Meeting Log

National Academy of Sciences Subcommittee on Flame Retardant Chemicals

Location: National Academy of Sciences
2001 Wisconsin Avenue
Washington, DC

Date: October 26, 1999

CPSC Attendees: M. Babich, P. Bittner, J. Ferrante, D. Ray, L. Saltzman, T. Thomas

Other Attendees: See attached list

This was the third and final meeting of the subcommittee, which met October 26-27. The public session of the meeting began at 8:30 am on October 26. Michael Babich and Patricia Bittner of the CPSC Division of Health Sciences made presentations to the subcommittee. Copies of the slides and transcripts of the presentations are attached. Subcommittee members and guests had questions for staff after the presentations. This part of the meeting lasted about 1 hour after which the meeting was closed to the public.

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National Academy of Sciences
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Institute of Medicine
National Research Council

Board on Environmental Studies and Toxicology
Committee on Toxicology

Subcommittee on Flame-Retardant Chemicals
October 26-27, 1999
2001 Wisconsin Ave., NW, GR 122
Washington, DC 20007

Participants List

Subcommittee

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TRIS (CHLOROPROPYL) PHOSPHATE -- TCPP*

Michael A. Babich, Ph.D.
Directorate for Health Sciences
U.S. Consumer Product Safety Commission

October 26, 1999

Slide 1. Good morning, Mr. Chairman, and members of the Subcommittee. Today the staff of the U.S. Consumer Product Safety Commission (CPSC) will complete its presentation on the toxicity of flame retardant (FR) chemicals that are candidates for use in upholstered furniture. The CPSC staff has reviewed all the available toxicity data on 16 FR chemicals or chemical classes. According to the Fire Retardant Chemicals Association (FRCA), these chemicals are likely to be used in upholstered furniture to comply with the CPSC draft open flame standard, if the draft standard is adopted. The first 14 chemicals were discussed in previous meetings of the Subcommittee. The 2 remaining chemical classes--tris (chloropropyl) phosphate, or TCPP, and the aromatic phosphates--will be discussed today. First, I will attempt to clarify some confusion regarding the identity of TCPP. Then, Patricia Bittner will review the toxicity of TCPP and the aromatic phosphates. Finally, I will give a very brief summary of CPSC's risk assessment of FR chemicals.

The views expressed in this and the following presentations by the CPSC staff are those of the Commission's Directorate for Health Sciences and have not been reviewed or approved by the Commission.

Slide 2. Two isomers of TCPP[1] are listed on the U.S. Environmental Protection Agency's (EPA's) TSCA inventory as high production volume chemicals-- isomer I, which is tris (1-chloro-2-propyl) phosphate (CAS # 13674-84-5), and isomer IV, which is tris (2-chloropropyl) phosphate (CAS # 6145-73-9).[2,3] Isomer IV has its propyl groups in the straight chain or "normal" configuration, whereas isomer I has propyl groups in the branched or "iso" configuration. Notice that in isomer IV, the number 1 and alpha positions on the propyl groups are equivalent. In isomer I, however, the number 1 position is equivalent to the beta position. Toxicity data for isomers I and IV have been submitted to EPA.[4,5] The Fire Retardant Chemicals Association listed tri (β-chloropropyl) phosphate, which is equivalent to isomer IV, as a candidate for use in upholstered furniture.[6]

However, Stevens and Mann[7] reported that the two TCPP isomers are, in fact, components of the same commercial product. This was confirmed by the two major U.S. manufacturers.[8] According to the manufacturers, commercial TCPP is a mixture of 4 isomers. Isomer I, the isopropyl form, is present at roughly 75%. Isomer II, which contains 2 isopropyl groups and 1 normal propyl group, is present at about 20 percent. Isomer III contains 1 isopropyl and 2 normal propyl groups, and is present at roughly 2 percent. Isomer IV, which contains 3 normal propyl groups, is present at less than 1 percent. While the exact composition of TCPP is

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* Presented before the National Academy of Sciences, Subcommittee on Flame Retardant Chemicals in Upholstered Furniture. Washington, DC. October 26, 1999.

variable, the order of abundance of the 4 isomers remains the same. Although isomer IV is listed as a HPV chemical, it is not manufactured as a distinct product by either of the two largest domestic manufacturers.[9] Rather, it exists only as a minor component of commercial TCPP.

The manufacturers also point out that any toxicological data submitted to EPA as either isomer I or IV are, in fact, derived from tests performed on the same commercial mixture. Therefore, in considering the toxicity of TCPP, it may be appropriate to combine data reported under the names or Chemical Abstracts Service (CAS) numbers of any of the 4 TCPP isomers.

The reason for the confusion over the identity of TCPP is not clear. It may be that the structure of TCPP was not fully elucidated when it was first synthesized in the 1970's. Alternatively, the confusion may be due to the existence of multiple systems of chemical nomenclature.

References

1 Saltzman, L.E., and Babich, M.A. (1999) Tris (chloropropyl) phosphate (TCPP). U.S. Consumer Product Safety Commission, Bethesda, MD 20814. August 4, 1999.

2 Personal communication from Randall Brinkhuis, U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics, Washington, DC 20204. June 30, 1999.

3 See also, *Flame Retardants: A General Introduction*. Environmental Health Criteria 192. World Health Organization, Geneva. 1997.

4 Reviewed in, Bittner, P.M. (1999) Toxicity review for tris(2-chloropropyl)phosphate. U.S. Consumer Product Safety Commission, Bethesda, MD 20814. March 3, 1999.

5 Reviewed in, Ferrante J. (1999) Toxicity review for tris (1-chloro-2-propyl) phosphate and bis (2-chloropropyl) 1-(chloro-2-propyl) phosphate. U.S. Consumer Product Safety Commission, Bethesda, MD 20814. July 9, 1999.

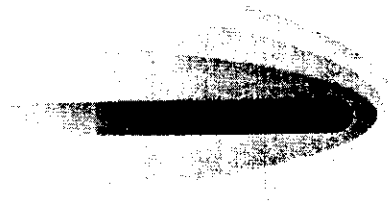
6 Parkes, D. (1998) Testimony presented before the U.S. Consumer Product Safety Commission. May 5, 1998.

7 Risks and Benefits in the Use of Flame Retardants in Consumer Products. Technical and Commercial Annexes. Prepared by G.C. Stevens and A.H. Mann, Polymer Research Centre, University of Surrey, UK for the UK Department of Trade and Industry. 1999.

8 Saltzman, L.E., and Babich, M.A. (1999).

9 Saltzman, L.E., and Babich, M.A. (1999).

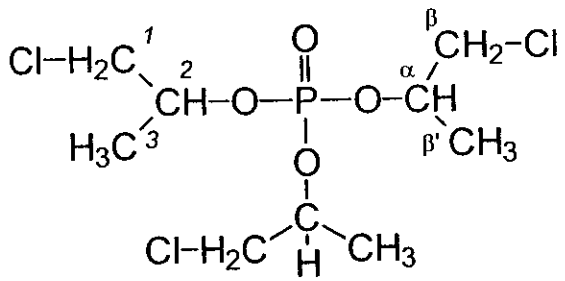
Tris (Chloropropyl) Phosphate (TCPP)



Michael A. Babich, Ph.D.

U.S. Consumer Product Safety Commission

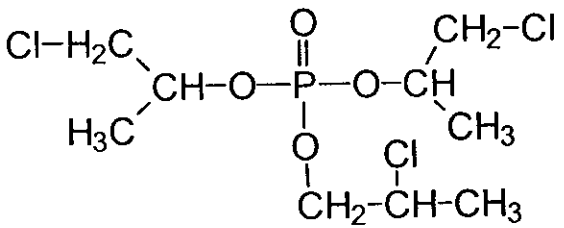
October 26, 1999



I

Tris (1-chloro-2-propyl) phosphate

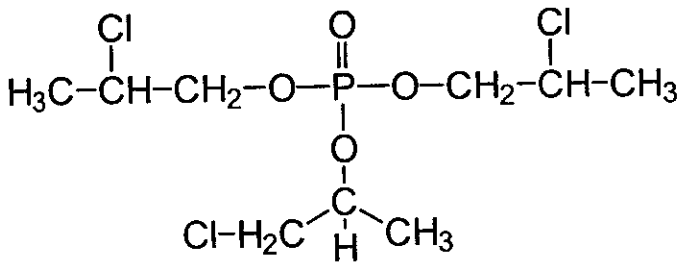
13674-84-5



II

Bis (1-chloro-2-propyl) 2-chloropropyl phosphate

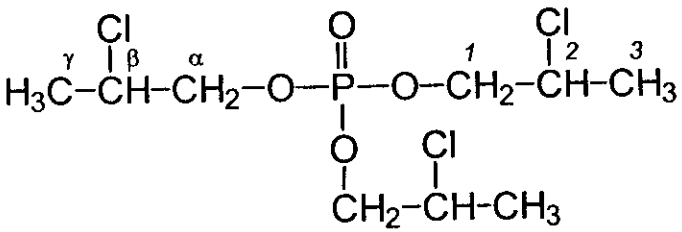
76025-08-6



III

Bis (2-chloropropyl) 1-chloro-2-propyl phosphate

76649-15-5



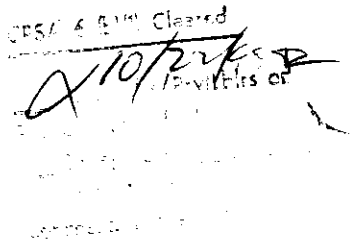
IV

Tris (2-chloropropyl) phosphate

6145-73-9

Statement to the National Academy of Sciences Subcommittee on Flame Retardant Chemicals

Patricia M. Bittner, M.S.
Directorate for Health Sciences
U.S. Consumer Product Safety Commission



October 26, 1999

Slide 1.

Good morning. This morning I will present summaries of the toxicity data on the remaining 2 flame retardant or FR chemicals that the CPSC staff reviewed. Staff summarized the toxicity data of the other 14 FR chemicals in the 2 previous meetings of the subcommittee. The data were reviewed using the criteria found in the relevant statute administered by our agency, the Federal Hazardous Substances Act or FHSA. In our two previous presentations to you, we outlined these criteria.

Slide 2.

The 2 chemical classes to be presented today are tris(chloropropyl) phosphate and the aromatic phosphate plasticizers.

Slide 3.

With regard to what is known as tris(2-chloropropyl)phosphate or TCPP, there has been some confusion regarding this chemical, as Dr. Babich explained. Thus, chemicals reviewed under this name include tris(1-chloro-2-propyl)phosphate, bis(1-chloro-2-propyl)2-chloropropyl phosphate, bis(2-chloropropyl)-1-(chloro-2-propyl)phosphate, and tris(2-chloropropyl)phosphate, with the CAS numbers shown on this slide. TCPP is used in the U.S. in draperies, wall-coverings, and automobile interiors.

Slide 4.

There are inadequate data available to sufficiently characterize the toxicity of the isomers represented by CAS #s 13674-84-5, 76649-15-5, and 76025-08-6. They do not meet the definition of toxic under the FHSA. There were no data for CAS # 76025-08-6 and limited data for CAS #s 13674-84-5 and 76649-15-5. There are no available data on chronic, neurologic, reproductive, dermal or ocular effects, or on pharmacokinetics. There were no carcinogenicity studies.

Slide 5.

Based on the limited available data, tris(2-chloropropyl)phosphate, CAS # 6145-73-9, is acutely toxic by the inhalation, oral, and dermal routes of exposure under the FHSA. However, based on the limited animal data available, it does not appear to be a primary skin or eye irritant.

There are insufficient toxicity data available on this substance to determine whether it causes chronic organ toxicity or neurotoxic, developmental, reproductive, genotoxic, or carcinogenic effects. Therefore, an acceptable daily intake (ADI) could not be calculated.

Because all of these tris compounds are structurally related to tris(1,3-dichloropropyl)phosphate and tris(2-chloroethyl)phosphate, which are carcinogenic in animals, the tris(chloropropyl)phosphates merit further study to determine whether they may be chronic toxicants in humans.

Slide 6.

The second chemical class to be reviewed today is aromatic phosphate plasticizers. The aromatic phosphate plasticizers that were reviewed by Dr. Ferrante of the CPSC staff are:

the ortho isomer of tricresyl phosphate or TOCP;
the mixed isomers of tricresyl phosphate, TCP;
triphenyl phosphate, TPP;
2-ethylhexyl diphenyl phosphate, EHDP;
iso-decyl diphenyl phosphate, IDDP;
t-butylphenyl diphenyl phosphate, BPDP;
and phenol isopropylated phosphate, PIP.

Aromatic phosphate esters are used as plasticizers, flame retardants, solvents, and antifoaming agents (Patty's 1981). PIP's are present in several commercial products including Kronitex® and Durad®.

Slide 7. (TOCP)

There is considerable variation in the toxicologic properties of the organic phosphate esters. The ortho isomer of tricresyl phosphate, or TOCP, is a minor component of commercial TCP. There is sufficient evidence of neurotoxicity from TOCP exposure in humans. Many cases of TOCP poisoning in humans have been documented. Most involved accidental ingestion of contaminated food, drink, or drugs. Neurological effects are often delayed, and

lesions include axonal degeneration. Paralysis was observed in some individuals at doses as low as 6 mg/kg, and was permanent in some cases. Therefore, TOCP is neurotoxic in humans based on sufficient evidence in humans and further supported by sufficient evidence of neurotoxicity in animals. However, there is insufficient information on the dose response to derive an ADI from the human or animal studies.

Slide 8. (TCP [mixture of isomers])

The isomeric mixture of tricresyl phosphate, or TCP, has also exhibited neurotoxicity in animal studies. Sufficient evidence of neurotoxicity of TCP, as evidenced by reduced serum cholinesterase, neurobehavioral changes, sciatic nerve degeneration, and microscopic lesions in the spinal cord, were reported in rats and mice (Deskin et al., 1985; NTP, 1994). The lowest observed effect level (LOEL) for these effects was 50 mg/kg-d. Therefore, TCP is probably neurotoxic in humans, based on sufficient evidence in animals.

There is also sufficient evidence of chronic toxicity to the adrenal glands, lymph nodes, spleen, and thymus in mice and rats exposed to TCP in subchronic studies. Therefore, TCP is probably toxic to humans based on chronic organ toxicity. The LOEL in these studies was 50 mg/kg-d in the male mouse (NTP, 1994).

TCP also may be regarded as probably toxic to the reproductive system in humans, based on sufficient evidence of reproductive toxicity, manifested as decreased sperm production and alterations in sperm morphology, in male mice and rats. The LOEL in these studies was 100 mg/kg-d. There were also ovarian effects observed in rodents.

Slide 9.

An ADI of 0.05 mg/kg-d for TCP was derived based on a LOEL of 50 mg/kg-day for cytoplasmic vacuolization in the adrenal cortex of rats.

Slide 10. (TPP)

Another aromatic phosphate is triphenyl phosphate, or TPP. It appears that TPP is less toxic than TOCP, although NOELs were not reported. There is limited evidence of neurotoxicity after TPP exposure in animals, and inadequate evidence in humans. Therefore, TPP may be regarded as possibly toxic in humans. Under the CPSC Chronic Hazard

Guidelines, ADI's are calculated only for known and probable toxicants.

Slide 11. (EHDP)

In rats, 2-ethylhexyl diphenyl phosphate, or EHDP, caused histopathologic effects in the adrenal cortex in both sexes. It also caused ovarian hyperplasia in females. Liver effects, such as increased weight and serum triglyceride levels, were observed in several rat studies. Rats and dogs fed 1% or more EHDP exhibited reduced growth rates; the NOEL was 100 mg/kg-d in rats.

EHDP may be regarded as probably toxic to humans, based on sufficient evidence of reduction in the rate of growth in 2 animal species. Furthermore, EHDP is probably toxic to the liver and adrenal glands, based on sufficient evidence in animals.

Slide 12.

An ADI of 1 mg/kg-d was derived from a NOEL of 100 mg/kg-d EHDP in a rat study.

Slide 13. (IDDP)

The compound isodecyl diphenyl phosphate or IDDP has limited toxicity data available for use in its classification under the FHSA. Reduced body weight gain and hepatotoxicity were observed in rats fed IDDP for four weeks. Therefore, IDDP may be regarded as possibly toxic in humans, based on limited evidence of organ toxicity in animals.

Slide 14. (t-BPDP)

Another aromatic phosphate with limited toxicity data is t-butylphenyl diphenyl phosphate. *In vitro* mutagenicity and carcinogenicity assays with t-BPDP were all negative. There were no treatment-related deaths, no significant differences in hematologic and clinical blood chemistry parameters, including cholinesterase activity, and no pathologic changes in rats fed t-BPDP for 90 days.

Slide 15. (PIP)

Another chemical in this class is phenol isopropylated phosphate or PIP. A number of commercial products are marketed with PIP according to the degree of alkylation of the phenol; these products include Kronitex® and Durad®. Toxicity data are available for some of these products. In acute oral and dermal animal studies, some Kronitex® or

Durad® products with PIP had low toxicity, but several phenol isopropylated phosphate products were shown to be neurotoxic in hen studies. Therefore, PIP's are possibly toxic in humans, based on limited evidence of neurotoxicity in one non-mammalian species.

The toxicity of the aromatic phosphate commercial formulations of Santicizers® 141, 148, and 154, are driven by their constituents, which are primarily EHDP, IDDP, diisodecyl phenyl phosphate, BPTP, TPP, and di-(2-ethylhexyl)phenyl phosphate.

Slide 16.

In summary, several chemicals meet the definition of toxic under the FHSA. Tris (2-chloropropyl)phosphate CAS # 6145-73-9 is toxic under the FHSA based on acute toxicity by the inhalation, oral, and dermal routes of exposure. There are insufficient data to determine whether it is also a chronic toxicant under the Act. Of the aromatic phosphate plasticizers, TOCP is a chronic toxicant, based on sufficient evidence of neurotoxicity in humans, supported by sufficient evidence in animals. TCP is a probable human toxicant, based on sufficient evidence of neurological, reproductive, and chronic organ toxicity in animals. EDHP is probably toxic to humans based on reduced growth rates.

Slide 17.

The following chemicals do not meet the definition of toxic under the FHSA, based on limited data: the tris compounds (best identified by CAS #) 13674-84-5, 76649-15-5, and 76025-08-6 and the aromatic phosphate plasticizers TPP, IDDP, t-BPDP, and PIP. Substances that are possibly toxic in humans are not classified as "toxic" under the FHSA. However, this conclusion is based on limited data. It does not mean that these chemicals are "safe," only that there are not sufficient data to satisfy the regulatory definition of toxic.

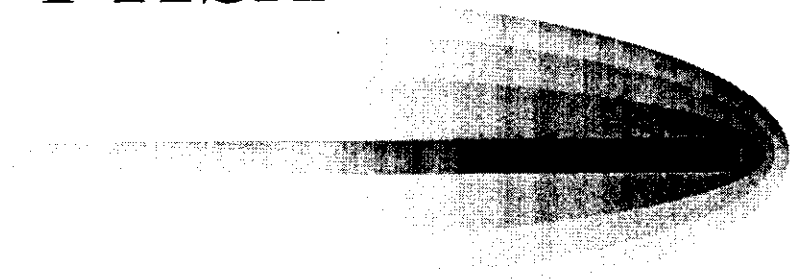
Slide 18.

I remind you that any toxicity associated with these chemicals satisfies only one of the two conditions that must be met for a substance to be considered hazardous under the FHSA. The CPSC staff has not fully evaluated the second condition that must be met in order for a substance to be considered hazardous under the Act, that is, the potential for causing substantial personal illness or

injury during reasonably forseeable handling and use. At this time, there is insufficient information for the CPSC staff to conduct the second part of the analysis, which would include an assessment of exposure, bioavailability, and dose response.

On behalf of the staff of the CPSC, I offer our most sincere gratitude to the Subcommittee members for your time and thoughtful deliberation on this project. Questions?

Toxicity Assessment of Two Flame Retardant Chemicals Under the FHSA



Patricia Bittner, M.S.

Jacque Ferrante, Ph.D.

October 26, 1999

FR Chemicals under Consideration by NAS

- Tris (chloropropyl)phosphate
- Aromatic Phosphate Plasticizers

Tris (chloropropyl)phosphate

- Tris (1-chloro-2-propyl) phosphate (CAS # 13674-84-5)
- Bis (1-chloro-2-propyl) 2-chloropropyl phosphate (CAS # 76025-08-6)
- Bis (2-chloropropyl) 1-chloro-2-propyl-phosphate (CAS # 76649-15-5)
- Tris (2-chloropropyl) phosphate (CAS # 6145-73-9)

Under the FHSA...

- CAS # 13674-84-5, 76649-15-5, and 76025-08-6 do not satisfy the FHSA definition of toxic due to limited data
- No data available on chronic toxicity, carcinogenicity, or neurological, reproductive, or dermal/ocular endpoints

Under the FHSA, Tris (2-chloropropyl) phosphate (CAS # 6145-73-9) is ...

- Acute toxicant by inhalation, oral, and dermal routes (sufficient evidence in animals)
- Insufficient data on chronic, neurological, reproductive/developmental, or carcinogenic effects

Aromatic Phosphate Plasticizers

- *o*-Tricresyl phosphate (TOCP)
- *o*-, *m*-, *p*-Tricresyl phosphate (TCP)
- Triphenyl phosphate (TPP)
- 2-Ethylhexyl diphenyl phosphate (EHDP)
- Isodecyl diphenyl phosphate (IDDP)
- t-Butylphenyl diphenyl phosphate (BPDP)
- Phenyl isopropylated phosphate (PIP)

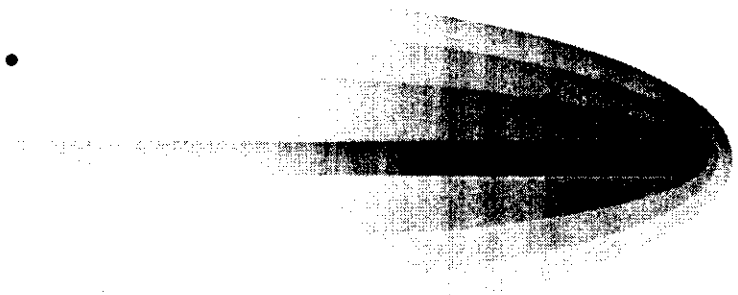
Under the FHSA, TOCP is…

- Toxic in humans (sufficient human evidence of neurotoxicity, supported by animal data)
- Insufficient data to derive an ADI

Under the FHSA, the isomeric mixture of TCP is...

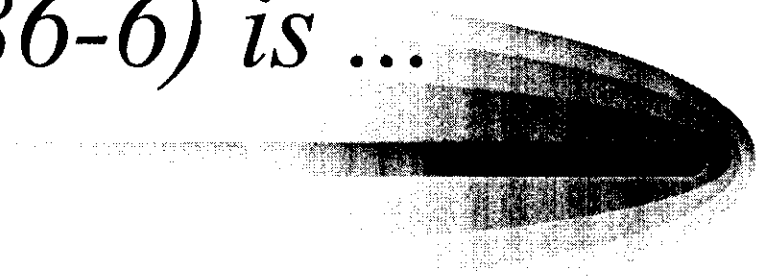
- Probable neurotoxicant (sufficient animal evidence)
- Probable chronic toxicant to adrenal glands, lymph nodes, spleen, thymus (sufficient evidence in animals)
- Probable reproductive toxicant (sufficient evidence in animals)

TCP...



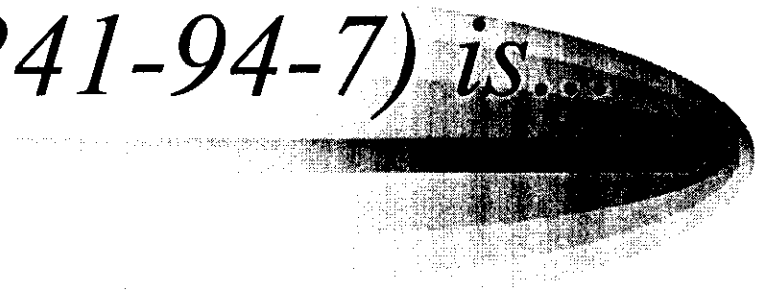
- ADI of 0.05 mg/kg-d, based on a LOEL of 50 mg/kg-d for cytoplasmic vacuolization in the adrenal gland in rats

Under the FHSA, TPP (CAS # 115-86-6) is ...



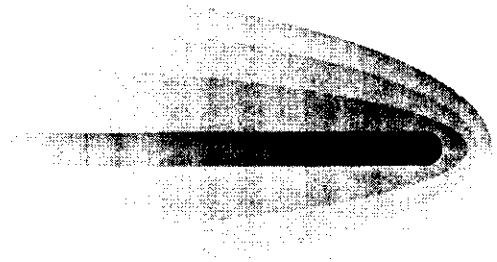
- Possibly toxic in humans (limited evidence of neurological in animals)
- ADI not calculated

Under the FHSA, EHDP (CAS # 1241-94-7) is...



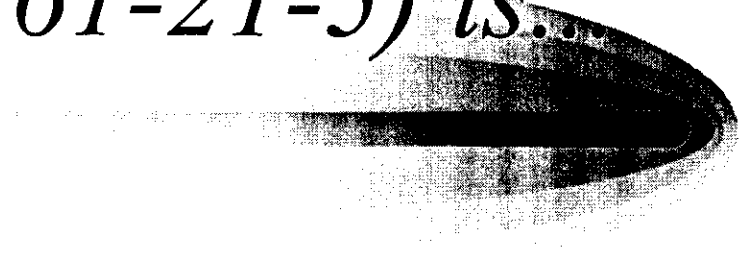
- Probable chronic toxicant based on reduced growth (sufficient evidence in 2 animal species)
- Probable toxicant to liver and adrenal glands (sufficient evidence in animals)

EHDP ...



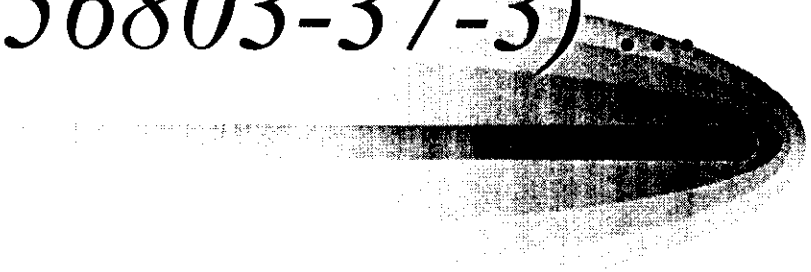
- ADI of 1 mg/kg-day based on a NOEL of 100 mg/kg-d EHDP in rats

Under the FHSA, IDDP (CAS # 29761-21-5) is...



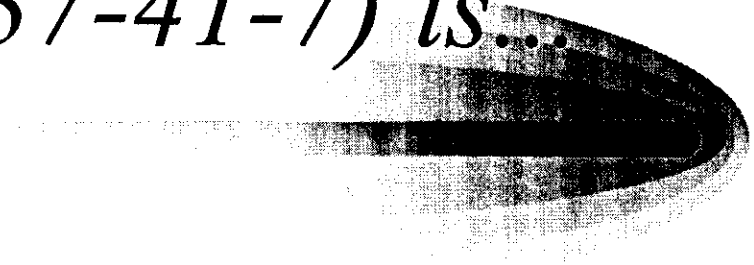
- Possibly toxic in humans (limited evidence of systemic toxicity in animals, i.e., reduced body weight gain and hepatotoxicity)
- ADI not calculated

Under the FHSA, t-BPDP (CAS # 56803-37-3)...



- Negative in mutagenicity and carcinogenicity studies
- ADI not calculated

Under the FHSA, PIP (CAS # 68937-41-7) is...



- Possibly neurotoxic in humans (limited evidence in hens)
- ADI not calculated

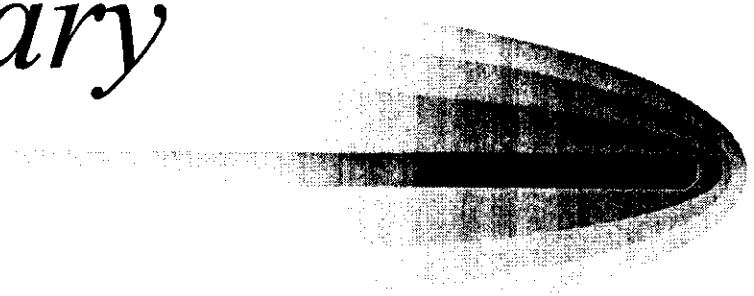
"Toxic" under FHSA...

- Tris (2-chloropropyl)phosphate (CAS # 6145-73-9)
- Aromatic Phosphate Plasticizers: TOCP, TCP, EHDP

Chemicals that do <u>not</u> meet the definition of "toxic" ...

- "Tris" compounds: 13674-84-5, 76649-15-5, and 76025-08-6
- Aromatic Phosphate Plasticizers: TPP, IDDP, t-BPDP, PIP

Summary



Chemicals considered toxic under the FHSA also must be evaluated for their potential to cause substantial personal injury or illness during reasonably forseeable handling and use, in order to be considered "hazardous."

UPDATE OF THE CPSC STAFF RISK ASSESSMENT OF FLAME RETARDANT CHEMICALS*

Michael A. Babich, Ph.D.
Directorate for Health Sciences
U.S. Consumer Product Safety Commission

October 26, 1999

Slide 1. The U.S. Consumer Product Safety Commission (CPSC) initiated a regulatory proceeding in 1994 to address the hazard of small open flame ignitions of upholstered furniture.[1] Small open flame sources include cigarette lighters, matches, and candles.

Slide 2. Such ignitions of upholstered furniture are associated with an estimated 90 deaths, 420 injuries, and $40 million in property damage per year in the U.S.[2] Most of the deaths involve children under 5 years old. The Commission is considering a draft performance standard to address this hazard.[3] Furniture manufacturers would be free to choose the means of complying with the standard. However, manufacturers have reported that they would generally use flame retardant- (FR-) treated fabrics to meet the draft standard. In addressing the hazard associated with the small open flame ignition of upholstered furniture, the CPSC staff is working to develop a performance standard to reduce furniture ignitions without creating other hazards to consumers. Thus, the CPSC staff is assessing the potential risks from exposure to FR chemicals.

Slide 3. CPSC addresses chemical hazards under the Federal Hazardous Substances Act, or FHSA. The FHSA is risk-based. To be considered a "hazardous substance" under the FHSA, a substance or product must satisfy a two-part definition.[4] First, it must be toxic under the FHSA, or present one of the other hazards enumerated in the statute. Second, it must have the potential to cause "substantial" illness or injury during or as a result of "reasonably foreseeable handling or use."

Slide 4. Therefore, exposure and risk must be considered in addition to toxicity when assessing potential hazards under the FHSA.[5] The FHSA includes both acute and chronic hazards. It does not require manufacturers to perform any specific battery of toxicological tests to assess the potential for chronic hazards. Thus, risk assessments are based on all the available data. The FHSA does not provide for pre-market registration or approval. This places the responsibility on manufacturers to ensure either that their products are not hazardous substances under the FHSA or, if they are, that they are labeled as required by the FHSA. CPSC is responsible for ensuring that consumer products comply with the FHSA.

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* Presented before the National Academy of Sciences, Subcommittee on Flame Retardant Chemicals in Upholstered Furniture. Washington, DC. October 26, 1999.

Slide 5. In 1992, the Commission issued guidelines for assessing chronic hazards under the FHSA, including carcinogenicity, neurotoxicity, reproductive and developmental toxicity, exposure, bioavailability, risk assessment, and acceptable risk.[6,7] The chronic hazard guidelines, which are not mandatory, are intended to assist manufacturers in complying with the FHSA. The guidelines describe a series of default procedures, which are used in the absence of evidence to the contrary. The default procedures are generally similar to those of other federal agencies, with certain exceptions. Further, the guidelines are intended to be sufficiently flexible to incorporate the latest scientific information, and to allow for determination of risk on a case-by-case basis. Deviation from the default procedures is permissible, provided that the procedures used are scientifically defensible and supported by appropriate data.

Slide 6. As part of the risk assessment process for FR chemicals, the Commission held a public hearing in May 1998. In its testimony, the Fire Retardant Chemicals Association (FRCA) provided a list of 16 chemicals or chemical classes that are candidates for use in upholstered furniture if the draft standard is adopted.[8] The CPSC staff has completed toxicity reviews on these 16 chemicals and reported its findings to the Subcommittee. Overall, a considerable number of toxicological studies were reviewed. While some FR chemicals have been well studied, only limited data were available for others.

In addition to the toxicity reviews, exposure and bioavailability data are needed to assess the potential risks associated with the use of FR chemicals in upholstered furniture. Migration studies with FR-treated fabrics are underway at the CPSC chemistry laboratory. Fabrics will be exposed to aqueous and non-aqueous solvents and detergent solutions to simulate a variety of potential exposures. *In vitro* percutaneous absorption studies with radiolabeled FR chemicals have recently begun at the U.S. Environmental Protection Agency's (EPA's) National Health and Environmental Effects Research Laboratory (NHEERL). Chemicals to be tested include decabromodiphenyl oxide, hexabromocyclododecane, and tris (1,3-dichloro-2-propyl) phosphate. The percentage of the applied dose that is absorbed in 24 hours will be determined. When completed, these studies will contribute to the CPSC staff risk assessment of FR chemicals in upholstered furniture.

Slide 7. As part of CPSC's FY99 appropriations, Congress provided funds for an independent study by the National Academy of Sciences of the "toxic risk" associated with the use of flame retardant chemicals in upholstered furniture, which is the work of this Subcommittee. The CPSC staff is cooperating with the EPA to develop a draft significant new use rule, or SNUR, for the use of FR chemicals in upholstered furniture. The SNUR process addresses potential risks to consumers, workers, and the environment. If the SNUR is adopted, it could be used to obtain additional toxicity or exposure data where needed. In addition, the CPSC staff has requested that the National Institute for Occupational Safety and Health (NIOSH) review the potential occupational exposures and health effects associated with the use of FR chemicals in textile and upholstered furniture manufacturing.

Slide 8. FR chemicals may be applied to textiles by a variety of methods, and the method of application may affect the potential for exposure.[9, 10, 11, 12] FR chemicals may be mixed with a latex, acrylic, or vinyl polymer which is applied to the back of the fabric. FR back-coating is the most common method of FR-treatment in furniture sold in the UK.[13, 14] Most FR back-coatings contain either decabromodiphenyl oxide or hexabromocyclododecane in combination with antimony trioxide. FR back-coating is used mainly with synthetic fabrics.

Slide 9. FR chemicals may also be mixed with an adhesive binder and applied to both surfaces of the fabric.[15] The binder is heat cured and then the fabric is washed. This method was developed for use with cotton-polyester blends. A typical formulation contains decabromodiphenyl oxide with antimony trioxide. Such adhesive-based FR treatments are reported to be used in some upholstered furniture sold in the UK.

Slide 10. Some FR's, such as cyclic phosphonate esters, are applied by immersing the fabric in a solution of FR chemicals. With synthetic fabrics, the immersion treatment may be followed by baking in an oven to soften the fibers, allowing a portion of the FR chemicals to become trapped within the fibers.[16, 17] The portion of FR chemicals remaining on the fiber surface can be washed off before the fabric is used, although this step is sometimes omitted.

Slide 11. Cotton and rayon fabrics may be treated with reactive FR chemicals. Certain phosphonate esters form covalent bonds with the cellulose fibers.[18, 19] This method is used in some furniture sold in the UK.[20] Tetrakis (hydroxymethyl) phosphonium salts react to form an insoluble polymer which is physically trapped within the fibers.[21, 22]

In the FR treatment methods which I just described, FR chemicals are either encapsulated in a back-coating or binder, or else physically or chemically bound to the fibers. This may reduce the potential for exposure to FR chemicals. While the potential for exposure is <u>expected</u> to be low, tests are underway at the CPSC chemistry laboratory to determine the extent to which FR chemicals may migrate from treated fabrics.

Slide 12. In conclusion, small open flame ignitions of upholstered furniture present a significant fire risk to the public. Such fires are associated with an estimated 90 deaths and 420 injuries per year. Most of the deaths are to children. The CPSC staff has developed a draft performance standard for residential upholstered furniture to address the small open flame ignition hazard. Furniture manufacturers are likely to use FR chemicals to comply with the draft standard <u>if</u> it is adopted. In addressing the hazard associated with the small open flame ignition of upholstered furniture, the CPSC staff is working to develop a performance standard to reduce furniture ignitions <u>without</u> creating other hazards to consumers. Thus, the CPSC staff is assessing the potential risks from exposure to FR chemicals. If at least <u>one</u> FR treatment is found that would <u>not</u> present a hazard to consumers, then it may be reasonable to use FR chemicals to address the small flame ignition hazard. Furniture manufacturers would <u>not</u> be permitted to use any FR chemical treatment that presents a hazard to consumers, as defined by the FHSA.

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[2] Medford, R.L. (1999) Opening statement of Ronald L. Medford, Assistant Executive Director for Hazard Identification and Reduction, U.S. Consumer Product Safety Commission, to the National Academy of Sciences Subcommittee on Flame Retardant Chemicals in Upholstered Furniture. Washington, DC. July 29, 1999.

[3] Briefing Package on Upholstered Furniture Flammability: Regulatory Options for Small Open Flame and Smoking Material Ignited Fires. U.S. Consumer Product Safety Commission, Bethesda, MD 20814. October 1997.

[4] 15 USC 1261 (f)(1)(A).

[5] U.S. Consumer Product Safety Commission (CPSC) (1992) Labeling requirements for art materials presenting chronic hazards; guidelines for determining chronic toxicity of products subject to the FHSA; supplementary definition of "toxic" under the Federal Hazardous Substances Act; final rules. Federal Register, 57: 46626-46674.

[6] U.S. Consumer Product Safety Commission (CPSC) (1992) Labeling requirements for art materials presenting chronic hazards; guidelines for determining chronic toxicity of products subject to the FHSA; supplementary definition of "toxic" under the Federal Hazardous Substances Act; final rules. Federal Register, 57: 46626-46674.

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[12] Fire Retardant Chemicals Association (1998) Letter from Russell C. Kidder, Fire Retardant Chemicals Association, Lancaster, PA to the Office of the Secretary, U.S. Consumer Product Safety Commission, with attachments. August 3, 1998.

[13] Powell, C., and R. Rose (1998) Testimony presented before the U.S. Consumer Product Safety Commission. May 5, 1998.

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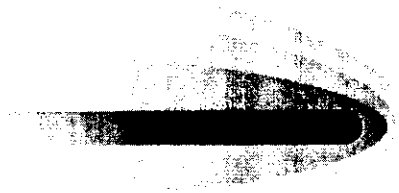
Update of the CPSC Risk Assessment of Flame Retardant Chemicals



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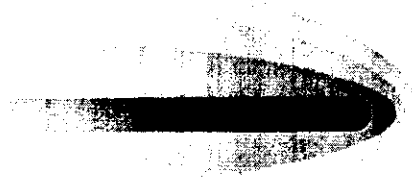
U.S. Consumer Product Safety Commission
October 26, 1999

Small open flame ignitions of upholstered furniture



Annually in the U.S.

- 90 Fatalities
- 420 Injuries
- $40 Million in property damage

Hazardous Substance

Two-Part definition of hazardous substance:

- "Toxic" under the FHSA
- Cause "substantial" illness or injury from "reasonably foreseeable handling or use"

The FHSA ...

- Considers exposure and risk
- Includes acute and chronic effects
- Does not require testing for chronic hazards
- Does not provide for pre-market approval
- Requires manufacturers to ensure that their products are not hazardous or are properly labeled

Chronic Hazard Guidelines

- Carcinogenicity
- Neurotoxicity
- Reproductive/developmental toxicity
- Exposure
- Bioavailability
- Risk assessment
- Acceptable risk

Risk Assessment of FR Chemicals

- Toxicity reviews of 16 chemicals
  - CPSC staff (completed)
- Migration studies with FR-treated fabrics
  - CPSC laboratory (in progress)
- Percutaneous absorption study
  - EPA / NHEERL (in progress)
- Risk assessment for consumer exposure
  - CPSC staff (in progress)

Related Activities

- NAS studying the "toxic risk" to consumers associated with FR chemicals in upholstered furniture.
- EPA / OPPT developing a draft Significant New Use Rule (SNUR)
- NIOSH to review potential occupational exposures and health effects

Application Methods

- Back-coating
  - Latex polymer applied to fabric back
  - Used in UK furniture
  - Decabromodiphenyl oxide + Sb_2O_3
  - Hexabromocyclododecane + Sb_2O_3
  - Used mainly with synthetic fabrics

Application Methods (continued)

- Adhesive-based
  - Latex binder applied to both fabric surfaces
  - Heat cured and washed
  - Used with cotton-polyester blends
  - Decabromodiphenyl oxide + Sb_2O_3

Application Methods (continued)

- Immersion treatment with heat cure
  - Cyclic phosphonates
  - Used with synthetic fabrics
  - Heat to fix the FR chemicals
  - Wash to remove unbound FR

Application Methods (continued)

- Reactive FR chemicals
  - Used with cellulosic fabrics
  - Phosphonate ester
    - Forms a chemical bond with cellulose
    - Used in some UK furniture
  - Tetrakis
    - Forms an insoluble polymer

Conclusions

- Fire hazard -- 90 deaths (mostly children) and 420 injuries per year
- Draft performance standard addresses the fire hazard
- Manufacturers may <u>not</u> use FR chemicals considered "hazardous" under the FHSA