



CEH

center for environmental health



Playing on Poisons

Harmful Flame Retardants
in Children's Furniture



CEH

center for environmental health

National Office

2201 Broadway, Suite 302

Oakland, CA 94612

T: (510) 655-3900

F: (510) 655-9100

www.ceh.org

East Coast Office

6 East 39th St, Suite 1201

New York, NY 10016

T: (212) 689-6999

F: (212) 689-6549

November 2013

Contributors to this report include Alaska Community Action on Toxics, Alliance for a Clean and Healthy Maine, Canadian Environmental Law Association, Clean and Healthy New York, Clean Water Action-Connecticut, Clean Water Action-Massachusetts, Ecojustice, Ecology Center, Healthy Legacy, Kentucky Environmental Foundation, Oregon Environmental Council, Vermont Public Interest Research Group, Washington Toxics Coalition, and Women's Voices for the Earth.

This report was written by Caroline Cox and Judy Levin at the Center for Environmental Health.



Whether you're a parent or not, keeping children safe is something you probably think about often. Keeping children safe from fires is just one of the many safety concerns that we all share.

Decades ago, this concern led to a misguided effort to require the use of chemical flame retardants in common furniture items, including children's products, made with polyurethane foam. Misguided, because these chemicals do not make children or families safer in case of fire. And further misguided, because exposure to chemical flame retardants has been linked to many serious health problems for children and adults.

In July and August of this year, the Center for Environmental Health (CEH, with offices in New York and California) and organizations from 11 other states and Toronto, Canada, purchased a total of 42 children's sofas, chairs, and other furniture products, many branded with characters from Disney, Marvel Comics, Sesame Street, and Nickelodeon. Products were purchased from Walmart, Target, Kmart, Babies "R" Us and Toys "R" Us, buybuy Baby, and other retailers.

CEH commissioned a Duke University researcher who is a leading national expert on testing products for flame retardant chemicals to conduct this testing. The testing found that all but four products (90% of the products) contain flame retardant chemicals that have been linked to serious health problems.

The flame retardant chemical that was found in the most products (22 of the 42 products) has recently been linked to harmful impacts on our bodies' natural hormones. Other chemicals found in the products include a flame retardant known to cause cancer and chemicals linked to infertility, genetic damage, and developmental health problems. Children are more highly exposed to flame retardants and are more vulnerable to these health hazards than adults.

What's especially troubling about our findings is that fire safety scientists say that these harmful, toxic flame retardant chemicals are not effective in reducing fire risks as they are used in children's (or adult) furniture. In other words, children's furniture with fire retardant chemicals is the worst of both worlds: the products are not safer in fires, but they threaten our children's health.

When shopping for furniture, it is almost impossible to find out what flame retardant chemicals have been used in a particular piece of furniture. Parents and other consumers have a right to know about the chemicals used in products for their children and families.

CEH and the groups who have contributed to this report recommend that parents purchase furniture that is not likely to contain flame retardant chemicals – polyester filled furniture, canvas chairs, wood furniture, and other products that do not contain foam. We also advocate for laws and regulations at the state and federal level that will eliminate unnecessary and harmful uses of chemical flame retardants.

Participating Organizations:

- **Alaska Community Action on Toxics**
(Anchorage, AK)
- **Alliance for a Clean and Healthy Maine**
(Portland, ME)
- **Canadian Environmental Law Association**
(Toronto, Canada)
- **Clean and Healthy New York**
(Albany, NY)
- **Clean Water Action-Connecticut**
(Hartford, CT)
- **Clean Water Action-Massachusetts**
(Boston, MA)
- **Ecojustice**
(Toronto, Canada)
- **Ecology Center**
(Ann Arbor, MI)
- **Healthy Legacy**
(Minneapolis, MN)
- **Kentucky Environmental Foundation**
(Berea, KY)
- **Oregon Environmental Council**
(Portland, OR)
- **Vermont Public Interest Research Group**
(Montpelier, VT)
- **Washington Toxics Coalition**
(Seattle, WA)
- **Women's Voices for the Earth**
(Missoula, MT)

What We Did

Earlier this year, CEH found harmful flame retardant chemicals in nap mats used in child care facilities nationwide (see http://www.ceh.org/legacy/storage/documents/Flame_Retardants/nap_mat_report_2_19_2013.pdf).

As a follow-up, in July and August we worked with groups from across the U.S. and Canada to purchase children's furniture and determine if these products pose similar health threats. See the panel to the left for the list of participating organizations.

We purchased 42 pieces of furniture containing polyurethane foam from major retailers: Babies "R" Us and Toys "R" Us, Walmart, Kmart, Target, buybuy Baby, and others. 18 were from California, 21 were from 12 other states, and 3 were from Canada. Many of the products carry colorful designs of leading children's characters from Disney, Marvel Comics, Sesame Street, and Nickelodeon.

We sent a sample from each piece of furniture to Dr. Heather Stapleton (Nicholas School of the Environment, Duke University) for independent analysis. Dr. Stapleton is a leading researcher in testing of consumer products for flame retardants. The samples were identified only by a code, so the lab did not know which products were being tested. Her lab analyzed the material from each piece of furniture for flame retardants using mass spectrometry (details of the analytical methods Dr. Stapleton used are described in *Environmental Science and Technology* 45: 5323–5331, available online at <http://pubs.acs.org/doi/abs/10.1021/es2007462>).

The analysis identified which flame retardants were present in the furniture; it did not determine the amount of flame retardant chemicals.



Disney Princess chair from Babies "R" Us



Spiderman chair from Walmart



Monsters U chair from Toys "R" Us



All but four of the 42 pieces of children's furniture that we tested contained toxic flame retardants.

What We Found

Dr. Stapleton's tests identified four flame retardants in the children's furniture.

- **Firemaster 550 or equivalent** (22 items)
- **Tris (1-chloro-2-propyl) phosphate, often called TCPP** (15 items)
- **Tris (1,3-dichloro-2-propyl) phosphate, often called Chlorinated Tris or TDCPP** (2 items)
- **Butylated Triphenyl Phosphate** (1 item)

Two products contained more than one of these flame retardants.

Firemaster 550 is a mixture of five chemicals: triphenyl phosphate, isopropyl phenyl diphenyl phosphate, di (isopropyl phenyl) phenyl phosphate, tetrabromobenzoate, and tetrabromodiethylhexyl phthalate.

Butylated Triphenyl Phosphate is a mixture of four chemicals: triphenyl phosphate, mono butyl diphenyl phosphate, di (butyl phenyl) phenyl phosphate, and tris butyl phenyl phosphate.

All four are widely used flame retardants. Firemaster 550 came on the market in 2003 as the use of certain problematic flame retardant chemicals (PBDEs) was being phased out.

All but four of the 42 pieces of children's furniture contained flame retardants that our analysis could detect.

For complete results about each of the pieces of furniture we tested, see "[Detailed Results](#)" at the end of this report.



Flame Retardants: Not Good for Children (or their Parents!)

The flame retardants used in children's furniture are a diverse group of chemicals that may cause a wide array of health problems. Cancer, obesity, reduced fertility, and hormone disruption are just a few of the problems that have been linked to exposure to these flame retardants. And this list is likely to be incomplete. None of the chemicals used as flame retardants have been comprehensively tested and there are large gaps in our knowledge about the toxicity of these chemicals.

The testing found four flame retardants (or flame retardant mixtures) in the children's furniture. Details about health hazards associated with the flame retardants we found include the following:

Health Hazards of Flame Retardants:

- **Firemaster 550:**
 - Obesity
 - Disrupted hormone function
- **TCPP**
 - Genetic damage
 - Abnormal menstrual cycles
- **TDCPP**
 - Cancer-causing
 - Genetic damage
 - Changes in hormone levels
- **Butylated Triphenyl Phosphate**
 - Decreased fertility
 - Abnormal menstrual cycles

- **Firemaster 550** caused obesity and disrupted normal hormone function in tests with laboratory animals and tests with living cells.
- **TCPP** caused genetic damage in studies of human cells. In tests with laboratory animals, TCPP changed the length of the menstrual cycle.
- **TDCPP** (chlorinated Tris) is identified as a cancer-causing chemical by the state of California and the U.S. National Research Council. In laboratory animals, it is toxic to developing embryos and also causes genetic damage in studies of human cells. In men attending infertility clinics, exposure to TDCPP was linked with changes in hormone levels.
- **Butylated Triphenyl Phosphate:** The U.S. Environmental Protection Agency has summarized the limited toxicology testing done with this flame retardant mixture. Health concerns identified in the EPA summary include decreased fertility and abnormal menstrual cycles.

Particularly concerning is the ability of these chemicals to disrupt the normal functions of our hormones. Hormones are chemical messengers that work together in a system that "regulates all biological processes in the body from conception through adulthood and into old age." Hormones are potent in tiny amounts, and research over the last several decades has shown, similarly, that "low-dose effects are remarkably common" in studies of hormone-disrupting chemicals.



A recent California study of house dust found flame retardant chemicals in all of the homes tested. Children, who are especially sensitive to chemicals, ingest this dust.

Exposure to Flame Retardants in Furniture

Flame retardant chemicals in furniture continuously escape into the air wherever the furniture is located. Covering the furniture with an extra layer does not prevent the chemicals from coming out. Children breathe this air while they sit on the furniture, and also if they play in the same room. A recent California study of house dust found Firemaster 550 or an equivalent in all but one sample tested. TCPP, the other flame retardant chemical commonly found in our study, was found in all of the homes tested.

Some of the evaporated flame retardants will settle on children's skin and be absorbed. In addition, some of the evaporated flame retardants settle on dust particles. Children ingest this dust when it gets on their fingers and they put their fingers in their mouths.

Children are especially sensitive to chemicals. "Children are at increased risk," writes the U.S. Department of Health and Human Services, "because of their increased exposures and increased vulnerability."

Children are more exposed to toxic chemicals than adults are because of their behaviors and physical needs. For example, for their size children breathe more air than adults do, so if there are toxic chemicals in the air, they will be more exposed. They also put their fingers in their mouths often. Children carry on average three times higher levels of some flame retardants in their bodies than the levels found in their mothers, according to a study from UC Berkeley's Center for Environmental Research and Children's Health. Other recent studies show that children of color and children from low-income communities have higher levels of flame retardant chemicals in their bodies than levels found in white children.

In addition, children go through stages when their bodies and brains are rapidly growing and developing and so are particularly vulnerable. In the words of the U.S. Department of Health and Human Services: "These are times when children are exquisitely sensitive to any adverse effects of chemicals."

And, according to the EPA, "Infants and children can be particularly vulnerable to the adverse health effects of endocrine-disrupting chemicals," like some flame retardant chemicals.



Flame Retardants: Not Effective Yet Still Widely Used in Children's Furniture

Flame retardants are used in children's furniture due to an outdated and ineffective California furniture flammability standard called TB 117. This decades-old standard has failed to deliver on its promise of enhanced fire safety and instead has exposed us to a series of toxic and untested chemicals.

TB 117 was implemented in 1975 and has become a de facto national requirement. Many companies choose to comply with the California standard for all of their products rather than create a special line for California. In addition, since many U.S. companies export products and many countries are urged to follow U.S. standards, California's TB 117 has increasingly become the de facto global standard.

TB 117 is a lose-lose regulation for consumers: it has failed to provide fire safety benefits and instead has exposed us to a series of toxic and untested flame retardant chemicals. It is based on unrealistic fire scenarios and fails to address the major cause of furniture fires: smoldering cigarettes.

TB 117 requires that the foam *inside* a piece of furniture or baby product withstand a 12-second exposure to a small open flame. But in a real-life fire, the *exterior* fabric of the product, not the foam interior, ignites first. Fire safety scientists say that once the fabric is burning, the flame is too large to be controlled by the flame retardant chemicals used in foam.

TB 117: California's Lose-Lose Furniture Flammability Standard

- Implemented in 1975 and has become a de facto national standard.
- Requires the foam inside furniture to withstand a 12-second exposure to a small open flame.
- In a real fire, the exterior fabric, not the foam, ignites first. Once the fabric is burning, the flame is too large to be controlled by flame retardant chemicals in the foam.
- When flame retardant-treated foam burns, it can produce higher levels of toxic gases.
- Inhalation of these toxic gases is the major cause of fire deaths and fire injuries.
- The CPSC and other government agencies have found that TB 117 flame retardant foam is not effective in reducing fire hazard.

In addition, when foam products containing flame retardant chemicals burn, they can produce higher levels of toxic gases -- carbon monoxide, soot, and smoke -- compared to untreated foam. Inhalation of these toxic gases is the major cause of fire deaths and fire injuries.

Research by the United States Department of Commerce, National Bureau of Standards, and Consumer Product Safety Commission (CPSC) all found that TB 117 flame retardant foam is not effective in reducing fire hazard. CPSC tests found that flame retardant foam can actually make the cover fabric more prone to burn from cigarettes, which are the leading cause of furniture fires.

Regulatory Change: Opening Markets for Safer Products

Earlier this year, California proposed a revision to its TB 117 flammability standard. For the first time in almost four decades, the new standard relies on the most modern fire safety science to provide companies with easy ways to make their products safer, without the use of any harmful flame retardant chemicals. The



revised standard reflects real world fire scenarios by evaluating the flammability performance of the upholstery cover fabric in combination with the underlying filling materials, and adopting rules that allow companies to make flame retardant-free products that are truly safer in fires and safer for our children and families.

The new standard, TB 117-2013, is expected to be implemented on January 1, 2014. Since most companies make all of their products comply with California rules, the updated California standard will drive global change throughout the furniture industry.

While the new California standard is easily achieved without the use of toxic flame retardant chemicals, it does *not* ban the use of flame retardant chemicals. Also, it allows companies to meet the new standard immediately on implementation of the rule on January 1, 2014, but does *not* require companies to comply for a year. Given the immense consumer demand for safer products without chemical health hazards, companies that are ready for the change sooner will have a significant market advantage over competitors who wait until compliance is mandatory.

CEH and our partner organizations nationwide in the U.S. and Canada are urging companies to offer safer, flame retardant-free products as quickly as possible. We will be promoting companies that make public their intentions to eliminate these unnecessary, harmful chemicals, and will be pressuring companies that fail to take swift health protective action.

TB 117-2013: Modern Fire Safety Science and Healthier Products

- Expected to come into effect on January 1, 2014.
- Evaluates the flammability of the upholstery cover fabric, along with the underlying foam.
- Adopts rules that allow companies to make flame retardant-free products.
- Does NOT ban the use of flame retardant chemicals.
- CEH and our partners are urging companies to comply with TB 117-2013 without the use of flame retardant chemicals.



Your Right to Know

Parents and other consumers generally have no way to know when they shop for children's furniture whether or not products contain harmful flame retardant chemicals. Our limited testing suggests that almost all children's foam furniture contains these risky chemicals -- but a few foam products did not. Nothing on the labeling on the products discloses whether the products contain -- or are free from -- these toxic chemicals.

We advocate for government policies that require companies to test their products *before* they are allowed on the market, and that protect our right to know about harmful products by requiring product labeling.

Unfortunately, state and federal chemical policies do not protect our right to know when products contain toxic flame retardants or other harmful or untested chemicals. Most people believe that products must be safe if they are allowed on store shelves, but in fact, current chemical regulations allow thousands of chemicals, including flame retardants, to be used in common everyday products without health or safety testing, and without labeling.

This backwards approach, whereby chemicals are assumed to be safe until proven deadly, has put our children and families at risk for decades. Over the past 40 years, the flame retardants industry has sequentially replaced its chemicals as they are found to be hazardous with new "improved" chemicals that a few years later prove to be equally harmful.

This approach needs to change. We advocate for government policies that require companies to test their products for safety *before* they are allowed on the market, and that protect our right to know about harmful chemicals by requiring product labeling.

In the meantime, we urge companies to disclose their use of flame retardant chemicals and to label their safer products when they are made without these harmful chemicals.



Alternative products include chairs made of polyester, canvas, and wood.

What You Can Do

Parents:

- Purchase products made without polyurethane foam. Opt for products made of polyester, wool, cotton or down.
- Children's furniture alternative options include: wood furniture, products filled with cotton, wool, or polyester fiber-fill, and canvas sling chairs.
- Avoid products that have a TB 117 label as these are likely to contain flame retardant chemicals.
- For products with a TB 117-2013 label: Read the label carefully to see if it says whether flame retardants are present. If the label does not indicate this, call the store manager or manufacturer and ask if the product contains flame retardant chemicals.
- Be a wary consumer of deeply discounted furniture. Manufacturers are allowed to sell their old TB 117 inventory indefinitely -- until their stock runs out. Ask companies if their products are free of flame retardants.
- Check CEH's website: As CEH learns which products do not contain flame retardant chemicals or which manufacturers have removed them, we will note this on our website: <http://www.ceh.org/campaigns/flame-retardants/>.
- Wash your hands and your children's hands often, especially before eating or after handling dryer lint or changing a vacuum cleaner bag.
- Vacuum or wet mop often. Use a HEPA vacuum cleaner if available.

Everyone:

- Support state efforts to provide toxic-free fire safety (see details on the next page). Take action to support flame retardant free furniture and baby products: <http://www.ceh.org/get-involved/take-action/content/we-cant-wait-another-year-for-safer-products/>
- Support efforts to fix our nation's outdated and ineffective chemical policy regulations.

Policy Recommendations

The **U.S. Consumer Product Safety Commission (CPSC)** and **Health Canada** should adopt national flammability standards that provide fire safety without the use of flame retardant chemicals. CPSC has never implemented a federal flammability standard despite numerous attempts. Canada also does not have a similar standard. California modeled TB 117-2013 on the CPSC's 2008 well-researched draft standard. It is time for the US and Canadian governments to adopt either the 2008 draft standard or California's TB 117-2013. We need enforceable national standards so that no matter where you live, you will have fire-safe products that won't expose your family to unnecessary and harmful flame retardant chemicals.

Businesses, cities, counties, states, and provinces should adopt policies that prefer or require the purchase of products that meet TB 117-2013 without the use of flame retardants. CEH has tools that can help.

Government and business should direct research money to determine how to safely dispose of old products that contain flame retarded foam.



The U.S. and Canada should require comprehensive health and safety testing of chemicals, promote green chemistry and encourage safer substitutes for hazardous chemicals.

States and provinces should adopt legislation that bans the use of unnecessary and toxic flame retardant chemicals in products to which children are exposed.

The U.S. and Canada should require comprehensive health and safety testing of chemicals. In addition, both countries should promote green chemistry and encourage safer substitutes for hazardous chemicals.

Pending State Actions

Massachusetts

Senator Cynthia Creem proposed *Bill S.351: an act to protect children and families from harmful flame retardants*. This bill restricts the manufacturing, sale, or distribution of products containing Tris, PBDEs, or other flame retardants that are identified as chemicals of high concern. It has been referred to the Joint Committee on Public Health.

Bill H.235 & S.354: An act for healthy families and businesses sponsored by Representative Jay Kaufman and Senator Ken Donnelly would create a program to require companies to systematically replace toxic chemicals in consumer products with safer alternatives wherever feasible. It has been referred to the Senate Committee on Ways & Means. For more information, see <http://www.healthytomorrow.org/2013/04/familiesbusinesses.html>.

Minnesota

"Toxic Free Kids Act of 2013" SF 466 (Eaton) / HF 605 (Winkler) would require all manufacturers to report their use of Nine Priority Chemicals in children's products and incentivizes the phase out of priority chemicals through increased reporting requirements and fees for manufacturers that continue to use priority chemicals.

New York

S.4614 (Boyle)/A.6328 (Sweeney et al.): Regulation of toxic chemicals in children's products creates a list of chemicals of high concern, prioritizes among them chemicals for further action, requires manufacturers to report their use of these priority chemicals in products meant for children, and prohibits the sale of items of children's apparel or novelty products containing these priority chemicals. For more information, see: www.cleanhealthyny.org.



Oregon

Oregon's 2014 legislature will consider the *Toxics Disclosure for Healthy Kids Act*. The act would require manufacturers of children's products to disclose the presence of toxic chemicals of high concern to children's health. The bill, sponsored by Rep. Alissa Keny-Guyer and Rep. Jason Conger in the 2013 session, passed the House but did not receive a vote in the Senate. For more information, see: <http://www.oeconline.org/toxicfree>.

Vermont

The Vermont legislature recently enacted bans on harmful flame retardant chemicals including chlorinated Tris (TDCPP and TCEP) and Deca, *Senate Bill 81*. In 2014, comprehensive chemical reform legislation will be pursued, which would allow the state to (1) identify chemicals of high concern, (2) require disclosure of the use of those chemicals in consumer products sold in Vermont, and (3) phase out those harmful chemicals. For more information, see: www.alliancevt.org.

Washington

Toxic-Free Kids & Families Act (HB 1294) will run in the 2014 legislative session. The bill will ban two forms of "tris" flame retardants (TDCPP & TCEP) in children's products and home furniture beginning July 1st, 2014. It also prevents makers of children's products and home furniture from replacing Tris with other toxic flame retardants that have been identified by the Washington Department of Ecology as a concern for children's health beginning July 1st, 2015. For more information, see: www.watoxics.org.

Detailed Results

Description	State	Store	Firemaster 550	Other Flame Retardants
Spiderman Chair	AK	Walmart	X	
Chair Cushion	CA	buybuy Baby	X	
Chair, No Character	CA	Big Lots	X	
Elmo Says Spin Chair	CA	Babies "R" Us	X	
Justice League Chair	CA	Target		Butylated Triphenyl Phosphate
Dora the Explorer Sofa	CA	Babies "R" Us	X	
Monsters U Chair	CA	Toys "R" Us	X	
Minnie Mouse Sofa	CA	Walmart	X	
Disney Princesses Sofa	CA	Walmart	X	
Spiderman Chair	CA	Walmart	X	
Princess Chair	CA	Kmart	X	
Disney Cars Sofa	CA	Kmart	X	
Mickey Mouse Chair	CA	Kmart	X	
Chair, No Character	CA	Wayfair		TCPP, TDCPP
Circo Robot Chair	CA	Target		TCPP
Circo Plaid Chair	CA	Target		TCPP
Circo Plaid Chair	CAN	Target		TCPP
Spiderman Chair	CAN	Toys "R" Us	X	
Sesame Street Chair	CAN	Walmart	X	
Disney Princess Chair	CT	Walmart	X	
Circo Plaid Chair	KY	Target		TCPP
Thomas & Friends Sofa	KY	Walmart	X	
Circo Robot Chair	MA	Target		TCPP
Circo Robot Chair	MI	Target		TCPP
Circo Robot Chair	MI	Target		TCPP
Circo Robot Chair	MI	Target		TCPP
Storage Ottoman	MN	Target		TCPP
Circo Robot Chair	ME	Target		TCPP
Storage Ottoman	ME	Target		TCPP
Storage Ottoman	MT	Target		TCPP
P'Kolino Little Reader Chair	NY	buybuy Baby	X	TDCPP
Minnie Mouse Rocker	NY	Kmart		TCPP
Disney Princess Chair	NY	Babies "R" Us	X	
Thomas & Friends Chair	OR	Walmart	X	
Minnie Mouse Chair	OR	Walmart	X	
Sesame Street Sofa	VT	Toys "R" Us	X	
Mickey Mouse Chair	WA	Walmart	X	
Blue Chair, No Character	WA	Target		TCPP
Furniture with no detected flame retardants				
Alex the Lionicon Chair	CA	Babies "R" Us		
Spongebob Chair	CA	Babies "R" Us		
Hello Kitty Sofa	CA	Babies "R" Us		
Blue Chair, No Character	MA	HomeGoods		

References

Flame Retardants - Not Good for Children (or their parents!)

- U.S. Environmental Protection Agency. 2011. What are endocrine disruptors? <http://www.epa.gov/endo/pubs/edsoverview/whatare.htm>
- Laura N. Vandenberg et al. 2012. Hormones and Endocrine-Disrupting Chemicals: Low-Dose Effects and Nonmonotonic Dose Responses. *Endocrine Reviews* 33(3): 378-455.

Firemaster 550

- Heather B. Patisaul et al. 2012. Accumulation and Endocrine Disrupting Effects of the Flame Retardant Mixture Firemaster 550 in Rats: An Exploratory Assessment. *J Biochem Molecular Toxicology*. 27 (2); p. 124-136
- David M.V. Saunders et al. 2013. In vitro endocrine disruption and TCDD-like effects of three novel brominated flame retardants: TBPH, TBB, & TBCO. *Toxicology Letters* 223: 252–259.

TCPP

- European Communities. 2008. Tris(2-Chloro-1-Methylethyl) Phosphate (TCPP) CAS No: 13674-84-5 EINECS No: 237-158-7 Risk Assessment. http://echa.europa.eu/documents/10162/13630/trd_rar_ireland_tccp_en.pdf.

TDCPP

- Office of Environmental Health Hazard Assessment. 2011. A Chemical Listed Effective October 28, 2011 as Known to the State of California to Cause Cancer Tris(1,3-Dichloro-2-Propyl) Phosphate (TDCPP) (CAS NO. 13674-87-8) [10/28/11]. http://oehha.ca.gov/prop65/prop65_list/102811list.html.
- National Research Council. Subcommittee on Flame-Retardant Chemicals, Committee on Toxicology, Board on Environmental Studies and Toxicology. 2000. *Toxicological Risks of Selected Flame-Retardant Chemicals*. p. 401. http://www.nap.edu/catalog.php?record_id=9841
- Sean P. McGee et al. 2012. Early Zebrafish Embryogenesis Is Susceptible to Developmental TDCPP Exposure *Environ Health Perspect* 120:1585–1591.
- Erik J. Sederlund et al. 1985. Comparative Genotoxicity and Nephrotoxicity Studies of the Two Halogenated Flame Retardants Tris(1,3-Dichloro-2-propyl)phosphate and Tris(2,3-Dibromopropyl)phosphate. *Acta pharmacol. et toxicol.* 56: 2&29.
- Laura V. Dishaw et al. 2011. Is the PentaBDE Replacement, Tris (1,3-dichloro-2-propyl) Phosphate (TDCPP), a Developmental Neurotoxicant? *Studies in PC12 Cells. Toxicol Appl Pharmacol.* 256(3): 281–289.

Butylated Triphenyl Phosphate

- Robin E. Dodson et al. 2012. After the PBDE Phase-Out: A Broad Suite of Flame Retardants in Repeat House Dust Samples from California. *Environmental Science & Technology* 46: 13056–13066.

Exposure to Flame Retardants in Furniture

- Heather M. Stapleton et al. 2011. Identification of Flame Retardants in Polyurethane Foam Collected from Baby Products. *Environ. Sci. Technol.* 45: 5323–5331.
- Robin E. Dodson et al. 2012. After the PBDE Phase-Out: A Broad Suite of Flame Retardants in Repeat House Dust Samples from California. *Environ. Sci. Technol.* 2012, 46, 13056–13066.
- Eskenazi B et al. 2011. A comparison of PBDE serum concentrations in Mexican and Mexican-American children living in California. *Environ Health Perspect.* 119(10):1442-8.
- Quirós-Alcalá L et al. 2011. Concentrations and loadings of polybrominated diphenyl ethers in dust from low-income households in California. *Environ Int.* 37(3):592-6.

- U.S. Department of Health and Human Services Agency for Toxic Substances and Disease Registry Division of Toxicology and Human Health Services Environmental Medicine Branch. 2012. Principles of Pediatric Environmental Health. <http://www.atsdr.cdc.gov/csem/csem.asp?csem=27&po=3>.
- U.S. Environmental Protection Agency. 2013. Protecting Growth and Development. <http://epa.gov/sciencematters/css/protect.htm>.

Flame Retardants - Not Effective Yet Still Widely Used in Children's Furniture

- U.S. Consumer Product Safety Commission. 2012. Upholstered Furniture Full Scale Chair Tests – Open Flame Ignition Results and Analysis. Memorandum dated May 9, p. 23. <http://www.cpsc.gov/PageFiles/93436/openflame.pdf>
- Jayakody C et al. 2000. Fire-retardant characteristics of Water-Blown Molded Flexible Polyurethane Foam Materials. J. Fire Sciences, Vol. 18, p. 430-455
- Vytenis Babrauskas. 1983. Upholstered Furniture Heat Release Rates: Measurements and Estimation. Journal of Fire Sciences 1: 9. <http://fire.nist.gov/bfrlpubs/fire83/PDF/f83013.pdf>
- Public/Private Fire Safety Council. 2006. Home Smoke Alarms and Other Fire Detection and Alarm Equipment. <http://www.usfa.fema.gov/downloads/pdf/white-paper-alarms.pdf>

Regulatory Change: Opening Markets for Safer Products

- California Dept of Consumer Affairs, 2013. Bureau of Electronic and Appliance Repair, Home Furnishings, and Thermal Insulation. Technical Bulletin. <tp://www.bhfti.ca.gov/industry/bulletin.shtml>.



www.ceh.org

National Office

2201 Broadway, Suite 302
Oakland, CA 94612
T: (510) 655-3900
F: (510) 655-9100

East Coast Office

6 East 39th St, Suite 1201
New York, NY 10016
T: (212) 689-6999
F: (212) 689-6549

The Center for Environmental Health (CEH) has a seventeen-year track record of protecting children and families from harmful chemicals in our air, water, food, and in dozens of everyday products. CEH also works with major industries and leaders in green business to promote healthier alternatives to toxic products and practices.