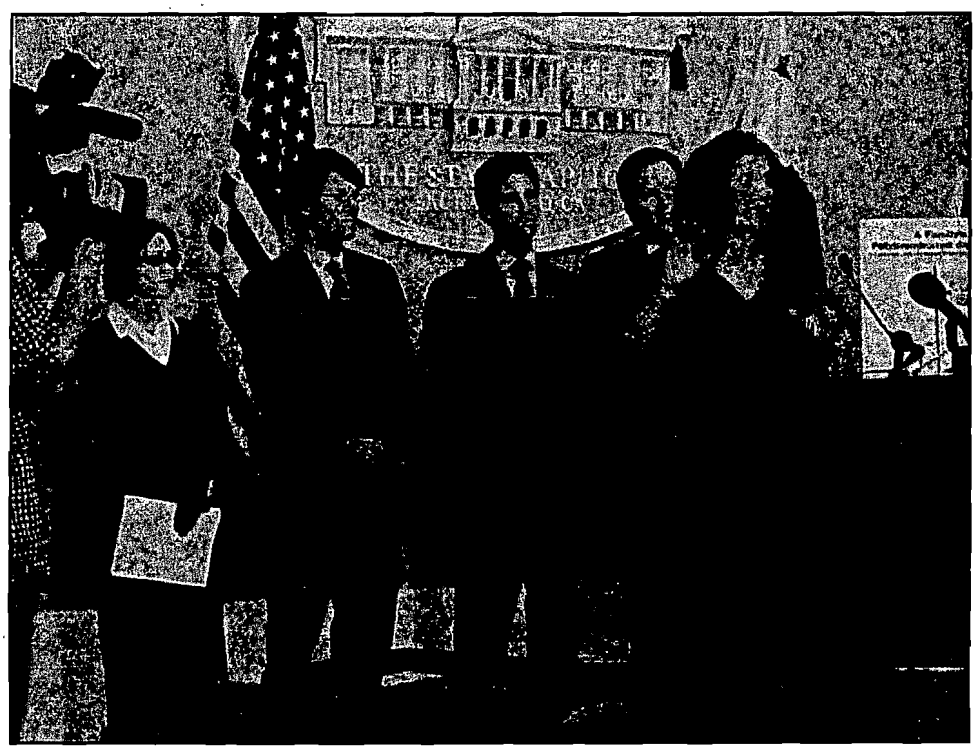
Environment & Reproduction : Windows of Vulnerability
Bad Actors: Brominated Flame Retardants, Heavy Metals

ALKYL BROMIDE MUTAGENS

1. Methyl bromide
2. Dibromomethane (methylene bromide)
3. Tribromomethane (bromoform)
4. Bromodichloromethane
5. Dibromochloromethane
6. Bromoethane
7. 1,2-dibromoethane
8. 1-bromobutane
9. 2-bromobutane
10. 2-bromo-2-methyl propane
11. 1-bromo-2-methyl propane
12. 3-bromopropionic acid
13. 2-bromopropionic acid (not mutagenic?)
14. 3-bromopropylamine (not mutagenic)
15. 2-bromoethyl ethyl ether
16. 2-bromoethyl methyl ether
17. 2-bromobutyric acid (not mutagenic?)
18. Bromomethyl acetate
19. Methyl-2-bromopropionate
20. Methyl-3-bromopropionate
21. 1,1,2,2-tetrabromoethane
22. Vinyl bromide
23. Epibromohydrin
24. 3-bromo-1-propanol
25. 1-bromo-2-propanol
26. 2-bromo-2-butene
27. 4-bromo-1-butene
28. 1-bromo-3-chloropropane
29. 1-bromo-4-chlorobutane
30. Bromotrichloromethane
31. 3-bromo-2-butanone
32. 2-bromoethanol

American Public Health Association Consensus Resolution

Virtually all organochlorides that have been studied exhibit one or more serious toxic effect such as endocrine dysfunction, developmental impairment, birth defects, reproductive dysfunction, immunosuppression, and cancer, often at extremely low doses.



AB 706 - The California Furniture Safety and Fire Prevention Act

- Improves fire safety standards for furniture such that equivalent fire safety is achieved with reduced use of potentially toxic chemical fire retardants.
- Transfers responsibility to manufacturer to show safety.
- Prohibited brominated and chlorinated chemicals can be reconsidered with safety data.
- Prohibits use of alternative fire retardants that cause harm to animal or human health.
- Labeling of furniture containing BFrs and CFrs.

California Assembly Bill 706 has wide support

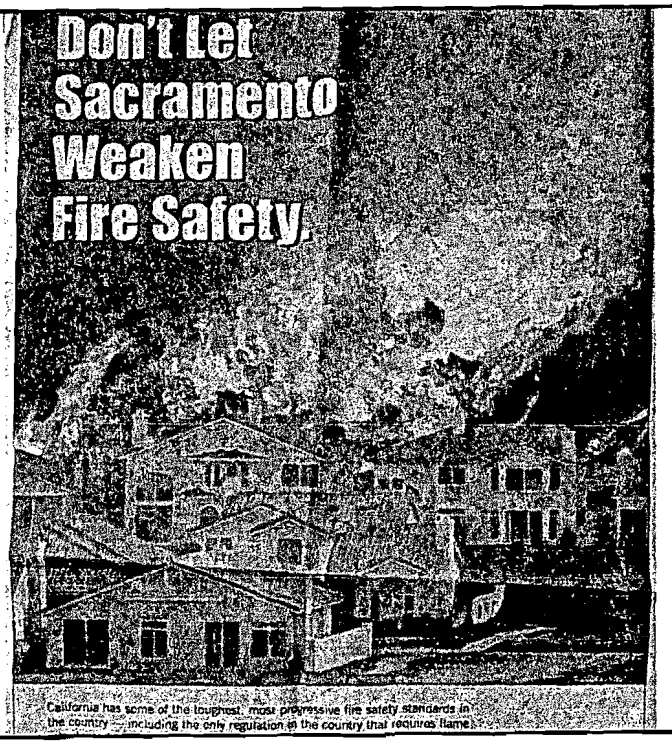
LA Times' Six "Must Pass Bills of 2007"

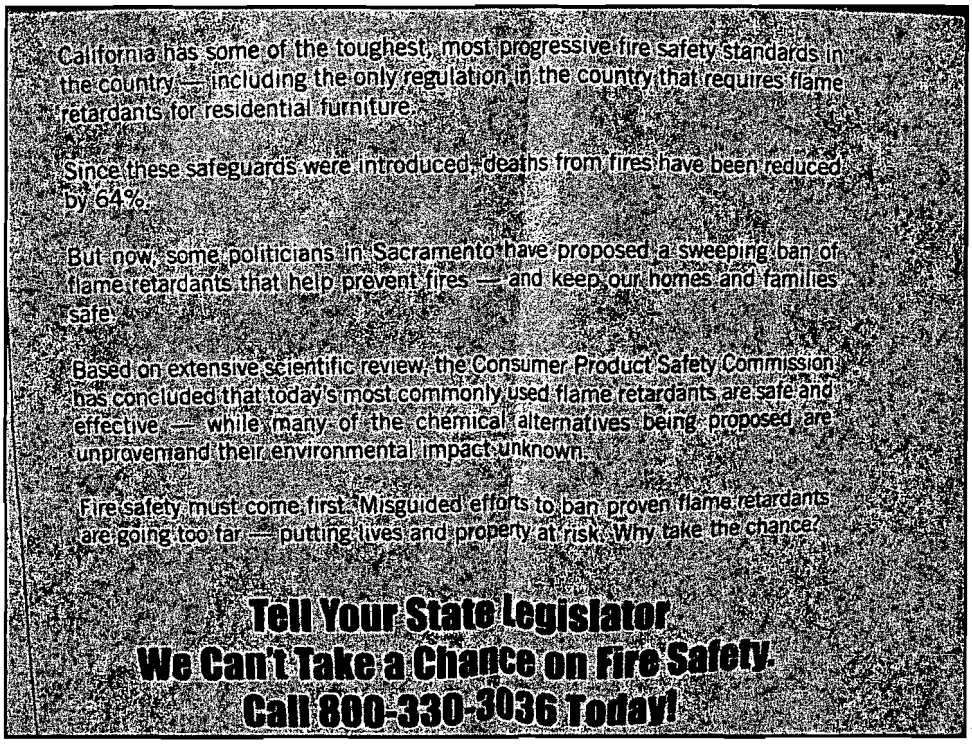
Here are some measures that ought to be no-brainers to pass and to sign: AB 706

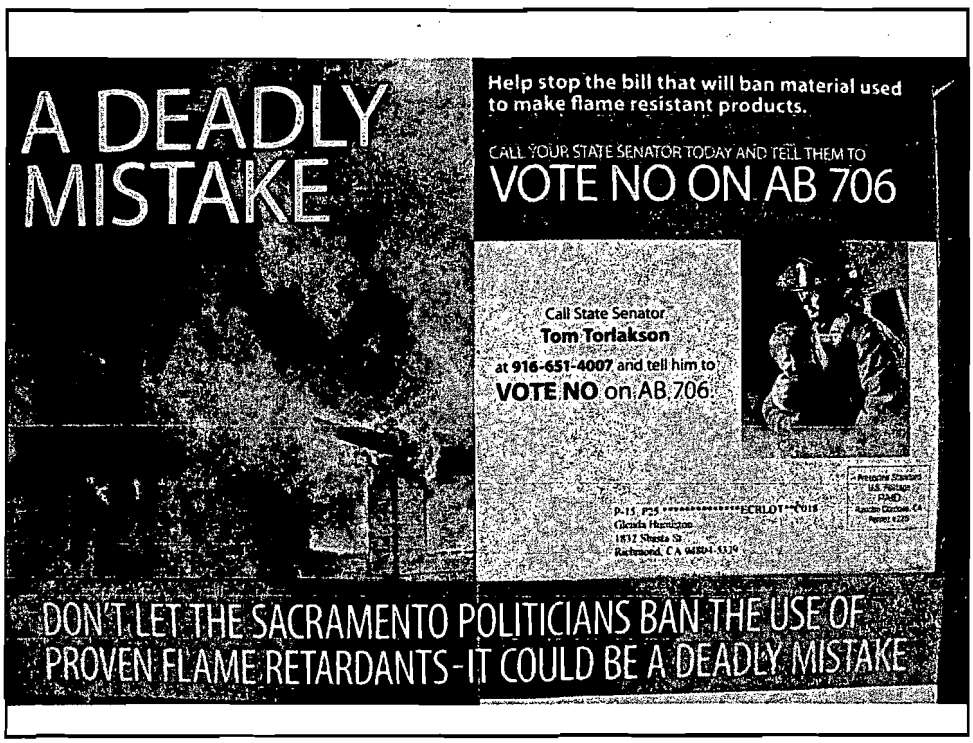
Letter to the SF Chronicle

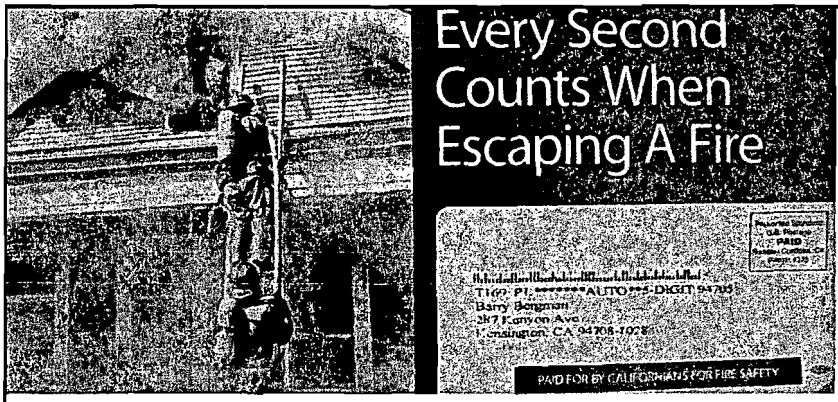
The San Francisco Fire Department is aligned with San Francisco Fire Fighters Local 798 in vigorously supporting this bill in an effort to reduce toxins in our environment

BARBARA SCHULTHEIS
Fire Marshal
San Francisco Fire Department



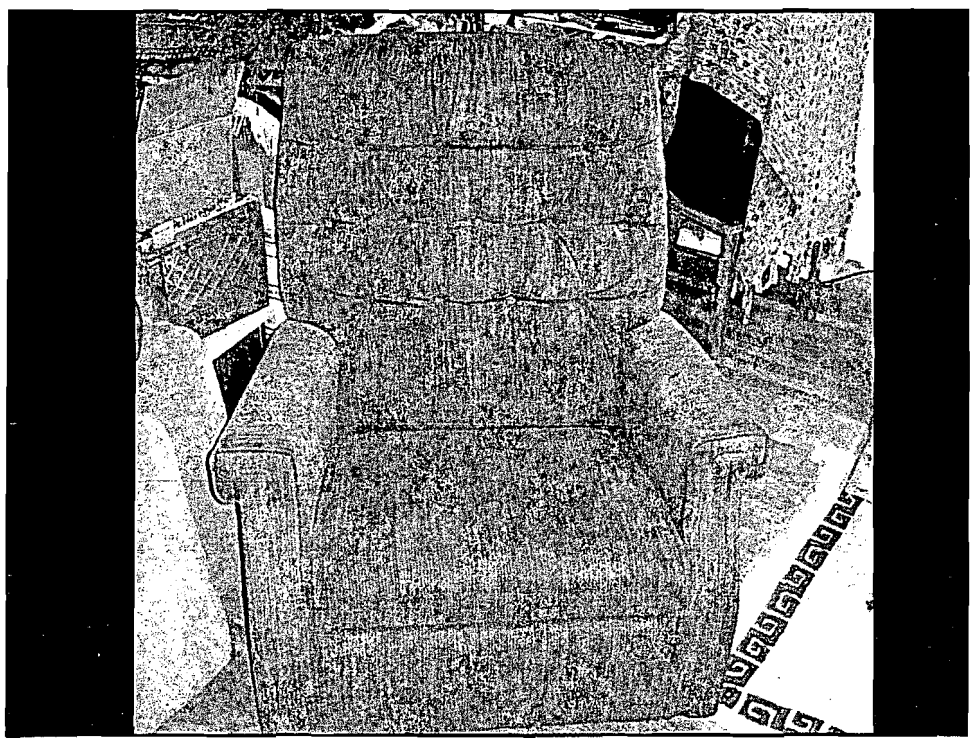

California has some of the toughest, most progressive fire safety standards in the country — including the only regulation in the country that requires flame retardants for residential furniture.
Since these safeguards were introduced, deaths from fires have been reduced by 64%.
But now, some politicians in Sacramento have proposed a sweeping ban of flame retardants that help prevent fires — and keep our homes and families safe.
Based on extensive scientific review, the Consumer Product Safety Commission has concluded that today's most commonly used flame retardants are safe and effective — while many of the chemical alternatives being proposed are unproven and their environmental impact unknown.
Fire safety must come first. Misguided efforts to ban proven flame retardants are going too far — putting lives and property at risk. Why take the chance?
Tell Your State Legislator
We Can't Take a Chance on Fire Safety.
Call 800-330-3036 Today!

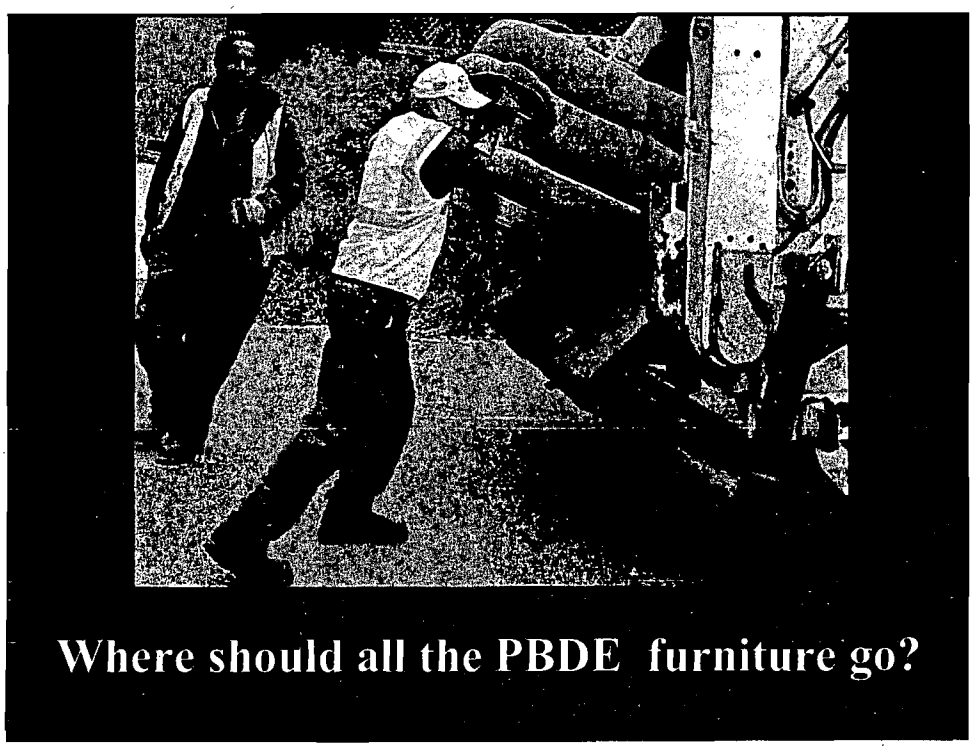

A DEADLY MISTAKE
Help stop the bill that will ban material used to make flame resistant products.
CALL YOUR STATE SENATOR TODAY AND TELL THEM TO
VOTE NO ON AB 706
Call State Senator
Tom Torlakson
at 916-651-4007 and tell him to
VOTE NO on AB 706.
DON'T LET THE SACRAMENTO POLITICIANS BAN THE USE OF PROVEN FLAME RETARDANTS-IT COULD BE A DEADLY MISTAKE



Californians for Fire Safety

- founded by Albemarle Corp., Chemtura Corp., and IC-Ltd Industrial Products
- from Louisiana, Connecticut, and Beer-Sheva, Israel
- suppliers of fire retardant chemicals




Where should all the PBDE furniture go?

Once potentially toxic materials enter the global environment, it is impossible to recall them

- PBBs
- PCBs
- Brominated Tris
- Halon
- Asbestos
- PBDEs
- Firemaster 550 and TDCP again
- What are the new fire retardant materials?
- Should they be tested in advance for toxicity and environmental effects?

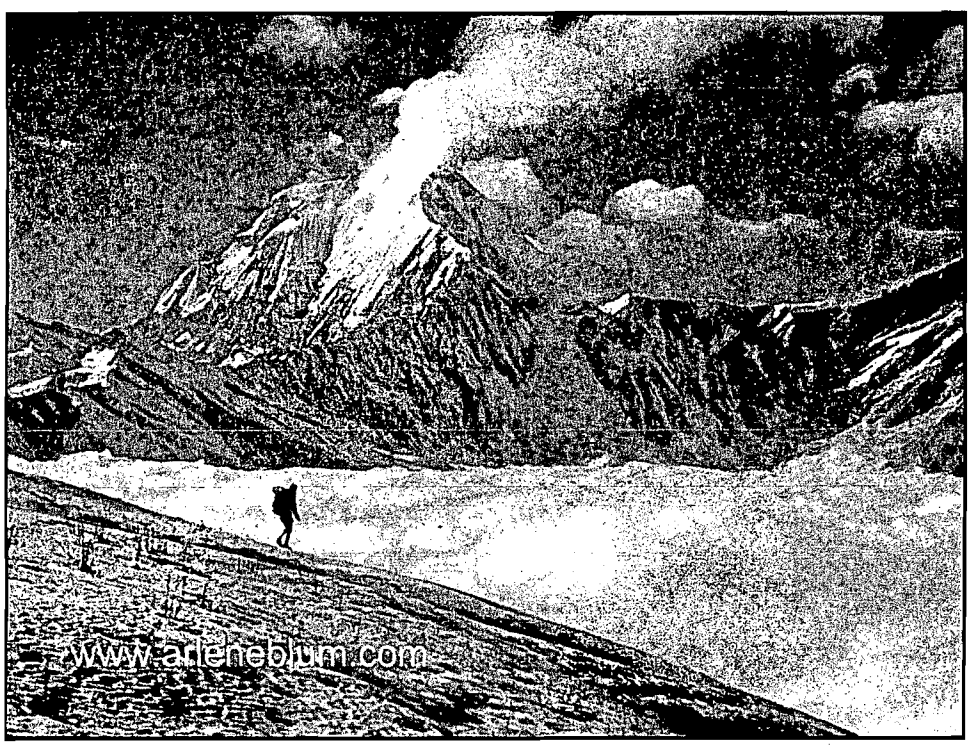
Health and Environment

"Many studies show that modern flame retardants, can be used in consumer products without significant risk to human health or the environment."

European Fire Retardant Association website

Policy Recommendations

- Fire retardant chemicals and materials must be shown safe for human health and environment before use.
- R&D money is needed to design and produce non-toxic fire retardants and materials using green chemistry.
- Moratorium on new flammability regulations until fire retardant materials or alternative strategies have been shown to be safe.



MEMO

November 6, 2007

From: Brian Roach, Global Development and Environment Institute
Tufts University, 44 Teele Ave, Medford, MA 02155
Phone: (617)627-6787 brian.roach@tufts.edu

To: Arlene Blum
Re: Cancer Costs from TDCP Exposure

The CPSC's cost-benefit analysis of their draft flammability standard did not include any monetary damages related to the health and environmental effects of flame retardant materials. Section VIII.A. of the CPSC analysis discusses the risks associated with the two primary FR materials: a proprietary brominated aryl ester and tris phosphate (TDCP). The report indicates that the "test data are very limited" for the brominated aryl ester but that the limited data suggest the material is "not expected to pose any appreciable health risk to consumers." The analysis notes that the "chemical would have to be more toxic than any other additive FR chemical previously reviewed by the staff to pose an appreciable risk." However, this statement appears to conflict with the CPSC's findings regarding the health risk of TDCP. More extensive data are available on the health risks of TDCP, and suggest cancer and non-cancer risks at or above the acceptable hazard index. In particular, the CPSC analysis indicates a lifetime cancer risk of 140 per million for TDCP – well above the one-in-a-million risk normally considered the threshold for regulatory consideration.

More recent analysis by the CPSC ("CPSC Staff Preliminary Assessment of Flame Retardant Chemicals in Upholstered Furniture Foam," Michael Babich, December 21, 2006) provides even higher risk estimates. Table 12 of this report, presented below, indicates a lifetime cancer risk of 300 per million in adults from TDCP exposure. Note that nearly 98% of the exposure is due to inhalation. However, the inhalation exposure is based on a mathematical model that assumes 100% absorption of TDCP, which likely overestimates exposure.

The purpose of this memo is to roughly estimate the cancer costs associated with exposure to TDCP in relation to the CPSC's draft flammability standard. These costs represent economic damages that should be amended to the CPSC's cost-benefit analysis. It is assumed that implementation of the CPSC's draft flammability standard would increase consumers' exposure to TDCP, and thus increase cancer risks. The analysis in this memo is based upon several assumptions, which are clearly indicated. These assumptions are meant to act as placeholders in the absence of more valid data. Thus the results presented here should be taken as preliminary and subject to further refinement.

Table 12. Exposure and Risk

Result	TDCP	
	Adults	Children
ADD (mg/kg-d)	$9.5x10^{-3}$	$2.6x10^{-2}$
Percent of total:		
Dermal	1.7	0.7
Oral, indirect	0.5	0.4
Oral, direct	0.0	0.2
Inhalation, vapor[b]	97.7	98.7
Inhalation, particles	0.0	0.0
ADI (mg/kg-d)	0.005	0.005
HI	2	5
LADD (mg/kg-d)	$9.5x10^{-3}$	$7.4x10^{-4}$
Cancer risk per million	300	20

To determine the cancer costs of TDCP exposure, quantitative values need to be provided for several variables. These variables include:

1. The population exposed to TDCP
2. The cancer risks
3. The proportion of cancer cases which are fatal
4. The time horizon of the analysis
5. The timeline for cancer cases
6. The discount rate
7. The economic values associated with cancer cases

The analysis now considers each of these variables.

Exposed Population

The CPSC standard would be a national standard. The current population of the United States is 303.3 million. The CPSC standard could potentially be met using a variety of FR materials, including TDCP and the proprietary brominated aryl ester discussed above. As health risk data are available only for TDCP, this analysis assumes that other FR materials pose the same risk. In other words, the analysis assumes that the entire U.S. population would be exposed to TDCP or other FR materials of comparable risk. Of course, the possibility of compliance with the standard using other FR materials could increase or decrease the overall health risk depending upon the relative toxicity of the other FR materials.

Cancer Risks

As mentioned above, the lifetime cancer risk from TDCP exposure of 300 per million presented in Table 12 of the Babich analysis is likely an overestimate. This analysis makes three assumptions about the TDCP cancer risk. First, only the dermal and oral exposures are considered. Assuming a linear dose-response function, this reduces the cancer risk from 300 per million to 6.6 per million (the dermal and oral exposures provide 2.2% of the total exposure in Table 12). Second, the analysis includes the inhalation exposure, but assumes that the exposure rate in Table 12 is over-estimated by a factor 10. Thus the ADD from inhalation in Table 12 is reduced from 97.7% to 9.8%, and the total exposure is reduced to 12.0% of the value in Table 12. Again assuming a linear does-response function, the cancer risk is reduced from 300 per million to 36 per million. Finally, the analysis considers the full inhalation risk presented in the Babich analysis – a lifetime cancer risk of 300 per million. Table 1 presents the estimated number of cancer cases in each of these three scenarios.

	Dermal and oral exposure only	Dermal and oral exposure, plus 10% of inhalation exposure	Dermal, oral, and 100% of inhalation exposure
Lifetime cancer risk per million	6.6	36.0	300
Exposed population (millions)	303.3	303.3	303.3
Cancer cases over 75 years	2,002	10,919	90,990
Annual cancer cases	26.7	145.6	1213.2

Fatality of Cancer Cases

Based on information provided by Michael Babich, this analysis assumes that all cancer cases are fatal. Reducing the fatality rate of cancer cases would reduce the damages associated with TDCP exposure.

Timeline for Cancer Cases

Cancer cases occur with some time lag after exposure. As a placeholder, this analysis assumes that all cancer cases occur 20 years after exposure. Thus the economic damages are discounted for the 20-year lag.

Discount Rate

Similar to the CPSC analysis, this analysis assumes a 3% discount rate.

Value of Cancer Cases

Similar to the CPSC analysis, this analysis assumes a statistical value of life of $5.0 million.

Results

Table 2 below presents the results. In the case of dermal and oral exposure only, TDCP exposure results in annual economic damages of $73.9 million. When inhalation exposure is included at the reduced 10% rate, total economic damages are $403.1 million. Finally, when the full risk of TDCP inhalation is considered, annual economic damages from cancer cases equal over $3 billion.

Table 2. Annual Economic Damages from TDCP Cancer Cases

Scenario	Discounted Annual Value of Cancer Cases ($ Millions)
Dermal and oral exposure only	74
Dermal and oral exposure, plus 10% of inhalation exposure	403
Dermal, oral, and 100% of inhalation exposure	3,359

These costs should be viewed in the context of the CPSC's cost-benefit analysis of the draft flammability standard. The CPSC estimates annual costs of compliance with the draft flammability standard as $184 million. The costs in the table below should be added to their estimate. Thus the compliance costs would range from $258 million to $3,543 million. Note that this analysis does not consider other potential costs, including the non-cancer health risks associated with TDCP and any potential health risks to fire fighters when FR materials are involved in a fire.

The CPSC estimates the gross annual benefits of the flammability standard as $779 million due to the reduction in cigarette-ignited fires, and $157 million due to the reduction in fires ignited by small open flames. Thus the total gross annual benefits are $936 million and the net benefits are $752.

However, as detailed elsewhere, the benefits due to the reduction in cigarette-ignited fires need to be adjusted downward to account for the widespread introduction of fire-safe cigarettes as a result of recent state laws. Current legislation already requires that fire-safe cigarettes be sold in states covering 52% of the U.S. population. It appears reasonable to expect that the remaining states will soon pass similar legislation, or that a federal standard will soon be enacted. It has been elsewhere estimated that a national fire-safe cigarette standard would reduce the benefits of the flammability standard due to the reduction in cigarette-ignited fires from $779 million annually, to $195-$390 million

annually (depending upon the assumed reduction in fire risk as a result of fire-safe cigarettes – 50% or 75%).

A final net benefit value can now be obtained considering both the national availability of fire-safe cigarettes and the cancer risk of TDCP. Table 3 presents the various categories of costs and benefits. If only the cancer risk associated with dermal and oral exposure is included the CPSC draft flammability standard still provides positive net benefits, although the net benefits decline by 62%-88% as compared with the CPSC estimate of $752 million. When inhalation exposure is included at 10% of the risk found by Babich, the draft flammability standard fails to provide positive net benefits and does not appear to be a worthwhile policy proposal. If the full Babich inhalation risk is considered, then the health risks associated with TDCP far outweigh any potential benefits of the flammability standard.

Table 3. Costs and Benefits of the CPSC Draft Flammability Standard

Cost/Benefit Category	Annual Value (dermal and oral exposure only)	Annual Value (dermal and oral exposure, 10% of inhalation exposure)	Annual Value (dermal and oral exposure, 100% of inhalation exposure)
Benefit from the reduction in cigarette-ignited fires (national adoption of fire-safe cigarettes)	$195 to 390 million	$195 to $390 million	$195 to $390 million
Benefit from the reduction in fires ignited by small open flames	$157 million	$157 million	$157 million
Compliance costs (from CPSC analysis)	$184 million	$184 million	$184 million
Economic damages from TDCP cancer cases	$74 million	$403 million	$3,359 million
Net benefits	$94 - $289 million	-235 million to -40 million	-3,191 to -2,996 million

This analysis indicates that the policy recommendation regarding the CPSC draft flammability standard appears to rest upon the inhalation risk associated with TCDP. The CPSC's own analysis suggests this risk may be substantial. At the least, this analysis implies that further investigation of the inhalation health risks of TDCP is warranted. Even if such risks are only $1/10^{th}$ the values produced by Babich, the CPSC draft flammability standard would appear to incur more costs than benefits.