

Recommendation on Chemical Listing
July 23, 2009
1-Bromopropane (n Propyl Bromide) CAS# 106-94-5

*Recommendation to the TURA Administrative Council
from the
Toxics Use Reduction Institute*

In the spring of 2009 TURA program staff noted n propyl bromide (nPB) was an alternative that was being considered and sometimes substituted for perchloroethylene and trichloroethylene – two substances recently designated as Higher Hazard Substances. Concerns were raised over the potential health effects of n propyl bromide, especially given that it is not listed on the TURA list of toxic or hazardous substances. Data was collected on nPB for the Science Advisory Board (SAB) to review and the SAB reviewed this information over two meetings in June and July of 2009.

The SAB voted unanimously to recommend the addition of nPB to the TURA list of toxic and hazardous substances. The SAB further recommended reviewing 2-bromopropane, an isomer of nPB. The review of this substance is planned for the fall. This document contains information only pertaining to 1-bromopropane.

This policy analysis presents the scientific information reviewed by the Science Advisory Board in developing its recommendation. In addition, it summarizes information on regulations that apply to this substance at the state, federal, and international levels and expected use. Finally, it contains information regarding the policy implications of listing nPB to the TURA program.

Based on the information presented here, TURI supports the SAB's recommendation to add 1-bromopropane to the TURA toxic or hazardous substance list.

1. Chemical Overview

1-Bromopropane, or n propyl bromide (nPB), is a halogenated hydrocarbon solvent with the formula C_3H_7Br , and a colorless liquid at room temperature and pressure. It has a low boiling point (64.7°C) and a high vapor pressure (110.8 mm Hg at 20°C), making it well suited as a carrier solvent and for use in vapor degreasing. Commercially available nPB typically includes a small amount of another isomer, 2-bromopropane, as a contaminant. OSHA has determined 2-bromopropane contaminant levels of 0.1 - 0.2%; recent industry sources indicate that contaminant levels have been reduced since the OSHA determination. This listing recommendation is only for 1-bromopropane; the SAB will consider whether 2-bromopropane should be listed in future deliberations.

2. Summary SAB Recommendation

The SAB recommends the listing of nPB to the TURA toxic or hazardous substance list (“TURA list”) primarily based on reproductive toxicity and neurotoxicity. Reproductive toxicity information is largely based on the National Toxicology Program’s (NTP’s) 2003 monograph on the reproductive toxicity of nPB.

At their meetings the SAB noted several follow up items for nPB:

- 1) Consider other similarly halogenated solvents for listing, to avoid having users switch to one that is not on the TURA list, thinking it is a safer alternative.
- 2) Consider categorization of nPB (determine whether it belongs on either the SAB’s more or less hazardous list)
- 3) Consider degradation products of nPB


These items will be discussed at future SAB meetings.

3. Basis for SAB recommendations

The SAB reviewed a number of summary documents, toxicological studies and other information sources. The key sources, which each include many additional study references, include:

- Toxnet’s Hazardous Substances Data Bank, U.S. National Library of Medicine <http://toxnet.nlm.nih.gov/cgi-bin/sis/search/r?dbs+hsdb:@term+@rn+@rel+106-94-5>
- *NTP-CERHR Monograph on the Potential Human Reproductive and Development Effects of 1-Bromopropane*, October 2003, NIH Publication No. 04-4479
- *1-Bromopropane: TLV® Chemical Substances 7th Edition Documentation*, 2005, ACGIH
- *N-Propyl Bromide as an Alternative to Tetrachloroethylene in Dry-Cleaning*, September 30, 2008, Draft document, Massachusetts Department of Environmental Protection
- US EPA Q and A: 2007 Final and Proposed Regulations for n-Propyl Bromide (nPB), Last updated on Friday, June 19th, 2009, <http://www.epa.gov/Ozone/snap/solvents/2007nPBRegsQA.html>
Other information on EPA’s SNAP ruling, including a summary of comments that EPA received both in favor and opposed to their SNAP ruling for n-Propyl Bromide.

Additional or specific sources are noted in the summary table below.

nPB; <u>CAS #</u> 106-94-5	Synonyms: 1-Bromopropane; n-Propyl Bromide; Propane,1-bromo-; Propyl bromide;; AI3-18129;; EINECS 203-445-0; HSDB 106 ; N-Propyl bromide; CCRIS 30 
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EPA PBT Profiler ⁱ					
Water	15	Sediment	140	BCF	8.3
Soil	30	Air	14	Fish ChV	8.5
IARC rating ⁱⁱ / carcinogenicity	No matches found in IARC monograph search NTP 2 yr inhalation study draft out for peer review ⁱⁱⁱ				
Neurotoxicity ^{iv}	Central Nervous System Depressant				
Developmental/Reprod uctive Toxicity	References include: NTP CERHR Monograph ^v ; EU Classification ^{vi} R60: May impair fertility, R63: Possible risk of harm to the unborn child; also on CA prop 65 list ^{vii} as developmental, female, male toxicant; IBSA Proposal ^{viii} ;				
Mutagenicity ^{ix}	CCRIS – 17 negative results				
LD50 ^x	Oral, rat, 4,260 mg/kg; Oral, rat, 3,600 mg/kg; Intraperitoneal, mouse, 1210 mg/kg				
LC50	Inhalation rat LC50: 253000 mg/m ³ /30minutes ^{xi} ; Inhalation mouse LC50: 7100 mg/m ³ ^{xii}				
RfC/RfD	No established values; further discussion available at “Development of an occupational exposure limit for <i>n</i> -propyl bromide using benchmark dose methods” ^{xiii}				
ATSDR-MRL ^{xiv}	Not found				
NIOSH-REL ^{xv}	Not found				
OSHA-PEL	Not found				
TLV-TWA ^{xvi}	10ppm (ACGIH TLV: TWA)				
TLV-STEL	Not found				
Flashpoint/ Flammability	EU Flammable classification (R11), Note inherent difficulties with determining flash point of halogenated hydrocarbon liquids ^{xvii} ; vapors may form flammable mixture at concentrations between 3 and 8% ^{xviii} ; 22 °C (72 °F) Closed Cup ^{xix}				
Primary Use	<i>Toxnet</i> : INTERMEDIATES (Alkylating Agent); <i>NJHSFS</i> : It is used in dry cleaning, and as a solvent, carrier solvent for adhesives, and in aerosols.				
Ecological ^{xx}	96 hour LC ₅₀ for fathead minnows is 67,300 ug/l				
Other (i.e. Asthmagen/Endocrine Disruption)	Irritating to the eyes and the respiratory tract.				
Ozone Depletion	ODP 0.013 - 0.018 ^{xxi} On List of Sony Ericsson list of banned substances in production ^{xxii}				
Additional information	<ul style="list-style-type: none"> • Toxicodynamics/kinetics by Dr. Garner, et al at RTI (2006)^{xxiii} • A 2-yr NTP cancer study – will provide access to raw results, still in peer review.^{xxiv} 				

Additional Bibliography of documents reviewed:

- *IBSA Proposal for Establishing a Specialized Expert Group for Reproductive and Developmental Toxicity Classification of 1-Bromopropane*, ECBI/89/01 Add.3

Science Advisory Board Members also submitted additional studies to be reviewed as part of the future categorization process. In addition, several industry representatives attended the July SAB meeting and submitted toxicological information regarding the substance. (Note: these additional references are listed in the SAB’s meeting minutes.)

4. Use Information

Use of nPB is somewhat difficult to estimate as there is currently no reporting information. However, users of nPB are expected to be similar in type to users of PCE and TCE, as nPB can easily be used for similar cleaning operations and as a carrier solvent. At the time of the 2003 NTP study, use was not considered to be widespread (although production and import in the US was around 3 million pounds). The literature and staff observations suggest that use is becoming more widespread, particularly due to the ease of replacement for TCE and PCE.

There is currently one producer of nPB in the US, Albemarle Corp; nPB is also imported from producers in Israel and China.^{xxv}

One distributor who attended the July SAB meeting stated that they had approximately 75 customers in Massachusetts that they supplied to. These customers use between 1 and 10 drums of nPB per year, which would not trip the TURA reporting threshold. Thus distributors would be potential TURA filers, but the end users would not likely be required to report.

5. Regulatory Context

- Substance is listed on the California Proposition 65 list.
- Substance is not identified as either an EPA Clean Water Act Priority Pollutant or an EPA Clean Water Act 311 List Hazardous Substance.
- Substance not found on the EPA Superfund Amendments and Reauthorization Act (SARA) 302A Extremely Hazardous Substances List.
- Substance not listed as a hazardous constituent under the Resource Conservation and Recovery Act (RCRA).
- Substance does not have maximum contaminant levels (MCLs) under the Safe Drinking Water Act and is not regulated as a criteria air pollutant under the Clean Air Act.
- Substance is listed on the Pennsylvania Hazardous Substances list.
- Substance is listed on the Domestic Substances list and indicated as 'Persistent.' However, substance does not meet the categorization criteria for the Government of Canada's Domestic Substances List categorization, indicating that there is a need for further attention to these substances based on human health and/or environmental criteria.
- Substance is listed on the NGO International Chemical Secretariat (ChemSec) – REACH – Substitute It Now list due to CMR classification.
- Substance is listed as a Low Production Volume chemical by OECD (Organization for Economic Co-operation and Development).

6. Implications for the TURA Program

The types of filers using nPB are expected to be users that the program is experienced with (e.g. dry cleaners, metal finishing and metal working, and other cleaning operations) and thus well suited to assist. Many other alternatives to TCE and PCE exist and the program is experienced in helping companies make switches to these alternatives.

The number of new filers is expected to be very small – perhaps a couple of chemical distributors and a couple miscellaneous other companies. Thus, revenue generated from this addition to the list is expected to be very small. Distributors are generally already paying the maximum fee for their facility size, so no change in fees due to distributors are expected. Fees from other expected filers would probably be well under \$10,000 total.

The primary goal of this listing is to discourage companies from switching from a HHS (specifically PCE or TCE) to another chemical with significant hazards. By listing nPB on the TURA list, awareness of the hazards of nPB will be raised to companies considering this alternative and a better alternative may be chosen.

7. Listing as the Appropriate Policy

Listing 1-bromopropane (nPB) (CAS #106-94-5) is appropriate for the following reasons:

- a. nPB is in use in similar ways that would affect a group of large quantity toxics users (LQTUs) in the same manner.
- b. The recommendation is practical, as nPB is easily recognized as such by a typical industry professional.
- c. The recommendation is practical in that information about purchasing, use, recycling and disposal in industry can be easily used to determine reporting applicability.
- d. The recommendation is verifiable in that it could be validated by a typical government inspector.

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- ⁱ www.pbtprofiler.net
- ⁱⁱ <http://monographs.iarc.fr/>
- ⁱⁱⁱ National Toxicology Program, Testing Status of 1-Bromopropane;
<http://ntp.niehs.nih.gov/?objectid=BD3C2054-123F-7908-7BB6085C71ABD211>
- ^{iv} <http://toxnet.nlm.nih.gov/cgi-bin/sis/search/r?dbs+hsdb:@term+@rn+@rel+106-94-5> ; Specifically, Human toxicity Excerpts/SIGNS AND SYMPTOMS/ **Propyl bromide** has a depressing action on CNS... [Bingham, E.; Cochrissen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V5 p.190]**PEER REVIEWED**
- ^v NTP-CERHR Monograph on the Potential Human Reproductive and Development Effects of 1-Bromopropane, October 2003, NIH Publication No. 04-4479
- ^{vi} <http://ecb.jrc.ec.europa.eu/esis/index.php?GENRE=CASNO&ENTREE=106-94-5>
- ^{vii} http://www.oehha.org/prop65/CRNR_notices/admin_listing/requests_info/dcallin21.html
- ^{viii} IBSA Proposal for Establishing a Specialized Expert Group for Reproductive and Developmental Toxicity Classification of 1-Bromopropane
- ^{ix} Expert Publishing, Inc., Chemical Hazard Information for EH&S Professionals, www.expub.com
- ^x RTECS: "Vrednie chemichescie veshstva, galogenproisvodnie uglevodorodov". (Hazardous substances: Halogenated hydrocarbons) Bandman A.L. et al., *Chimia*, 1990. -,593,1990; RTECS: "Vrednie chemichescie veshstva, galogenproisvodnie uglevodorodov". (Hazardous substances: Halogenated hydrocarbons) Bandman A.L. et al., *Chimia*, 1990. -,572,1990
- ^{xi} <http://www.jtbaker.com/msds/englishhtml/b5152.htm>
- ^{xii} RTECS: "Vrednie chemichescie veshstva, galogenproisvodnie uglevodorodov". (Hazardous substances: Halogenated hydrocarbons) Bandman A.L. et al., *Chimia*, 1990. -,593,1990
- ^{xiii} <http://www.riskworld.com/Abstract/2002/SRAam02/ab02aa282.htm>;
http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6WPT-4D2WMF0-1&_user=528622&_rdoc=1&_fmt=&_orig=search&_sort=d&_view=c&_acct=C000023638&_version=1&_urlVersion=0&_userid=528622&_md5=44729d7550d7812bac25a788dd668f33
- ^{xiv} <http://www.atsdr.cdc.gov/mrls/>
- ^{xv} <http://www.cdc.gov/niosh/nmam/pdfs/1025.pdf>
- ^{xvi} RTECS: The Threshold Limit Values (TLVs) and Biological Exposure Indices (BEIs) booklet issues by American Conference of Governmental Industrial Hygienists (ACGIH), Cincinnati, OH, 1996 TLV/BEI,2007
- ^{xvii} ECBI/59/02 Add.1, Summary Record Expert meeting on classification for flammability hazard, December 2002 , http://ecb.jrc.ec.europa.eu/documents/Classification-Labeling/ADOPTED_SUMMARY_RECORDS/5902a1_sr_physchem_1202.pdf
- ^{xviii} Federal Register, May 30, 2007, EPA Rule: Air programs: Stratospheric ozone protection— N-propyl bromide in solvent cleaning <http://www.scribd.com/doc/2774994/Rule-Air-programsStratospheric-ozone-protection8212-Npropyl-bromide-in-solvent-cleaning-listing-of-substitutes-for-ozonedepleting-substances>
- ^{xix} <http://www.jtbaker.com/msds/englishhtml/b5152.htm>
- ^{xx} US EPA Q and A: 2007 Final and Proposed Regulations for n-Propyl Bromide (nPB), <http://www.epa.gov/Ozone/snap/solvents/2007nPBRegsQA.html>
- ^{xxi} Federal Register, May 30, 2007, EPA Rule: Air programs: Stratospheric ozone protection— N-propyl bromide in solvent cleaning <http://www.scribd.com/doc/2774994/Rule-Air-programsStratospheric-ozone-protection8212-Npropyl-bromide-in-solvent-cleaning-listing-of-substitutes-for-ozonedepleting-substances>
- ^{xxii} <http://www.sonyericsson.com/cws/download/1/573/756/1226332896/SEListsofBannedandRestricted.pdf>
- ^{xxiii} Toxicol Appl Pharmacol. 2006 Aug 15;215(1):23-36. Epub 2006 Mar 2. Metabolism and disposition of 1-bromopropane in rats and mice following inhalation or intravenous administration, Garner, CE, et al <http://www.ncbi.nlm.nih.gov/pubmed/16513153?dopt=Citation>
- ^{xxiv} <http://cerhr.niehs.nih.gov/chemicals/bromopropanes/1-bromopropane/1-bromo-eval.html>
- ^{xxv} http://www.albemarle.com/about_albemarle/sustainability/product_stewardship_and_advocacy/product_summaries/nPB.pdf ; importing information from industry representatives at July SAB meeting