MELAMINE

HSDB - Hazardous Substances Data Bank

0.0 ADMINISTRATIVE INFORMATION

Hazardous Substances Data Bank Number: 2648
Last Revision Date: 970508
Review Date: Reviewed by SRP on 1/23/97
Update History:

1 Complete Update on 05/08/97, 8 fields added/edited/deleted.
2 Field Update on 01/27/97, 1 field added/edited/deleted.
3 Complete Update on 12/05/96, 39 fields added/edited/deleted.
4 Complete Update on 05/11/96, 1 field added/edited/deleted.
5 Complete Update on 01/24/96, 1 field added/edited/deleted.
6 Complete Update on 05/08/95, 1 field added/edited/deleted.
7 Complete Update on 12/28/94, 1 field added/edited/deleted.
8 Complete Update on 03/25/94, 1 field added/edited/deleted.
9 Complete Update on 09/14/93, 1 field added/edited/deleted.
10 Field update on 12/25/92, 1 field added/edited/deleted.
11 Complete Update on 09/03/92, 1 field added/edited/deleted.
12 Complete Update on 09/26/91, 1 field added/edited/deleted.
13 Complete Update on 10/22/90, 5 fields added/edited/deleted.
14 Field Update on 05/04/90, 1 field added/edited/deleted.
15 Field Update on 03/01/89, 1 field added/edited/deleted.
16 Complete Update on 10/14/86

1.0 SUBSTANCE IDENTIFICATION

Name of Substance: MELAMINE
CAS Registry Number: 108-78-1
Synonyms:

1 2,4,6-TRIAMINO-S-TRIAZINE [Peer Reviewed] *U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry ofToxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS fi*
2 CYANURAMIDE [Peer Reviewed] *U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry ofToxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS fi*
3 CYANUROTRIAMINE [Peer Reviewed] *U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry ofToxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS fi*
4 CYMEL [Peer Reviewed] *U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry ofToxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS fi*
5 NCI-C50715 [Peer Reviewed] *U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry ofToxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS fi*
6 S-TRIAZINE, 2,4,6-TRIAMINO- [Peer Reviewed] *U.S. Department of Health and Human*

6 S-TRIAZINE, 2,4,6-TRIAMINO- [Peer Reviewed] *U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry ofToxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS fi*
7 TR [Peer Reviewed] *U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry ofToxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS fi*
8 1,3,5-TRIAZINE-2,4,6(1H,3H,5H)-TRIIMINE [Peer Reviewed]
9 1,3,5-TRIAZINE-2,4,6-TRIAMINE [Peer Reviewed]
10 2,4,6-TRIAMINO-1,3,5-TRIAZINE [Peer Reviewed]
11 2,4,6-TRIAMINOTRIAZINE [Peer Reviewed]
12 CYANUROTRIAMIDE [Peer Reviewed]
13 ISOMELAMINE [Peer Reviewed]
14 S-TRIAZINETRIAMINE [Peer Reviewed]
15 TEOHARN [Peer Reviewed]
16 THEOHARN [Peer Reviewed]
17 VIRSET 656-4 [Peer Reviewed]

Molecular Formula: C3-H6-N6 [Peer Reviewed]
Wiswesser Line Notation: T6N CN ENJ BZ DZ FZ [Peer Reviewed] *U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry ofToxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS fi*
RTECS Number: NIOSH/OS0700000

2.0 MANUFACTURING/USE INFORMATION

Methods of Manufacturing:

1 HEATING OF UREA UNDER PRESSURE WITH THE ELIMINATION OF AMMONIA & CARBON DIOXIDE [Peer Reviewed] *SRI*
2 USUALLY PREPD BY HEATING DICYANDIAMIDE...UNDER PRESSURE. ALTERNATE METHODS STARTING WITH UREA. [Peer Reviewed] *Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996. 990*
3 1) BY HEATING UREA AND AMMONIA; THE RESULTING MIXTURE OF ISOCYANIC ACID AND AMMONIA REACTS OVER A SOLID CATALYST AT ABOUT 400 deg C TO FORM MELAMINE, 2) FROM CYANAMIDE, DICYANAMIDE OR CYANURIC CHLORIDE [Peer Reviewed] *Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 12th ed. New York, NY: Van Nostrand Rheinhold Co., 1993 736*

Formulations/Preparations:

MIN-99% [Peer Reviewed] *Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 12th ed. New York, NY: Van Nostrand Rheinhold Co., 1993 736*

Manufacturers:

1 American Melamine Industries, Hq, 10800 River Rd, Westwego, LA 70094, (504) 431-6312; Production site: Avondale, LA 70094 [Peer Reviewed] *SRI. 1996 Directory of Chemical Producers-United States of America. Menlo Park, CA: SRI International, 1996. 732*
2 Melamine Chemicals, Inc, Hq, PO Box 748, Donaldsonville, LA 70346, (504) 473-0550; Production site: Donaldsonville, LA 70346 [Peer Reviewed] *SRI. 1996 Directory of Chemical Producers-United States of America. Menlo Park, CA: SRI International, 1996. 732*

Other Manufacturing Information:

Other Manufacturing Information:

1 WHEN 64 DERIVATIVES OF MELAMINE WERE TESTED FOR CHEMOSTERILANT ACTIVITY ON THE HOUSEFLY, IT WAS FOUND THAT SUBSTITUTION OF 1 HYDROGEN IN MELAMINE WITH AN ALKYL GROUP CONTAINING LESS THAN 3 CARBONS IN A CHAIN GAVE HIGHLY ACTIVE COMPOUNDS SUCH AS N2-METHYLMELANINE. [Peer Reviewed] *BORKOVEC AB, DEMILO AB; J MED CHEM 10 (3): 457 (1967)*

2 IF MELAMINE IS REACTED WITH FORMALDEHYDE, TRIMETHYLOL MELAMINE... IS PRODUCED, FROM WHICH RESIN IS MADE BY POLYCONDENSATION. TRIMETHYLOLAMINE RESINS ARE USED IN PAPER & TEXTILE FINISHES, IN ADHESIVES & IN IMPREGNATION OF PLASTER OF PARIS BANDAGES TO SPEED UP CURING OF CAST. [Peer Reviewed] *International Labour Office. Encyclopedia of Occupational Health and Safety. Volumes I and II. New York: McGraw-Hill Book Co., 1971. 852*

3 [NAGATSU H, CATIONIC POLYMER FLOCCULANTS FOR WASTE WATER TREATMENT; JAPAN KOKAI PATENT NO 77 61185 05/20/77 (KURITA WATER INDUSTRIES, LTD)] MIXT OF PARTIALLY AMINOALKYLATED POLYACRYLAMIDE & UREA, THIOUREA, GUANIDINE, DICYANDIAMIDE, ANILINE, & MELAMINE WERE USED AS FLOCCULANTS FOR WASTEWATER SLUDGE TREATMENT. [Peer Reviewed] *Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 12th ed. New York, NY: Van Nostrand Rheinhold Co., 1993 736*

4 SOX-CONTAINING GAS IS CONTACTED WITH AN AQ SUSPENSION OF MELAMINE CONTAINING AN OXIDATION INHIBITOR CAUSING THE FORMATION OF SOLID HYDRATED MELAMINE SULFITE & SOLID HYDRATE MELAMINE SULFATE. THE SOLIDS ARE SEPARATED & THE LIQ RECYCLED. [Peer Reviewed] *KOHLER JJ ET AL; REMOVAL AND RECOVERY OF SULFUR OXIDES FROM GAS STREAMS WITH MELAMINE; DEF PUBL US PATENT OFF T PATENT NO 970008 05/02/78 (TVA)*

5 ALLIED CHEMICAL CORP CEASED PRODUCTION/OF MELAMINE/IN 1978 [Peer Reviewed] *CHEMICAL PRODUCTS SYNOPSIS: MELAMINE, 1983*

6 METHOD OF PURIFICATION; RECRYSTALLIZATION FROM WATER [Peer Reviewed] *Hawley, G.G. The Condensed Chemical Dictionary. 10th ed. New York: Van Nostrand Reinhold Co., 1981. 649*

Major Uses:

1 ORGANIC SYNTHESIS; LEATHER TANNING [Peer Reviewed] *Hawley, G.G. The Condensed Chemical Dictionary. 9th ed. New York: Van Nostrand Reinhold Co., 1977. 542*

2 TO MAKE HIGH PRESSURE LAMINATE RESINS, MOLDING COMPOUNDS & SURFACE COATING RESINS, TEXTILE & PAPER TREATING RESINS, ADHESIVE RESINS FOR GLUING LUMBER, PLYWOOD, & FLOORING [Peer Reviewed] *Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 2769*

3 MFR OF MELAMINE-FORMALDEHYDE THERMOSETTING RESINS [Peer Reviewed] *Lefaux, R. Practical Toxicology of Plastics. Cleveland: CRC Press Inc., 1968. 330*

4 COMONOMER WITH FORMALDEHYDE FOR AMINO RESIN PRODN [Peer Reviewed] *SRI*

Consumption Patterns:

1 AS A COMONOMER IN THE PRODN OF AMINO RESINS IN THE FOLLOWING APPLICATIONS: 36% IN HIGH PRESSURE LAMINATES; 22.5% IN MOLDING COMPDS; 15.5% IN SURFACE COATINGS; 7% IN TEXTILE PRINTING; 8% IN PAPER TREATING; 11% IN MISC APPLICATIONS (1974) [Peer Reviewed] *SRI*

2 26% FOR LAMINATES; 22% FOR COATINGS; 20% FOR MOLDING COMPOUNDS; 13% FOR PAPER COATINGS; 5% FOR ADHESIVES; 3% FOR TEXTILE TREATMENT RESINS; 7% OTHER (1985) [Peer Reviewed] *CHEMICAL PROFILE: MELAMINE, 1985*

3 CHEMICAL PROFILE: Melamine. Surface coatings, 29%; laminates, 22%; exports, 14%; paper coatings, 13%; molding compounds, 6%; textile treatment resins, 5%; adhesives, 4%; flame retardants, 3%; miscellaneous uses (including tanning and pigment cross-linking agents), 4%. [Peer Reviewed] *Kavaler AR; Chemical Marketing Reporter 233 (12): 54 (1988)*

agents), 4%. [Peer Reviewed] *Kavaler AR; Chemical Marketing Reporter 233 (12): 54 (1988)*
4 CHEMICAL PROFILE: Melamine. Demand: 1987: 132 million lb; 1988: 135 million lb; 1992 /projected/: 149 million lb. [Peer Reviewed] *Kavaler AR; Chemical Marketing Reporter 233 (12): 54 (1988)*

U.S. Production:

1 1990/1991 97,000 TONS/ANNUALLY [Peer Reviewed] *Gerhartz, W. (exec ed.). Ullmann's Encyclopedia of Industrial Chemistry. 5th ed.Vol A1: Deerfield Beach, FL: VCH Publishers, 1985 to Present.,p. VA16 180*
2 (1974) 5.49X10+10 GRAMS (EST) [Peer Reviewed] *SRI*
3 (1983) 8.17X10+10 g [Peer Reviewed] *CHEM & ENG NEWS, 62(21): 39 (1984)*

U.S. Imports:

1 (1983) 8.76X10+9 g [Peer Reviewed] *CHEM WEEK, 134(9): 24(1984)*
2 (1972) 5.31X10+9 GRAMS [Peer Reviewed] *SRI*
3 (1975) 2.88X10+9 GRAMS [Peer Reviewed] *SRI*

U.S. Exports:

1 (1972) NEGLIGIBLE [Peer Reviewed] *SRI*
2 (1975) NEGLIGIBLE [Peer Reviewed] *SRI*
3 (1983) NEGLIGIBLE [Peer Reviewed] *CHEMICAL PRODUCT SYNOPSIS: MELAMINE, 1983*

3.0 CHEMICAL AND PHYSICAL PROPERTIES

Color/Form:

1 MONOCLINIC PRISMS [Peer Reviewed] *Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996. 990*
2 COLORLESS [Peer Reviewed] *Sax, N.I. Dangerous Properties of Industrial Materials. 5th ed. New York: Van Nostrand Rheinhold, 1979. 791*
3 WHITE CRYSTALS [Peer Reviewed] *Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 12th ed. New York, NY: Van Nostrand Rheinhold Co., 1993 736*

Melting Point: LESS THAN 250 DEG C [Peer Reviewed] *Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996. 990*
Molecular Weight: 126.13 [Peer Reviewed] *Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996. 990*
Density/Specific Gravity: 1.573 at 14 deg C [Peer Reviewed] *Lide, D.R. (ed.). CRC Handbook of Chemistry and Physics. 76th ed. Boca Raton, FL: CRC Press Inc., 1995-1996.,p. 3-323*
Dissociation Constants: Kb = 1.1X10-9 [Peer Reviewed] *Gerhartz, W. (exec ed.). Ullmann's Encyclopedia of Industrial Chemistry. 5th ed.Vol A1: Deerfield Beach, FL: VCH Publishers, 1985 to Present.,p. VA16 172*
Heat of Combustion: -1967 kJ/mol at 25 deg C [Peer Reviewed] *Gerhartz, W. (exec ed.). Ullmann's Encyclopedia of Industrial Chemistry. 5th ed.Vol A1: Deerfield Beach, FL: VCH Publishers, 1985 to Present.,p. VA16 172*
Solubilities:

1 SLIGHTLY SOL IN WATER, VERY SLIGHTLY SOL IN HOT ALC; INSOL IN ETHER [Peer Reviewed] *Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996. 990*
2 SPARINGLY SOL IN GLYCOL, GLYCEROL, PYRIDINE; VERY SLIGHTLY SOL IN ETHANOL; INSOL IN BENZENE, CARBON TETRACHLORIDE [Peer Reviewed] *Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 12th ed. New York, NY: Van Nostrand Rheinhold Co., 1993 736*

Spectral Properties:

1 MAX ABSORPTION (0.1 N HCL): 235 NM (LOG E= 4.01); (WATER PH= 7): 236 NM (LOG E= 3.4); SADTLER REF NUMBER: 5460 (IR, PRISM); 477 (IR, GRATING); INDEX OF REFRACTION: 1.872 AT 20 DEG C/D [Peer Reviewed] *Weast, R.C. (ed.). Handbook of Chemistry and Physics. 60th ed. Boca Raton, Florida: CRC Press Inc., 1979.,p. C-370*

2 IR: 2344 (Coblentz Society Spectral Collection) [Peer Reviewed] *Weast, R.C. and M.J. Astle. CRC Handbook of Data on Organic Compounds. Volumes I and II. Boca Raton, FL: CRC Press Inc. 1985.,p. V1 830*

3 UV: 1499 (Sadtler Research Laboratories Spectral Collection) [Peer Reviewed] *Weast, R.C. and M.J. Astle. CRC Handbook of Data on Organic Compounds. Volumes I and II. Boca Raton, FL: CRC Press Inc. 1985.,p. V1 830*

4 MASS: 67 (Aldermaston, Eight Peak Index of Mass Spectra, UK) [Peer Reviewed] *Weast, R.C. and M.J. Astle. CRC Handbook of Data on Organic Compounds. Volumes I and II. Boca Raton, FL: CRC Press Inc. 1985.,p. V1 830*

Vapor Density: 4.34 (AIR= 1) [Peer Reviewed] *Sax, N.I. Dangerous Properties of Industrial Materials. 5th ed. New York: Van Nostrand Rheinhold, 1979. 791*

Vapor Pressure: 50 MM HG AT 315 DEG C [Peer Reviewed] *Sax, N.I. Dangerous Properties of Industrial Materials. 5th ed. New York: Van Nostrand Rheinhold, 1979. 791*

Other Chemical/Physical Properties:

1 BP SUBLIMES [Peer Reviewed] *Lide, D.R. (ed.). CRC Handbook of Chemistry and Physics. 76th ed. Boca Raton, FL: CRC Press Inc., 1995-1996.,p. 3-323*

2 pKa = 5 [Peer Reviewed] *Weber JB; Soil Sci Soc Proc 34: 401-404 (1970)*

3 Heat of sublimation = -121 kJ/mol at 25 deg C [Peer Reviewed] *Gerhartz, W. (exec ed.). Ullmann's Encyclopedia of Industrial Chemistry. 5th ed.Vol A1: Deerfield Beach, FL: VCH Publishers, 1985 to Present.,p. VA16 172*

4.0 SAFETY AND HANDLING

FIRE FIGHTING INFORMATION

Toxic Combustion Products:

THE EVOLUTION OF HYDROGEN CYANIDE DURING COMBUSTION & PYROLYSIS OF MELAMINE RESIN WAS DETECTED. [Peer Reviewed] *MORIKAWA T; J COMBUST TOXICOL 5 (3): 315 (1978)*

HAZARDOUS REACTIONS

Decomposition:

DANGEROUS; WHEN HEATED TO DECOMP, EMITS HIGHLY TOXIC FUMES OF /NITROGEN OXIDES AND HYDROGEN CYANIDE/. [Peer Reviewed] *Sax, N.I. Dangerous Properties of Industrial Materials. 6th ed. New York, NY: Van Nostrand Reinhold, 1984. 1737*

OTHER SAFETY AND HANDLING

Cleanup Methods:

1 DISSOLVED CYANURIC ACID, CYANURATES, & OTHER DERIVATIVES (0.2-3.0%) CONTAINED IN WASTE WATER FROM THE MFR OF CHLORINATED CYANURIC ACIDS ARE REMOVED BY SLURRYING WITH POWDERED OR GRANULATED ACTIVE

CARBON FOR 0.5-3 HR & FILTRATION. [Peer Reviewed] *CARLSON RH; REMOVAL OF CYANURATES FROM WASTE WATER; GER OFFEN PATENT NO 2417845 10/24/74 (FMC CORP)*

2 ACID WASTEWATERS FROM MFR OF CYANURIC ACID & ITS CHLORINATED DERIVATIVES WHICH CONTAIN CYANURIC ACID, MELAMINE, AMMELINE, & AMMELIDE & HAVE PH 0-6, ARE HEATED TO 245-270 DEG C UNDER EVOLVED PRESSURE, WHICH MAY BE 1-30 ATM & ARE HYDROLYZED COMPLETELY. [Peer Reviewed] *BERKOWITZ S, JUELKE CV; THERMAL HIGH-PRESSURE HYDROLYSIS OF ACID WASTE WATERS CONTAINING CYANURIC ACID AND ITS DERIVATIVES; GER OFFEN PATENT NO 2616054 10/28/76 (FMC CORP)*

Disposal Methods:

SRP: At the time of review, criteria for land treatment or burial (sanitary landfill) disposal practices are subject to significant revision. Prior to implementing land disposal of waste residue (including waste sludge), consult with environmental regulatory agencies for guidance on acceptable disposal practices. [Peer Reviewed]

5.0 TOXICITY/BIOMEDICAL EFFECTS

SUMMARY

Evidence for Carcinogenicity:

No data are available in humans. Inadequate evidence of carcinogenicity in animals. OVERALL EVALUATION: Group 3: The agent is not classifiable as to its carcinogenicity to humans. [Peer Reviewed] *IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. S7 65 (1987)*

Antidote and Emergency Treatment:

...SKIN...SPLASHES SHOULD BE WASHED OFF IMMEDIATELY WITH WATER OR CLEANED WITH PIECE OF COTTON MOISTENED WITH ACETONE. [Peer Reviewed] *International Labour Office. Encyclopedia of Occupational Health and Safety. Volumes I and II. New York: McGraw-Hill Book Co., 1971. 852*

TOXICITY EXCERPTS

Human Toxicity Excerpts:

1 HUMAN SUBJECTS WERE GIVEN PATCH TESTS WITH MELAMINE. NO EVIDENCE OF EITHER PRIMARY IRRITATION OR SENSITIZATION WAS FOUND. [Peer Reviewed] *Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 2772*

2 DERMATITIS HAS BEEN REPORTED FROM MFR OF MELAMINE FORMALDEHYDE RESINS & GLUES. IT IS PROBABLE THAT THESE CASES WERE CHIEFLY DUE TO FORMALDEHYDE OR INTERMEDIATE REACTION PRODUCTS OF FORMALDEHYDE & MELAMINE. [Peer Reviewed] *Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 2772*

3 SUMMARY TOXICITY STATEMENT: ACUTE... MODERATE VIA ORAL ROUTE. MODERATE= MAY CAUSE REVERSIBLE OR IRREVERSIBLE CHANGES TO EXPOSED TISSUE, NOT PERMANENT INJURY OR DEATH; CAN CAUSE CONSIDERABLE

TISSUE, NOT PERMANENT INJURY OR DEATH; CAN CAUSE CONSIDERABLE DISCOMFORT. [Peer Reviewed] *Sax, N.I. Dangerous Properties of Industrial Materials. 5th ed. New York: Van Nostrand Rheinhold, 1979. 791*

Non-Human Toxicity Excerpts:

1 Melamine was applied under a rubber cuff to guinea pig skin as a 1 percent solution in water. Little or no irritation was observed. ... On rabbits, melamine caused no primary skin irritation or signs of systemic toxicity when applied under an impervious cover at doses as high as 1 g/kg for 18 hr. The dry compound and a 10 percent aqueous suspension were introduced into rabbit eyes. Mild irritation occurred with the powder but no irritation was caused by the suspension. [Peer Reviewed] *Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 2770*

2 ... MELAMINE HAS A PRONOUNCED DIURETIC EFFECT IN RATS & DOGS. LARGE SINGLE ORAL DOSES OF 20 MMOL/KG (2.4 G/KG) IN RATS CAUSED NO EFFECTS OTHER THAN CRYSTALLURIA & DIURESIS. THE CRYSTALLURIA WAS DUE TO THE EXCRETION OF DIMELAMINE MONOPHOSPHATE CRYSTALS. [Peer Reviewed] *Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 2771*

3 ... Crystalline deposits /were observed/ in the renal tubules of rats given five successive intraperitoneal doses of 500 mg/kg. No symptoms were observed except for moderate transient weight loss, and histological examinations were essentially negative. [Peer Reviewed] *Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 2771*

4 CHRONIC FEEDING TESTS HAVE BEEN CARRIED OUT ON RATS OVER A 2-YR PERIOD AT A DIETARY LEVEL OF 1000 PPM AND ON DOGS FOR 1 YR AT A LEVEL OF 30,000 PPM. THROUGHOUT THE STUDY, THE GENERAL HEALTH ... WAS NOT SIGNIFICANTLY DIFFERENT FROM THAT OF THE CONTROLS ... AFTER 60 TO 90 DAYS, HOWEVER, THE DOGS SHOWED MELAMINE CRYSTALLURIA, WHICH PERSISTED THROUGHOUT THE REMAINDER OF THE 1 YR OF OBSERVATION. AT THESE LEVELS AT AUTOPSY, GROSS AND MICROSCOPIC EXAMINATION OF THE TISSUES REVEALED NO ABNORMALITY ATTRIBUTABLE TO THE FEEDING OF MELAMINE. [Peer Reviewed] *Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 2771*

5 ... WHEN RATS WERE FED MELAMINE AT A 1.0% LEVEL (10,000 PPM) OVER THEIR LIFE-SPAN (IN 2 YR, A TOTAL INGESTION OF ABOUT 2 LB OF MELAMINE PER RAT), BLADDER STONES ASSOCIATED WITH BENIGN PAPILLOMATA WERE FOUND IN ABOUT 1/3 OF THE ANIMALS. THESE PAPILLOMATA ARE INTERPRETED AS A TYPICAL RESPONSE OF THE RAT'S BLADDER MUCOSA TO THE PRESENCE OF FOREIGN BODY. ... NO DISTURBANCE OF THE NUTRITION OR GENERALLY HEALTHY APPEARANCE OF THESE ANIMALS WAS NOTED. [Peer Reviewed] *Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 2771*

6 SIGNS OF TOXICITY FOLLOWING LETHAL DOSES TO MICE INCLUDED LACRIMATION, DYSPNEA, INTERMITTENT TREMORS, AND COMA PRECEDING DEATH. VASODILATION IN TAIL AND EARS AND PARALYSIS OF FOREQUARTERS WAS ALSO OBSERVED. [Peer Reviewed] *Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 2771*

7 EXPOSURE OF BIOMPHALARIA GLABRATA FOR 45 DAYS TO SUBLETHAL CONCN (500, 1000 & 2000 MG/L) OF MELAMINE IN WATER CAUSED A CONCN-DEPENDENT DECREASE IN REPRODUCTIVE ABILITY. [Peer Reviewed] *RAMUSINO MC, TENCONI A: EFFECT OF MELAMINE ON BIOMPHALARIA GLABRATA SAY (MOLLUSCA, GASTEROPODA) RIV BIOL 73 (4): 588 (1980)*

GASTEROPODA) RIV BIOL 73 (4): 588 (1980)

8 MELAMINE AT 500 & 1000 MG/L LOWERED THE RATE OF SALMO GAIRDNERI EGG HATCHABILITY & AT 125 & 250 MG/L IT INCREASED THE INCIDENCE OF MALFORMATION IN EXPOSED LARVAE. [Peer Reviewed] *RAMUSINO MC, VAILATI G; ACTA EMBRYOL MORPHOL EXP 3 (1): 41 (1982)*

9 Groups of 50 male and 50 female B6C3F, mice, six weeks of age, were fed a diet containing 2250 or 4500 mg/kg melamine (97% pure, with six unspecified impurities (possibly including ammeline (4,6-diamino-s-triazine-2-ol), ammelide (6-amino-s-triazine-2,4-diol) and cyanuric acid)) ad libitum for 103 weeks, followed by a basal diet for two weeks before sacrifice. Groups of 50 male and 50 female mice were maintained on basal diet and served as controls. No effect was observed on body-weight gain in either male or female mice. Survival at termination of the study was: 39/49 (80%) control, 36/50 (72%) low-dose and 28/50 (56%) high-dose males and 37/50 (74%) control, 43/50 (86%) low-dose and 41/50 (82%) high-dose females. The reduction in the survival of high-dose males was statistically significant (p = 0.013). No treatment-related increase in the incidence of tumors was observed. In male mice, treatment-related increases were observed in the incidence of urinary bladder stones (2/45 control, 40/47 low-dose and 41 /44 high-dose animals), in the incidence of acute and chronic inflammation of the urinary bladder (0/45 controls, 25/47 low-dose and 24/44 high-dose animals) and in the incidence of epithelial hyperplasia of the bladder (l/45 controls, 11/47 low-dose and 13/44 high-dose mice). Urinary bladder stones were seen in 4/50 high-dose females. [Peer Reviewed] *IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V39 338 (1986)*

10 Groups of 50 male and 50 female Fischer 344/N rats, six weeks of age, were fed diets containing 2250 or 4500 mg/kg (males) or 4500 or 9000 mg/kg (females) melamine (97% pure, with six unspecified impurities possibly including ammeline (4,6-diamino-s-triazine-2-ol), ammelide (6-amino-s-triazine-2,4-diol) and cyanuric acid), respectively, ad libitum for 103 weeks, followed by a basal diet for two weeks prior to sacrifice. Groups of 50 male and 50 female rats fed basal diet only served as controls. Survival was significantly reduced in high-dose males (p = 0.03) from 101 weeks on study. Survival rates at termination of the study were: 30/49 (61%) control, 30/50 (60%) low-dose and 19/50 (38%) high-dose males and 34/50 (68%) control, 30/50 (60%) in low-dose and 27/50 (54%) high-dose females. The incidence of transitional-cell carcinomas of the urinary bladder in males was: 0/45 controls, 0/50 low-dose and 8/49 high-dose (control versus high-dose animals, p + 0.016). There was also a dose-related incidence of bladder stones in male rats (0/45 controls, 1/50 low-dose and 10/49 high-dose). Of 49 high-dose animals, seven had transitional-cell carcinomas and bladder stones, one had a carcinoma without stones and three had stones without carcinoma (one of these rats had a papilloma and one had epithelial hyperplasia). Female rats had no bladder stones, and one female in each of the low-dose and the high-dose group had a papilloma of the bladder. [Peer Reviewed] *IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V39 339 (1986)*

11 In an initiation-promotion study, a group of 20 female CD-I mice, eight weeks old, received a single topical application of 1, umol (6 mg/ kg bw assuming a 20 g mouse) melamine (purity unspecified) in 0.2 ml acetone on shaven back skin, followed by twice weekly applications of 10 nmol 12-O-tetradecanoylphorbol 13-acetate (TPA) in 0.2 ml acetone for 31 weeks, at which time they were killed. A control group of 20 female mice received a single application of acetone alone, followed by applications of TPA. No increase in the incidence of papillomas was observed in melamine-treated mice (19%) as compared to controls (14%). [Peer Reviewed] *IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V39 340 (1986)*

12 In male and female Fischer 344 rats and B6C3F, mice fed diets containing 5000-30000 mg/ kg melamine (purity, 97%) for 14 days, a hard crystalline solid was found in the urinary bladder in most male rats receiving 10 000 mg/ kg or more and in all treated male mice. In females, this effect was noted at dose levels of 20 000 mg/ kg or more in rats and in 2/ 5

females, this effect was noted at dose levels of 20 000 mg/ kg or more in rats and in 2/ 5 mice given 30000 mg/kg. In a subsequent study, diets containing 0, 6000, 9000, 12000, 15000 or 18000 mg/kg melamine were fed to groups of 12 male and 12 female rats and to groups of 10 male and 10 female mice for 13 weeks. Stones were found in the urinary bladders of most male rats, in a dose-related incidence, and the bladders of some female rats receiving 15000 mg/kg or more. Bladder stones were observed in both male and female mice receiving 12000 mg/kg or more. Ulceration of the urinary bladder was also noted in treated mice of both sexes fed 12000 mg/kg or more; 60% of the mice that had bladder ulcers also had stones. The distribution of bladder ulcers and stones was not considered to provide evidence for an association between ulceration and bladder stones in animals of either sex. In a second study of the same duration, diets containing 750, 1500, 3000, 6000 and 12000 mg/kg melamine were fed to rats. Hyperplasia of the bladder epithelium was noted in male rats receiving 3000 mg/ kg or more, but in none of the female rats. Urinary bladder stones were not observed in treated or control female rats, but among male rats the incidence increased in a dose-related manner from the lowest-dose group (2/10) to the 12000 mg/kg level (9/9). [Peer Reviewed] *IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V39 340 (1986)*

13 No toxic effect or gross malformation was found in fetuses of pregnant rats injected intraperitoneally with 70 mg/kg bw melamine on gestation days 5 and 6, 8 and 9, or 12 and 13. [Peer Reviewed] *IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V39 340 (1986)*

14 Melamine (tested at up to 5550 ug/plate) was not mutagenic to Salmonella typhimurium TA1535, TA1537, TA98 or TA100 in the presence or absence of a metabolic system (S9) from the liver of Aroclor-induced rats or hamsters, when tested in the liquid preincubation assay. [Peer Reviewed] *IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V39 341 (19860*

15 Sex-linked recessive lethal mutations were not induced in Drosophila melanogaster given melamine in the diet. [Peer Reviewed] *IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V39 341 (1986)*

16 Urinary bladder carcinogenesis associated with melamine treatment was examined with concomitant use of NaCl to allow assessment of the relationship between uroliths and lesion development. Analysis of the chemical composition of calculi was also performed. F344/DuCrj male rats received diets containing 3 or 1 melamine alone or in combination with either 10 or 5% NaCl, or 10% NaCl alone for 36 wk, and then diet without NaCl supplement for a further 4 wk. The water intake, used as an index of urinary output, was increased by NaCl treatment. The incidences of bladder transitional cell carcinomas and papillomas were 90 and 55% in the group treated with 3% melamine alone; 0 and 15% in the group treated with 3% melamine and 10% NaCl; and 21 and 42% in group treated with 1% melamine alone; and 0 in the other groups. Calculus formation resulting from melamine admin was suppressed dose dependently by the simultaneous NaCl treatment, along with the occurrence of hyperplasia of the papilla in the kidneys. The main constituent of calculi were melamine itself and uric acid (total contents 61.1-81.2%), contained in equal molar ratio. The results indicate that melamine induced proliferative lesions of the urinary tract of rats were directly due to the irritative stimulation of calculi, and not molecular interactions between melamine itself or its metabolites with the bladder epithelium. [Peer Reviewed] *Ogasawara H et al; Carcinogenesis 16 (11): 2773-7 (1995)*

17 Urinary bladder lesions induced by admin of thymine or melamine were investigated in male F344 rats. Animals, 6 weeks old at the beginning of the experiment, received either 3.0 or I.O% thymine or 3.0, 1.0 or 0.3% melamine in the diet for 36 weeks followed by a 4 week period without chemical /admin/, the total observation time being 40 wk. Carcinomas of the urinary bladder were observed in 1/20 (5%) rats in each of the 3.0% thymine and 1.0%

melamine groups, and in 15/19 (79%) animals given the 3.0% melamine treatment. Papillomas were induced in 9/20 (455), 12/19 (63%) and 1/20 (5%) among rats receiving the 3.0% thymine, 3.0% and 1.0% melamine treatments respectively. Exploratory laparotomy at the end of week 36 revealed calculus formation in 9/10 (90%), 10/10 (100%) and 7/10 (70%) rats in these groups. In the ureter of the 3.0% melamine treated group, carcinoma and papillomas were induced in 1/19 (5%) and 3/19 (16%) animals respectively. ... No tumors were observed in the renal pelvis in any of the other treated groups. Thus, admin of 3.0% thymine in the diet results in calculus formation in the urinary bladder of F344 rats, and is associated with development of tumors. It was also confirmed that a 3.0% dose level of melamine in the diet induces tumors in both the urinary bladder and the ureter. [Peer Reviewed] *Okumura M et al; Carcinogenesis 13 (6): 1043-5 (1992)*

18 ... Under the conditions of this bioassay, melamine was carcinogenic for male F344/N rats, causing transitional cell carcinomas in the urinary bladder. ... Melamine was not carcinogenic for female F344/N rats or B6C3F1 mice of either sex. [Peer Reviewed] *Toxicology and Carcinogenesis Studies of Melamine in F344/N Rats and B6C3F1 Mice (Feed Studies) Technical Rpt Series 245 (1983) NIH Pub 83-2501 U.S. Department of Health and Human Services, National Toxicology Program, National Institute of Environmental*

TOXICITY VALUES

Non-Human Toxicity Values:

1 LD50 Mouse (male) gavage 3.3 g/kg [Peer Reviewed] *IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V39 339 (1986)*

2 LD50 Mouse (female) gavage 7.0 g/kg [Peer Reviewed] *IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V39 339 (1986)*

3 LD50 Rat (male) gavage 3.2 g/kg [Peer Reviewed] *IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V39 339 (1986)*

4 LD50 Rat (female) gavage 3.8 g/kg [Peer Reviewed] *IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V39 339 (1986)*

National Toxicology Program Reports:

A carcinogenesis bioassay of melamine (>95% pure) ... was conducted by feeding diets containing 2,250 or 4,500 ppm melamine to groups of 50 male F344/N rats and 50 B6C3F1 mice of each sex for 103 wk. Groups of 50 female rats were fed diets containing 4,500 or 9,000 ppm melamine. Groups of 49 male rats, 50 female rats, 49 male mice, and 50 female mice served as controls. ... Under the conditions of this bioassay, melamine was carcinogenic for male F344/N rats, causing transitional cell carcinomas in the urinary bladder. ... Melamine was not carcinogenic for female F344/N rats or B6C3F1 mice of either sex. [Peer Reviewed] *Toxicology and Carcinogenesis Studies of Melamine in F344/N Rats and B6C3F1 Mice (Feed Studies) Technical Rpt Series 245 (1983) NIH Pub 83-2501 U.S. Department of Health and Human Services, National Toxicology Program, National Institute of Environmental*

IARC Summary and Evaluation:

No data are available in humans. Inadequate evidence of carcinogenicity in animals. OVERALL

No data are available in humans. Inadequate evidence of carcinogenicity in animals. OVERALL EVALUATION: Group 3: The agent is not classifiable as to its carcinogenicity to humans. [Peer Reviewed] *IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. S7 65 (1987)*

TSCA Test Submissions:

in Male Weanling Fischer 344 Rats (Final Report) [3 Parts] W-Attachments & Letter Dated 01/09/92; 02/28/83; EPA Doc. No. 88-920000641; Fiche No. OTS0535236] Melamine (CAS# 108-78-1) was evaluated for subchronic dietary toxicity. The test substance was administered in the diet of male weanling Fischer 344 rats (40/group, except for 19 animals in the 2,000 ppm group) at concentrations of 0, 2,000, 4,000, 7,000, 10,000, 13,000, 16,000, or 19,000 ppm for 4-weeks. At the 16,000 and 19,000 ppm dose-level, treatment-related effects included a significant decrease in body weight gain. All dose levels exhibited increased water intake and decreased food consumption early in the exposure period, an increase midway through the exposure period, and a decrease in the latter part of the exposure period. Clinical signs included a dose-related increase in piloerection, lethargy, bloody urine spots in the cage and on the pelage of animals, and chromodacryorrhea. Necropsy findings concluded a treatment-related incidence of urinary bladder calculi at 4,000 ppm and above, and urinary bladder hyperplasia at 1,000 ppm and above. It was concluded that the NOEL was estimated to be 2,000 ppm. *AMER CYANAMID CO; Initial Submission: Evaluation of Urolithiasis Induction by Melamine [CAS 108-78-1*

PHARMACOKINETICS

Absorption, Distribution and Excretion:

1 FOLLOWING SINGLE ORAL DOSES IN RATS & DOGS, 50 TO 60% OF ADMIN MELAMINE WAS RECOVERED IN 6 HR. IN DOGS, 60 TO 85% WAS RECOVERED IN 24 HR. [Peer Reviewed] *Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 2770*

2 DOSES OF 2.4 G/KG CAUSE DIURESIS & ELIMINATION OF FINE CRYSTALS OF DIMELAMINE MONOPHOSPHATE IN URINE. [Peer Reviewed] *Lefaux, R. Practical Toxicology of Plastics. Cleveland: CRC Press Inc., 1968. 330*

3 After administration of a single oral dose of 250 mg/kg bw melamine to rats, 50% of the dose was recovered from the urine within 6 hours. [Peer Reviewed] *IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V39 340 (1986)*

4 After administration of a single oral dose of 0.38 mg (14)C-melamine to adult male Fischer 344/N rats, 90% of the administered dose was excreted in the urine within the first 24 hours. Negligible radioactivity was detected in exhaled air and feces; and radioactivity was concentrated in the kidney and bladder. Virtually no residual radioactivity was observed in tissue after 24 hours or more. Chromatography of the radioactivity found in plasma or urine indicated that melamine is not metabolized in rats. [Peer Reviewed] *IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V39 340 (1986)*

Metabolism/Metabolites:

CRYSTALLURIA WAS DUE TO EXCRETION OF DIMELAMINE-MONOPHOSPHATE CRYSTALS. [Peer Reviewed] *Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 2771*

7.0 ENVIRONMENTAL FATE/EXPOSURE POTENTIAL

SUMMARY

Environmental Fate/Exposure Summary:

Melamine's production and use in resins for the paper and textile industries or for leather tanning may result in its release to the environment through various waste streams. Based upon an extrapolated vapor pressure of 3.6X10-10 mm Hg at 20 deg C, melamine is expected to exist as a particulate in the ambient atmosphere. Particulate-phase melamine may be physically removed from the air, mainly by wet deposition. Volatilization from moist soilsurfaces is not expected based on an estimated Henry's Law constant of 1.8X10-14 atm-cu m/mol. In water, melamine is shown to adsorb to suspended solids or sediment by varying amounts as a function of pH. Maximum adsorption occurs at a pH near the pKa value for melamine. Volatilization from water surfaces is not expected based upon its estimated Henry's Law constant. BOD studies conducted with melamine and sewage inoculum resulted in 0% theoretical biochemical oxygen demand. Pure culture studies of 3 mM melamine samples indicated the degradation pathway of melamine involves the conversion of melamine to ammeline and eventually cyanuric acid. Bioconcentration in aquatic organisms is considered low based upon the estimated BCF value of 0.05. Occupational exposure will occur through dermal contact at workplaces where melamine is produced or used. (SRC) [Peer Reviewed]

POLLUTION SOURCES

Artificial Sources:

Melamine's production and use in resins for the paper and textile industries or for leather tanning(1,2) may result in its release to the environment through various waste streams(SRC). [Peer Reviewed] *(1) Crews GM et al; Ullmann's Encycl of Indust Chem 5th ed Deerfield, FL: VCH Publishers, A16: 171-185 (1990) (2) Lewis RJ; Hawley's Condensed Chemical Dictionary. 12th ed. NY,NY: Van Nostrand Reinhold Co., p. 736 (1993)*

ENVIRONMENTAL FATE

1 TERRESTRIAL FATE: Adsorption of melamine to suspended clay samples was reported from pH 1 to 6.5, with a maximum adsorption of 500X10-6 mols/g occurring at pH 4.0(1). Volatilization of melamine will not be important from moist soil surfaces(SRC) given an estimated Henry's Law constant of 1.8X10-14 atm-cu m/mole(SRC), from its extrapolated value for vapor pressure, 3.6X10-10 mm Hg(2), and experimental value for water solubility, 3240 mg/l(3). Pure culture studies of 3 mM melamine samples indicated the degradation pathway of melamine involves the conversion of melamine to ammeline and eventually cyanuric acid(4). [Peer Reviewed] *(1) Weber JB; Soil Sci Soc Amer Proc 34: 401-404 (1970) (2) Hirt RC et al; J Polym Sci 27: 1040-1053 (1960) (3) Yalkowsky SH, Dannenfelser RM; Aquasol Database of Aqueous Solubility V5. Univ Ariz Tucson AR (1992) (4) Jutzi K et al; Biochem J 208: 679-684*

2 AQUATIC FATE: Adsorption of melamine to suspended clay sediment was reported from pH 1 to 6.5, with a maximum adsorption of 500X10-6 mols/g at pH 4.0(1). The Henry's Law constant for melamine is estimated as 1.8X10-14 atm-cu m/mole(SRC) from its extrapolated value for vapor pressure, 3.6X10-10 mm Hg(2), and experimental value for water solubility, 3240 mg/l(3). Melamine is not expected to volatilize from water surfaces(4,SRC) based upon its Henry's Law constant. According to a classification scheme(4), an estimated BCF value of

0.05(4,SRC), from an experimental log Kow(5,SRC), suggests that bioconcentration in aquatic organisms is low(SRC). A standard 5 day BOD test of melamine resulted in almost no biochemical oxygen demand(6,7). [Peer Reviewed] *(1) Weber JB; Soil Sci Soc Amer Proc 34: 401-404 (1970) (2) Hirt RC et al; J Polym Sci 27: 1040-1053 (1960) (3) Yalkowsky SH, Dannenfelser RM; Aquasol Database of Aqueous Solubility V5. Univ Ariz Tucson AR (1992) (4) Lyman WJ et al; Handbook of Chemical*

3 ATMOSPHERIC FATE: According to a model of gas/particle partitioning of semivolatile organic compounds in the atmosphere(1), melamine, which has an extrapolated vapor pressure of 3.6X10-10 mm Hg at 20 deg C(2,SRC), will exist as a particulate in the ambient atmosphere. Particulate-phase melamine may be physically removed from the air by wet deposition(SRC). [Peer Reviewed] *(1) Bidleman TF; Environ Sci Technol 22: 361-367 (1988) (2) Hirt RC et al; J Polym Sci 27: 1040-1053 (1960)*

ENVIRONMENTAL TRANSFORMATIONS

Biodegradation:

Pure culture studies of 3 mM melamine samples indicated the degradation pathway of melamine involves the conversion of melamine to ammeline and eventually cyanuric acid(1). A standard 5 day BOD test of melamine resulted in almost no biochemical oxygen demand(2,3). Based on the five day BOD data the author considered melamine to be non biodegradable(3). [Peer Reviewed] *(1) Jutzi K et al; Biochem J 208: 679-684 (1982) (2) Swope HG, Kenna M; Sewage Ind Waste 21: 467-468 (1950) (3) Sasaki S; pp. 283-98 in Aquatic Pollutants:Transformation and Biological effects. Hutzinger O, Von Letyold LH, Zoeteman BC, eds Oxford: Pergam*

ENVIRONMENTAL TRANSPORT

Bioconcentration:

An estimated BCF value of 0.05 was calculated for melamine(SRC), using an experimental log Kow of -1.37(1) and a recommended regression-derived equation(2). According to a classification scheme(3), this BCF value suggests that bioconcentration in aquatic organisms is low(SRC). [Peer Reviewed] *(1) Hansch C et al; Exploring QSAR Hydrophobic, Electronic and Stearic Constants Washington DC: Amer Chem Soc (1995) (2) Lyman WJ et al; Handbook of Chemical Property Estimation Methods. Washington DC: Amer Chem Soc pp. 5-4, 5-10 (1990) (3) Franke C et a*

Soil Adsorption/Mobility:

Adsorption of melamine to suspended clay sediment was reported from pH 1 to 6.5, with a maximum absorption of 500X10-6 mols/g at pH 4.0(1). [Peer Reviewed] *(1) Weber JB; Soil Sci Soc Amer Proc 34: 401-404 (1970)*

Volatilization from Soil/Water:

The Henry's Law constant for melamine is estimated as 1.8X10-14 atm-cu m/mole(SRC) from its extrapolated value for vapor pressure, 3.6X10-10 mm Hg(1), and experimental value for water solubility, 3240 mg/l(2). This value indicates that melamine will be nonvolatile from water surfaces(3,SRC). Melamine's Henry's Law constant(SRC) indicates that volatilization from moist soil surfaces is not important(SRC). [Peer Reviewed] *(1) Hirt RC et al; J Polym Sci 27: 1040-1053 (1960) (2) Yalkowsky SH, Dannenfelser RM; Aquasol Database of Aqueous Solubility V5. Univ Ariz Tucson AR (1992) (3) Lyman WJ et al; Handbook of Chemical Property Estimation Methods. Washington DC: Amer Chem So*

ENVIRONMENTAL CONCENTRATIONS

Effluents Concentrations:

Concentrations from 0.4 to 1.4 ppm of melamine were detected in the extract of tableware manufactured from thermosetting resins(1). [Peer Reviewed] *(1) Martin RE et al; J Food Prot 55:632-635 (1992)*

HUMAN EXPOSURE

Probable Routes of Human Exposure:

1 MELAMINE ITSELF DOES NOT SEEM TO BE IMPORTANT INDUSTRIAL HAZARD EXCEPT IF DECOMP BY HEAT. ...SKIN SHOULD BE KEPT FREE FROM UNREACTED RESINS... [Peer Reviewed] *International Labour Office. Encyclopedia of Occupational Health and Safety. Volumes I and II. New York: McGraw-Hill Book Co., 1971. 852*

2 NIOSH (NOES Survey 1981-1983) has statistically estimated that 21999 workers (2290 of these are female) are potentially exposed to melamine in the US(1). Occupational exposure may occur through dermal contact with this compound at workplaces where melamine is produced or used(SRC). [Peer Reviewed] *(1) NIOSH; National Occupational Exposure Survey (NOES) (1983)*

9.0 MONITORING AND ANALYSIS METHODS

Analytical Laboratory Methods:

1 A GAS-LIQUID CHROMATOGRAPHIC METHOD FOR DETERMINATION OF MELAMINE @ NANOGRAM LEVEL USING TRIFLUOROACETIC ACID AS SOLVENT & N-METHYL-N-TRIMETHYL SILYLTRIFLUORO- ACETAMIDE AS THE SILYLATION REAGENT IS DESCRIBED. [Peer Reviewed] *STOKS PG, SCHWARTZ AW; J CHROMATOGR 168 (2): 455 (1979)*

2 Absorption of s-Triazines by Montmorillonite As a Function of pH and Molecular Structure; A UV spectroscopic procedure to determine the amount of melamine adsorbed to clay sediments as a function of pH. [Peer Reviewed] *Weber JB; Soil Sci Amer Proc 34: 431-434 (1970)*

Clinical Laboratory Methods:

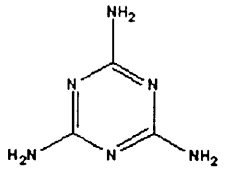
A METHOD IS DESCRIBED FOR DETERMINING THE URINE & BLOOD MELAMINE CONTENT, USING THE SENSITIVE & SPECIFIC REACTION OF FORMATION OF MELAMINE CYANURATE. THE METHOD CAN DETECT 0.01 MG/ML MELAMINE. [Peer Reviewed] *KECHEK YU A, KADZHOYAN DN; GIG TR PROF ZABOL 6: 55 (1975)*

10.0 ADDITIONAL REFERENCES

Special Reports:

Toxicology and Carcinogenesis Studies of Melamine in F344/N Rats and B6C3F1 Mice (Feed Studies) Technical Rpt Series 245 (1983)NIH Pub 83-2501 U.S. Department of Health and Human Services, National Toxicology Program, National Institute of Environmental Health Sciences, Research Triangle Park, NC 27709

TR-245
Carcinogenesis Bioassay of Melamine (CAS No. 108-78-1) in F344/N Rats and B6C3F1 Mice (Feed Study)



Chemical Formula: $C_3H_6N_6$ - 3D Structure

A carcinogenesis bioassay of melamine (>95% pure), a chemical intermediate in the manufacture of amino resins and plastics, was conducted by feeding diets containing 2,250 or 4,500 ppm melamine to groups of 50 male F344/N rats and 50 B6C3F1 mice of each sex for 103 weeks. Groups of 49 male rats, 50 female rats, 49 male mice, and 50 female mice served as controls.

Mean body weights of dosed rats of each sex were lower than those of the controls after week 20. Survival of high-dose male rats was significantly lower (P¾0.05) than that of the controls. Survival of all other dosed rat groups was comparable with that of the respective controls.

Transitional-cell carcinomas in the urinary bladder of male rats occurred with a statistically significant positive trend (P¾0.002; controls, 0/45; low-dose, 0/50; high-dose, 8/49, 16%) and the incidence in the high-dose group was significantly higher (P¾0.016) than that in the controls. A transitional-cell papilloma was observed in the urinary bladder of an additional high-dose male rat. These tumors were not observed in statistically significant proportions in female rats. Seven of the eight high-dose male rats with the transitional-cell carcinomas also had bladder stones. An association (P¾0.001) was found between bladder stones and bladder tumors in male rats.

Chronic inflammation, distinguishable from the nephropathy observed in aging F344/N rats, was significantly increased (P¾0.01) in the kidney of dosed female rats (controls, 4/50,8%; low-dose, 17/50, 34%; high-dose, 41/50, 82%) and is attributed to the administration of melamine

The mean body weight of high-dose male mice was lower than that of controls after week 50 of the study. The mean body weights of dosed and control female mice were comparable throughout the study. Survival of high-dose male mice was significantly less (P<0.02) than that of the controls. Survival of all other dosed groups was similar to that of the respective controls.

Acute and chronic inflammation and epithelial hyperplasia of the urinary bladder were found in increased incidence in dosed male mice. The incidence of bladder stones in dosed male mice was increased relative to controls (control, 2/45, 4%; low dose, 40/47, 85%; high-dose, 41/45, 93%); however, there was no evidence of bladder tumor development in this species. Also, four high-dose female mice had bladder stones without any tumors.

Under the conditions of this bioassay, melamine was carcinogenic for male F344/N rats, causing transitional-cell carcinomas in the urinary bladder. With one exception, urinary bladder stones were observed in male rats that had transitional-cell carcinomas. Melamine was not carcinogenic for female F344/N rats or for B6C3F1 mice of either sex.

Synonyms: 2,4,6-triamino-*s*-triazine; cyanurotriamide

Report Date: March 1983

Levels of Evidence of Carcinogenicity:
Male Rats: Positive

Female Rats: Negative
Male Mice: Negative
Female Mice: Negative

NTIS# PB83-202630

Phosphorothioic acid, O,O-dimethyl ester, O-ester with p-hydroxybenzenesulfonamide

RTECS - Registry of Toxic Effects of Chemical Substances

1.0 SUBSTANCE IDENTIFICATION

RTECS Number: TF7525000
Chemical Name: Phosphorothioic acid, O,O-dimethyl ester, O-ester with p-hydroxybenzenesulfonamide
CAS Number: 115-93-5
Molecular Formula: C8-H12-N-O5-P-S2
Molecular Weight: 297.30
Wiswesser Notation: ZSWR DOPS&O1&O1
Substance Investigated as: Agricultural Chemical
Last Revision Date: 1997

2.0 SYNONYM(S)/TRADENAME(S)

1 AC 26,691
2 American CL-26691
3 American cyanamid CL-26,691
4 Benzenesulfonamide, p-hydroxy-, O-ester with O,O-dimethyl phosphorothioate
5 CL 26691
6 Cyflee
7 Cythioate
8 ENT 25,640
9 O,O-Dimethyl O-p-sulfamoylphenyl phosphorothioate
10 O-(4-(Aminosulfonyl)phenyl) O,O-dimethyl phosphorothioate
11 Phosphorothioic acid, O-(4-(aminosulfonyl)phenyl) O,O-dimethyl ester (9CI)
12 Proban

3.0 HEALTH HAZARD DATA

ACUTE TOXICITY

LD50/LC50 - LETHAL DOSE/CONC 50% KILL

Rat

LD50 - ROUTE: Oral; **DOSE:** 160 mg/kg *CODEN: PEMNDP Bibliographic Data: Pesticide Manual. (The British Crop Protection Council, 20 Bridport Rd., Thornton Heath CR4 7QG, UK) V.1- 1968- CODEN Reference: 9:300,1991*

Mouse

LD50 - ROUTE: Oral; **DOSE:** 38 mg/kg *CODEN: BESAAT Bibliographic Data: Bulletin of the Entomological Society of America. (Entomological Soc. of America, 4603 Calvert Rd., College Park, MD 20740) V.1- 1955- CODEN Reference: 15:116,1969*

Rabbit

LD50 - ROUTE: Skin; **DOSE:** >2500 mg/kg *CODEN: PEMNDP Bibliographic Data: Pesticide Manual. (The British Crop Protection Council, 20 Bridport Rd., Thornton Heath CR4 7QG, UK) V.1- 1968- CODEN Reference: 9:300,1991*

4.0 STANDARDS AND REGULATIONS

EPA FIFRA 1988 PESTICIDE SUBJECT TO REGISTRATION OR RE-REGISTRATION *CODEN:*

EPA FIFRA 1988 PESTICIDE SUBJECT TO REGISTRATION OR RE-REGISTRATION *CODEN: FEREAC Bibliographic Data: Federal Register. (U.S. Government Printing Office, Supt. of Documents, Washington, DC 20402) V.1- 1936- CODEN Reference: 54:7740,1989*

7.0 STATUS IN U.S.

EPA TSCA Section 8(b) CHEMICAL INVENTORY

CF98-1-12

BORIC ACID

HSDB - Hazardous Substances Data Bank

0.0 ADMINISTRATIVE INFORMATION

Hazardous Substances Data Bank Number: 1432
Last Revision Date: 970508
Review Date: Reviewed by SRP on 08/25/89
Update History:

1 Complete Update on 05/08/97, 1 field added/edited/deleted.
2 Complete Update on 04/07/97, 1 field added/edited/deleted.
3 Complete Update on 03/17/97, 2 fields added/edited/deleted.
4 Complete Update on 02/27/97, 1 field added/edited/deleted.
5 Complete Update on 10/13/96, 1 field added/edited/deleted.
6 Complete Update on 04/18/96, 1 field added/edited/deleted.
7 Complete Update on 01/21/96, 1 field added/edited/deleted.
8 Complete Update on 08/21/95, 1 field added/edited/deleted.
9 Complete Update on 04/20/95, 1 field added/edited/deleted.
10 Complete Update on 04/20/95, 1 field added/edited/deleted.
11 Complete Update on 12/28/94, 1 field added/edited/deleted.
12 Complete Update on 03/25/94, 1 field added/edited/deleted.
13 Complete Update on 08/30/93, 1 field added/edited/deleted.
14 Field update on 12/20/92, 1 field added/edited/deleted.
15 Complete Update on 11/04/92, 1 field added/edited/deleted.
16 Complete Update on 10/07/92, 1 field added/edited/deleted.
17 Complete Update on 09/03/92, 1 field added/edited/deleted.
18 Complete Update on 09/26/91, 1 field added/edited/deleted.
19 Field update on 11/09/90, 1 field added/edited/deleted.
20 Complete Update on 07/19/90, 59 fields added/edited/deleted.
21 Complete Update on 09/23/88, 1 field added/edited/deleted.
22 Complete Update on 04/24/87, 45 fields added/edited/deleted.

1.0 SUBSTANCE IDENTIFICATION

Name of Substance: BORIC ACID
CAS Registry Number: 10043-35-3
Synonyms:

1 BORACIC ACID [Peer Reviewed] *The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 185*
2 BOROFAX [Peer Reviewed] *The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 185*
3 EPA pesticide code 011001 [Peer Reviewed] *USEPA/OPP; Catalog of Pesticide Chemical Names and Their Synonyms p.31 (1986)*
4 ORTHOBORIC ACID [Peer Reviewed] *The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 185*
5 Three elephant [QC Reviewed] *U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health Registry ofToxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS fi*
6 BORIC ACID (H3BO3) [Peer Reviewed]
7 BORON TRIHYDROXIDE [Peer Reviewed]
8 Borsaure (German) [Peer Reviewed]

7
8 Borsaure (German) [Peer Reviewed]
9 NCI-C56417 [QC Reviewed]

Molecular Formula: B-H3-O3 [Peer Reviewed] *The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 185*
Wiswesser Line Notation: QBQQ [QC Reviewed] *U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry ofToxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS fi*
RTECS Number: NIOSH/ED4550000
OHM-TADS Number: 7216606

2.0 MANUFACTURING/USE INFORMATION

Methods of Manufacturing:

1 From weak borax brines, by extraction with a kerosine solution of chelating agent such as 2-ethyl-1,3-hexanediol, or other polyols. Borates are stripped from the chelate by sulfuric acid [Peer Reviewed] *Sax, N.I. and R.J. Lewis, Sr. (eds.). Hawley's Condensed Chemical Dictionary. 11th ed. New York: Van Nostrand Reinhold Co., 1987. 162*
2 BORIC ACID IS PRODUCED FROM NATIVE BORAX, OR FROM OTHER BORATES, BY REACTING WITH HYDROCHLORIC OR SULFURIC ACID. [QC Reviewed] *Osol, A. (ed.). Remington's Pharmaceutical Sciences. 16th ed. Easton, Pennsylvania: Mack Publishing Co., 1980. 1257*

Impurities:

The principal impurities in technical grade boric acid are the by-product sulfate (0.1%) and various minor metallic impurities present in the borate ore /technical grade/ [Peer Reviewed] *Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984.,p. 4(78) 76*

Formulations/Preparations:

1 Technical, 99.9%; Chemically pure; USP [Peer Reviewed] *Sax, N.I. and R.J. Lewis, Sr. (eds.). Hawley's Condensed Chemical Dictionary. 11th ed. New York: Van Nostrand Reinhold Co., 1987. 162*
2 Three grades of granular and powdered boric acid are manufactured in the United States. ... technical grade, NF grade ... /and/ special quality grade [Peer Reviewed] *Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984.,p. 4(78) 76*
3 Saturated solutions at 0 deg C contain 2.6% acid; at 100 deg C, 28% boric acid is soluble [Peer Reviewed] *Sax, N.I. and R.J. Lewis, Sr. (eds.). Hawley's Condensed Chemical Dictionary. 11th ed. New York: Van Nostrand Reinhold Co., 1987. 162*

Manufacturers:

1 Kerr-McGhee Corporation, Hq, Kerr-Mcbee Center, PO Box 25861, Oklahoma City, OK 73125, (405) 270-1313; Subsidiary: Kerr-McGhee Chemical Corporation (address same as Hq), Production sites: Argus-Trona-Westend Complex, Trona, CA 93562; Westend, CA 93562 [QC Reviewed] *SRI. 1989 Directory of Chemical Producers - United States of America. Menlo Park, CA: SRI International, 1989. 488*
2 US Borax & Chemical Corporation, Hq, 3075 Wilshire Boulevard, Los Angeles, CA 90010, (213) 251-5400; Production site: Boron, CA 93516 [QC Reviewed] *SRI. 1989 Directory of Chemical Producers - United States of America. Menlo Park, CA: SRI International, 1989. 489*
3 In-Cide Technologies, Inc, Hq, 50 North 41st Ave, Phoenix, AZ 85009, (602) 233-0756; Production site: Phoenix, AZ 85000 [QC Reviewed] *SRI. 1989 Directory of Chemical Producers - United States of America. Menlo Park, CA: SRI International, 1989. 488*

Producers - United States of America. Menlo Park, CA: SRI International, 1989. 488

4 Mountain States Mineral Enterprises, Inc, Hq, 4370 South Fremont Ave, Tucson, AZ 85714, (602) 792-2800; Production site: Newberry Springs, CA 92365 [QC Reviewed] *SRI. 1989 Directory of Chemical Producers - United States of America. Menlo Park, CA: SRI International, 1989. 489*

Other Manufacturing Information:

1 Method of purification: Recrystallization [Peer Reviewed] *Sax, N.I. and R.J. Lewis, Sr. (eds.). Hawley's Condensed Chemical Dictionary. 11th ed. New York: Van Nostrand Reinhold Co., 1987. 162*

2 ITS USE AS PRESERVATIVE IN BEVERAGES & FOODS IS PROHIBITED BY NATIONAL & STATE LEGISLATION. [QC Reviewed] *Osol, A. (ed.). Remington's Pharmaceutical Sciences. 16th ed. Easton, Pennsylvania: Mack Publishing Co., 1980. 1258*

Major Uses:

1 Boric acid is used in the manufacture of paper and paperboard products used in food packaging for use in adhesives, sizes, and coatings. [Peer Reviewed] *21 CFR 181.30 (4/1/88)*

2 FLAME RETARDANT IN WOOD & TEXTILES; CATALYST; ADDITIVE FOR GLASS FIBERS [Peer Reviewed] *SRI*

3 Porcelain enamels; heat-resistant glass [Peer Reviewed] *Sax, N.I. and R.J. Lewis, Sr. (eds.) Hawley's Condensed Chemical Dictionary. 11th ed. New York: Van Nostrand Reinhold Co., 1987. 162*

4 Nuclear-reactor cooling water additive [Peer Reviewed] *Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984.,p. 19(85) 177*

5 Manufacturing synthetic inorganic borate salts, boron phosphate, fluoborate, borate esters, and metal alloys such as ferroboron; catalyst for alcohol production from air oxidation of hydrocarbons [Peer Reviewed] *Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984.,p. 4(78) 76*

6 Component in high contrast lith-type film developer formula, such as Kodak D-85 Developer [Peer Reviewed] *Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984.,p. 19(85) 118*

7 HAS FLY REPELLANT INSECTICIDAL QUALITIES. [Peer Reviewed] *Rossoff, I.S. Handbook of Veterinary Drugs. New York: Springer Publishing Company, 1974. 51*

8 Sequestrant [Peer Reviewed] *40 CFR 180.1001 (7/1/88)*

9 HAS BEEN INCL IN COCKROACH BAITS & ANT POISONS, ... USED TO KILL LARVAE HARBORING IN MANURES. [Peer Reviewed] *Farm Chemicals Handbook 1989. Willoughby, OH: Meister Publishing Co., 1989.,p. C-46*

10 WEATHERPROOFING WOOD; NICKLING BATHS, FOR PRINTING & DYEING, & FOR IMPREGNATING WICKS; MFR CEMENTS, CROCKERY, PORCELAIN, ENAMELS, GLASS, BORATES, LEATHER, CARPETS, HATS, SOAPS, ARTIFICIAL GEMS; IN PAINTING; PHOTOGRAPHY; ELECTRIC CONDENSERS, HARDENING STEEL [QC Reviewed] *The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 185*

11 Flux in soldering and brazing [QC Reviewed] *CONSIDINE. CHEMICAL AND PROCESS TECHNOL ENCYC 1974 p.177*

12 /USED AS/ BUFFER, & IT IS THIS USE THAT IS OFFICIALLY RECOGNIZED. [QC Reviewed] *Osol, A. (ed.). Remington's Pharmaceutical Sciences. 16th ed. Easton, Pennsylvania: Mack Publishing Co., 1980. 1257*

13 MEDICATION [QC Reviewed]

14 MEDICATION (VET) [QC Reviewed]

Consumption Patterns:

1 Textile-grade glass fibers, 35%; borosilicate glasses, 20%; fire retardants, 15%; enamels, fruits and glazes, 7%; metallurgy, 5%; adhesives, 3%; miscellaneous, 15% (1984) [Peer Reviewed] *CHEMICAL PRODUCTS SYNOPSIS: Boric Acid, 1984*

2 Principal uses for boron compounds consumed in the United States in 1988 were estimated

2 Principal uses for boron compounds consumed in the United States in 1988 were estimated to be glass products, 56%; soaps and detergents, 6%; agriculture, 4%; and other, 34% /Boron compounds/ [Peer Reviewed] *BUREAU OF MINES. MINERAL COMMODITY SUMMARIES 1989 P.28*

U.S. Production:

1 (1984) 1.26X10+11 g (est) [Peer Reviewed] *CHEMICAL PRODUCTS SYNOPSIS: Boric Acid, 1984*
2 (1972) 6.17X10+10 G [QC Reviewed] *SRI*
3 (1975) 6.81X10+10 G [QC Reviewed] *SRI*

U.S. Imports:

1 (1984) 7.03x10+9 g [Peer Reviewed] *BUREAU OF THE CENSUS. U.S. IMPORTS FOR CONSUMPTION AND GENERAL IMPORTS 1984 p.1-345*
2 (1986) 6 short tons [Peer Reviewed] *BUREAU OF MINES. MINERAL COMMODITY SUMMARIES 1989 P.28*
3 (1987) 2 short tons [Peer Reviewed] *BUREAU OF MINES. MINERAL COMMODITY SUMMARIES 1989 P.28*
4 (1986) 12.28x10+6 lb [Peer Reviewed] *BUREAU OF THE CENSUS. US IMPORTS FOR CONSUMPTION AND GENERAL IMPORTS 1986 P. 1-511*
5 (1985) 10 short tons [Peer Reviewed] *BUREAU OF MINES. MINERAL COMMODITY SUMMARIES 1989 P.28*

U.S. Exports:

1 (1984) 3.63X10+10 g [Peer Reviewed] *BUREAU OF THE CENSUS. U.S. EXPORTS, SCHEDULE E, 1984 p.2-88*
2 (1987) 5.95X10+4 content ton [Peer Reviewed] *BUREAU OF THE CENSUS. U. S. EXPORTS, SCHEDULE E, DECEMBER 1987, P.2-93*
3 (1975) 1.91X10+10 G [QC Reviewed] *SRI*
4 (1972) 1.72X10+11 G (PLUS SODIUM BORATES) [QC Reviewed] *SRI*

3.0 CHEMICAL AND PHYSICAL PROPERTIES

Color/Form: COLORLESS, TRANSPARENT CRYSTALS OR WHITE GRANULES OR POWDER [QC Reviewed] *The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 185*
Odor: ODORLESS [QC Reviewed] *The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 185*
Taste: Faintly bitter [Peer Reviewed] *Hayes, Wayland J., Jr. Pesticides Studied in Man. Baltimore/London: Williams and Wilkins, 1982. 62*
Boiling Point: 300 DEG C (LOSES 1 1/2 WATER) [Peer Reviewed] *Weast, R.C. (ed.) Handbook of Chemistry and Physics. 69th ed. Boca Raton, FL: CRC Press Inc., 1988-1989.,p. B-77*
Melting Point: 169 + or - 1 Deg C in transition to boric acid [Peer Reviewed] *Weast, R.C. (ed.) Handbook of Chemistry and Physics. 69th ed. Boca Raton, FL: CRC Press Inc., 1988-1989.,p. B-77*
Molecular Weight: 61.84 [QC Reviewed] *The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 185*
Density/Specific Gravity: 1.435 AT 15 DEG C [Peer Reviewed] *Weast, R.C. (ed.) Handbook of Chemistry and Physics. 69th ed. Boca Raton, FL: CRC Press Inc., 1988-1989.,p. B-77*
pH: 5.1 (0.1 MOLAR) [QC Reviewed] *The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 185*
Solubilities:

1 20 G/100 CC METHANOL AT 25 DEG C [Peer Reviewed] *Weast, R.C. (ed.) Handbook of Chemistry and Physics. 69th ed. Boca Raton, FL: CRC Press Inc., 1988-1989.,p. B-77*
2 1 G/18 ML COLD WATER [Peer Reviewed] *The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 185*
3 1.92 G/100 CC LIQ AMMONIA @ 25 DEG C [Peer Reviewed] *Weast, R.C. (ed.) Handbook of*

3 1.92 G/100 CC LIQ AMMONIA @ 25 DEG C [Peer Reviewed] *Weast, R.C. (ed.) Handbook of Chemistry and Physics. 69th ed. Boca Raton, FL: CRC Press Inc., 1988-1989.,p. B-77*
4 SLIGHTLY SOL IN ACETONE [Peer Reviewed] *Weast, R.C. (ed.) Handbook of Chemistry and Physics. 69th ed. Boca Raton, FL: CRC Press Inc., 1988-1989.,p. B-77*
5 1 G/4 ML BOILING WATER [Peer Reviewed] *Weast, R.C. (ed.) Handbook of Chemistry and Physics. 69th ed. Boca Raton, FL: CRC Press Inc., 1988-1989.,p. B-77*
6 1 G/6 ML ALCOHOL [Peer Reviewed] *Weast, R.C. (ed.) Handbook of Chemistry and Physics. 69th ed. Boca Raton, FL: CRC Press Inc., 1988-1989.,p. B-77*
7 1 G/4 ML GLYCEROL [Peer Reviewed] *Weast, R.C. (ed.) Handbook of Chemistry and Physics. 69th ed. Boca Raton, FL: CRC Press Inc., 1988-1989.,p. B-77*

Spectral Properties: INDEX OF REFRACTION: 1.337, 1.461, 1.462 [Peer Reviewed] *Weast, R.C. (ed.) Handbook of Chemistry and Physics. 69th ed. Boca Raton, FL: CRC Press Inc., 1988-1989.,p. B-77*
Other Chemical/Physical Properties:
1 SOLUBILITY IN WATER INCR BY HYDROCHLORIC, CITRIC OR TARTARIC ACIDS [Peer Reviewed] *Weast, R.C. (ed.) Handbook of Chemistry and Physics. 69th ed. Boca Raton, FL: CRC Press Inc., 1988-1989.,p. B-77*
2 SLIGHTLY UNCTUOUS TO TOUCH [QC Reviewed] *The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 185*

4.0 SAFETY AND HANDLING

FLAMMABLE PROPERTIES

Fire Potential:

Not flammable [Peer Reviewed] *U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5.*

HAZARDOUS REACTIONS

Reactivities and Incompatibilities:
1 During an attempt to make triacetyl borate, a mixture of boric acid and acetic anhydride exploded when heated to 58-60 deg C. [Peer Reviewed] *National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 9th ed. Boston, MA: National Fire Protection Association, 1986.,p. 491M-33*
2 A mixture of potassium and /boric acid/ ... may explode on impact ... [Peer Reviewed] *National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 9th ed. Boston, MA: National Fire Protection Association, 1986.,p. 491M-33*

WARNING PROPERTIES

Skin, Eye and Respiratory Irritations:
1 Irritant to skin in dry form. [Peer Reviewed] *Sax, N.I. and R.J. Lewis, Sr. (eds.). Hawley's Condensed Chemical Dictionary. 11th ed. New York: Van Nostrand Reinhold Co., 1987. 162*
2 ... May produce irritation of the nasal mucous membranes, the respiratory tract, and eyes. /Boron compounds/ [Peer Reviewed] *Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 1985. 2nd ed. Park Ridge, NJ: Noyes Data Corporation, 1985. 138*

PREVENTIVE MEASURES

Protective Equipment and Clothing:

/Wear/ chemical goggles [Peer Reviewed] *U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5.*

Other Preventative Measures:

1 Contact lenses should not be worn when working with this chemical. /Boron oxide/ [Peer Reviewed] *NIOSH. Pocket Guide to Chemical Hazards. 2nd Printing. DHHS (NIOSH) Publ. No. 85-114. Washington, D.C.: U.S. Dept. of Health and Human Services, NIOSH/Supt.of Documents, GPO, February 1987. 58*

2 SRP: The scientific literature for the use of contact lenses inindustry is conflicting. The benefit or detrimental effects of wearing contact lenses depend not only upon the substance, but also on factors including the form of the substance, characteristics and duration of the exposure, the uses of other eye protection equipment, and the hygiene of the lenses. However, there may be individual substances whose irritating or corrosive properties are such that the wearing of contact lenses would be harmful to the eye. In those specific cases, contact lenses should not bewom. In any event, the usual eye protection equipment should be worn even when contact lenses are in place. [Peer Reviewed]

3 Containers of boric acid should bear an autoclavable poison label. [QC Reviewed] *Gilman, A. G., L. S. Goodman, and A. Gilman. (eds.). Goodman and Gilman's The Pharmacological Basis of Therapeutics. 6th ed. New York: Macmillan Publishing Co., Inc. 1980. 971*

OTHER SAFETY AND HANDLING

Stability/Shelf Life:

1 ... stable up to 100 deg C [Peer Reviewed] *Hayes, Wayland J., Jr. Pesticides Studied in Man. Baltimore/London: Williams and Wilkins, 1982. 62*

2 STABLE IN AIR [QC Reviewed] *Osol, A. (ed.). Remington's Pharmaceutical Sciences. 16th ed. Easton, Pennsylvania: Mack Publishing Co., 1980. 1257*

Storage Conditions:

Preserve in well-closed containers. [Peer Reviewed] *USP Convention. The United States Pharmacopeia 21st Revision/The National Formulary 16th ed. Rockville, MD: United States Pharmacopeial Convention, Inc.,Jan. 1, 1985 (plus Supplements 1-6). 1537*

Disposal Methods:

SRP: At the time of review, criteria for land treatment or burial (sanitary landfill) disposal practices are subject to significant revision. Prior to implementing land disposal of waste residue (including waste sludge), consult with environmental regulatory agencies for guidance on acceptable disposal practices. [Peer Reviewed]

5.0 TOXICITY/BIOMEDICAL EFFECTS

SUMMARY

Antidote and Emergency Treatment:

TREATMENT IS PURELY SYMPTOMATIC. PLASMA VOL SHOULD BE MAINTAINED BY INFUSION OF COPIOUS AMT OF APPROPRIATE FLUID. [Peer Reviewed] *Goodman, L.S., and A. Gilman. (eds.) The Pharmacological Basis of Therapeutics. 5th ed. New York: Macmillan Publishing*

Co., Inc., 1975. 994

Medical Surveillance:

No specific considerations are needed for boric acid or borates except for general health and liver and kidney function. /Boric acid & borates/ [Peer Reviewed] *Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 1985. 2nd ed. Park Ridge, NJ: Noyes Data Corporation, 1985. 139*

TOXICITY EXCERPTS

Human Toxicity Excerpts:

1 WITH REPEATED APPLICATIONS OF THE POWDER TO ABRADED OR INFLAMED SKIN, SUFFICIENT AMT ... IS OR /MAY BE/ ABSORBED TO CAUSE ACUTE POISONING, ESP IN INFANTS. LETHAL AMT CAN BE ABSORBED FROM WOUND CAVITIES IRRIGATED WITH BORIC ACID SOLN. [Peer Reviewed] *Gilman, A. G., L. S. Goodman, and A. Gilman. (eds.). Goodman and Gilman's The Pharmacological Basis of Therapeutics. 6th ed. New York: Macmillan Publishing Co., Inc. 1980. 971*

2 CHRONIC INTOXICATION GIVES RISE TO ANOREXIA, ASTHENIA, CONFUSION, MENSTRUAL DISORDERS, & ALOPECIA. IT HAS OCCURRED FROM USE OF BORATE CONTAINING MOUTHWASHES. [Peer Reviewed] *Goodman, L.S., and A. Gilman. (eds.) The Pharmacological Basis of Therapeutics. 5th ed. New York: Macmillan Publishing Co., Inc., 1975. 994*

3 BORIC ACID POISONING BEGINS WITH NAUSEA, VOMITING AND DIARRHEA, REGARDLESS OF ROUTE OF ADMIN. THE BODY TEMP FALLS, & ERYTHEMATOUS RASH ... DEVELOPS. THIS IS FOLLOWED BY DESQUAMATION, NOT ONLY IN AREAS OF RASH BUT ALSO OF MUCOUS MEMBRANES. ... HEADACHE, RESTLESSNESS, & WEAKNESS ... RENAL INJURY ... DEATH RESULTS FROM CIRCULATORY COLLAPSE & SHOCK USUALLY WITHIN 5 DAYS. [Peer Reviewed] *Goodman, L.S., and A. Gilman. (eds.) The Pharmacological Basis of Therapeutics. 5th ed. New York: Macmillan Publishing Co., Inc., 1975. 994*

4 ... BORIC ACID MAY PRODUCE ... CYANOSIS, DELIRIUM, CONVULSIONS, & COMA. [Peer Reviewed] *American Hospital Formulary Service. Volumes I and II. Washington, DC: American Society of Hospital Pharmacists, to 1984.,p. 84:04*

5 VITAMIN B12 DETERMINED IN 14 PT, CHILDREN & ADULT AFTER BORIC ACID INGESTION. URINARY RIBOFLAVIN GREATLY INCR IN APPROX 2/3 OF PT. EVIDENCE OF INGESTION HAZARD IS PROVIDED. [Peer Reviewed] *PINTO J ET AL; J LAB CLIN MED 92 (1): 126-34 (1978)*

6 LETHAL DOSE ... EST TO BE 15-20 G IN ADULTS & 5-6 G IN INFANTS. [Peer Reviewed] *Goodman, L.S., and A. Gilman. (eds.) The Pharmacological Basis of Therapeutics. 5th ed. New York: Macmillan Publishing Co., Inc., 1975. 994*

7 Borax and boric acid used in powders and ointments have resulted in serious poisonings and death. [Peer Reviewed] *Seiler, H.G., H. Sigel and A. Sigel (eds.). Handbook on the Toxicity of Inorganic Compounds. New York, NY: Marcel Dekker, Inc. 1988. 135*

8 The fatal dose of boric acid, sodium borate, or sodium perborate is 0.1-0.5 g/kg. [Peer Reviewed] *Dreisbach, R.H. Handbook of Poisoning. 12th ed. Norwalk, CT: Appleton and Lange, 1987. 360*

9 Chronic boron poisoning ... syndrome usually is seen in children who have been treated in the past with a boric acid preparation for diaper rash. Cutaneous findings develop regardless of the route of poisoning. Renal toxicity includes oliguria, anuria, and renal tubular necrosis, which may supervene after several days. Hypothermia and hyperthermia may occur. Death is more common in infants than adults. [Peer Reviewed] *Ellenhorn, M.J. and D.G. Barceloux. Medical Toxicology - Diagnosis and Treatment of Human Poisoning. New York, NY: Elsevier Science Publishing Co., Inc. 1988. 922*

Science Publishing Co., Inc. 1988. 922

10 Four cases of nonfatal ingestion of boric acid were reported after two subjects (adult females) ingested 298 g of a 99% boric acid containing insecticide and 80 g of boric acid in a fungicide, respectively (presumably 1.0 and 0.28 g B/kg, respectively, for a 50 kg body weight). Ingested doses for the two other subjects were not fully specified. All four subjects recovered, and the two adults presented no systemic symptoms following release from the hospital. [Peer Reviewed] *Linden CH et al; Clin Toxicol 24: 269-79 (1986) as cited in USEPA; Health Advisory for Boron (Draft) p.6 (1988)*

11 Six male volunteers aged 30-58 years received single oral doses of boric acid. Three volunteers ingested 750 mg boric acid dissolved in 100 ml of water. Three other volunteers swallowed 24.95 g to 49.6 g of commercial water-emulsifing ointment containing 2.97% (wt/wt) boric acid. The accumulated mean 96 hour excretion was 93.9% of the dose after ingestion of the solution and 92.4% after ingestion of the ointment. The initial urinary excretion rate was generally lower after ingestion of the ointment than after ingestion of solution. More than 50% of the ingested dose was excreted within the first 24 hours post ingestion. No adverse health effects were reported for any of the individuals following a single ingestion of about 1.8 mg boron/kg during the 96 hour observation period. [Peer Reviewed] *Jansen JA et al; Food Chem Toxicol 22: 49-53 (1984) as cited in USEPA; Health Advisory for Boron (Draft) p.6 (1988)*

12 Application of boric acid powder for diaper rash /produced/ severe erythema of the skin, gastrointestinal symptoms and deaths in infants. [Peer Reviewed] *Goldbloom RB, Goldbloom A; J Pediat 43: 631-43 (1953) as cited in Baselt RC; Biological Monitoring Methods for Industrial Chemicals p. 50 (1980)*

13 Eleven infants accidentally ingested boric acid in their formula; from 2-4.5 g of the compound was ingested by six of the survivors, who developed serum borate levels of 20-150 mg/l, while the five infants who ingested larger amounts (4.5 - 14 g) exhibited levels of 200-1600 mg/l and died within 3 days. [Peer Reviewed] *Wong LC et al; Can Med Assoc J 90: 1018-23 (1964) as cited in Baselt RC; Biological Monitoring Methods for Industrial Chemicals p. 50-1 (1980)*

14 A transplacental distribution of boric acid in a human was reported when a 34-week pregnant female accidentally swallowed 70 g of boric acid (approximately 245 mg B/kg, 50 kg body weight). A fetus delivered 2 hours later by cesarean section died shortly afterward from cardiovascular failure. [Peer Reviewed] *Grella PB et al; Acta Anaesthesiol 27: 745-8 (1976) as cited in USEPA; Health Advisory for Boron (Draft) p.5 (1988)*

15 A mixture containing 3 g of boric acid and 300 mg of cinchocaine chloride prescribed due to painful dental protrusion was accidentally ingested by a 12 month old girl. She developed violent vomiting and coughing. Irritability, tremor, seizures and a delirious reaction. She was treated with diazepam, intubated, sedated and ventilated. Her diuresis was stimulated with furosemide and fluid. Within the first 24 hr she was treated with hemodialysis twice on femoral catheters. Her renal function was unaffected. In two days she fully recovered. The maximum measured levels of boric acid and cinchocaine chloride approximately 6 hr after ingestion were 26 ug/ml and 71 ng/ml respectively. The plasma half-life of boric acid was 7.0 hr and decreased to 3.6 and 4.4 hr during the two hemodialyses. The total body clearance of boric acid increased correspondingly from 21 ml/min to 41 and 34 ml/min. The in vitro clearance of boric acid of the dialyser was later determined to be 18 ml/min. It is concluded that hemodialysis is valuable in the treatment of boric acid intoxication because it increases the elimination of the drug even in patients without any sign of renal toxicity. [Peer Reviewed] *Egfjord M et al; Hum Toxicol 7 (2): 175-8 (1988)*

16 113 workers exposed to these dusts and 214 unexposed workers were interviewed regarding symptoms. Statistically significant associations were found between eye irritation, dryness of the mouth or throat, sore throat and productive cough, on the one hand, and mean exposures of 4.1 mg/cu m, on the other. The study indicates that exposures to boric acid at concentrations <10 mg/cu m are associated with irritation of the eyes and upper respiratory tract. [Peer Reviewed] *Garabrant DH; J Occup Med 26 (8): 584-86 (1984)*

17 A retrospective chart review was conducted at two regional poison centers to determine the clinical outcome of boric acid ingestions and to assess the relationship between serum boric

17
clinical outcome of boric acid ingestions and to assess the relationship between serum boric acid levels and clinical presentation. A total of 784 cases were studied; all but 2 were acute ingestions. No patients developed severe manifestations of toxicity, and 88.3% were entirely asymptomatic. The most common symptoms were vomiting, abdominal pain, and diarrhea. Lethargy, headache, lightheadedness, and atypical rash were seen less frequently. Boric acid levels were obtained in 51 patients and ranged from 0 to 340 ug/ml. Blood levels were 70 ug/ml or more in 7 patients; 4 remained asymptomatic, whereas the other 3 had nausea or vomiting. Dialysis was performed in 4 of these patients, only 1 of whom had symptoms (vomiting). On the basis of data from 9 patients, the mean half-life of boric acid was determined to be 13.4 hours (range, 4.0 to 27.8). Hemodialysis in 3 patients significantly shortened the half-life compared with pre- and postdialysis half-lives. Results suggest that acute boric acid ingestions produce minimal or no toxicity and that aggressive treatment is not necessary in most patients. [Peer Reviewed] *Litovity TL et al; Am J Emerg Med 6 (3): 209-13 (1988)*

18 Boric acid and its derivatives have been shown to promote riboflavinuria in both animals and man. Boric acid complexes with the polyhydroxyl ribitol side chain of riboflavin and greatly increases its water solubility. Individuals who have accidentally consumed boric acid or one of its derivatives excrete high levels of riboflavin within the first 24 to 48 hours following ingestion. The administration of certain agents, either therapeutic or toxic, which enhance urinary ribovlavin excretion may be of particular concern for high-risk patients who are already nutritionally compromised because of illness or disease. [Peer Reviewed] *Pinto JT, Rivlin S; Drug Nutr Interact 5 (3): 143-51 (1987)*

19 Symptomatology: 1. Nausea, vomiting, diarrhea, epigastric pain. ... Vomitus & feces may contain blood, hemorrhagic gastroenteritis may develop ... 2. Weakness, lethargy, headache, restlessness, tremors, & ... convulsions with ... CNS depression. 3. Erythematous skin eruptions ... followed by extensive exfoliation. 4. Shock syndrome, cold clammy skin, cyanosis, thready pulse, & low blood pressure. 5. Occasionally kidney injury (oligura, albuminuria, anuria) & rarely liver damage (hepatomegaly, jaundice) ... reported; former may be cause of death. ... 6. Metabolic acidosis & signs of intravascular coagulation ... 7. ... Fever ... described in absence of recognized intercurrent infection. 8. Death is due to vascular collapse in the early stages or to CNS depression later in the course ... Bronchopneumonia, meningitis, and other terminal infections have been described. /Borate/ [Peer Reviewed] *Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, 1984.,p. III-67*

20 INFANTS & YOUNG CHILDREN ARE THOUGHT TO BE MORE SUSCEPTIBLE TO BORATE INTOXICATION THAN ARE ADULTS. ... IN STUDY OF OVER 100 CASES OF ACCIDENTAL POISONING, OVERALL FATALITY RATE WAS 55%, BUT IN INFANTS UNDER 1 YR OF AGE, 70% OF CASES ENDED FATALLY. DEATH MAY OCCUR IN FEW HR BUT IS USUALLY DELAYED SEVERAL DAYS. /BORATE/ [Peer Reviewed] *Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, 1984.,p. III-67*

21 ACUTE POISONING HAVE FOLLOWED INGESTION, PARENTERAL INJECTION, ENEMAS, LAVAGE OF SEROUS CAVITIES, & APPLICATION OF POWDERS & OINTMENTS TO BURNED & ABRADED SKIN. /BORATE/ [Peer Reviewed] *Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, 1984.,p. III-67*

22 ONCE A TETRA-, DI-, META-, ORTHO-, OR PYROBORATE SALT DISSOLVES IN A BUFFERED SOLN, ONE BORATE CANNOT BE DISTINGUISHED ON CHEMICAL OR TOXICOLOGICAL GROUNDS, FROM ANY ONE OF THE OTHERS. /BORATE/ [Peer Reviewed] *Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, 1984.,p. II-118*

23 In chronic poisoning with low levels of ingestion, there may be little more than dry skin and mucous membranes, followed by appearance of a red tongue, patchy alopecia, cracked lips, conjunctivitis, and sometimes periorbital edema and irritability. /Borates/ [Peer Reviewed] *Haddad, L.M. and Winchester, J.F. Clinical Management of Poisoning and Drug*

Haddad, L.M. and Winchester, J.F. Clinical Management of Poisoning and Drug Overdosage. Philadelphia, PA: W.B. Saunders Co., 1983. 931

24 Chronic poisoning: (From ingestion, skin absorption, or absorption from body cavities or mucous membranes) prolonged absorption causes anorexia, weight loss, vomiting, mild diarrhea, skin rash, alopecia, convulsions and anemia. /Boric acid & boron derivatives/ [Peer Reviewed] *Dreisbach, R.H. Handbook of Poisoning. 12th ed. Norwalk, CT: Appleton and Lange, 1987. 361*

25 BECAUSE HIGHEST CONCN ARE REACHED DURING EXCRETION, THE KIDNEYS ARE MORE SERIOUSLY DAMAGED THAN OTHER ORGANS. /BORIC ACID & BORON DERIVATIVES/ [Peer Reviewed] *Dreisbach, R.H. Handbook of Poisoning. 12th ed. Norwalk, CT: Appleton and Lange, 1987. 360*

Non-Human Toxicity Excerpts:

1 ... MANY INSTANCES ... OF ACCIDENTAL POISONING ... MOST OF THE FATALITIES HAVE OCCURRED IN YOUNG ANIMALS. ... SIGNS OF BORIC ACID POISONING ARE NAUSEA, VOMITING, DIARRHEA ... INCLUDE SHOCK & ULTIMATELY COLLAPSE. MUSCULAR & NERVOUS DISTURBANCES LEADING TO CONVULSIONS & GENERAL PARALYSIS ... THE USUAL POST-MORTEM FINDINGS ARE INFLAMMATION OF THE ALIMENTARY TRACT, TOXIC DEGENERATIVE CHANGES IN THE LIVER & KIDNEYS, & CEREBRAL EDEMA. [Peer Reviewed] *Clarke, M. L., D. G. Harvey and D. J. Humphreys. Veterinary Toxicology. 2nd ed. London: Bailliere Tindall, 1981. 36*

2 IN ANIMALS CHRONIC POISONING HAS SHOWN ITSELF ONLY IN INHIBITION OF GROWTH WHEN BORIC ACID WAS GIVEN IN AMT OF 0.25% IN DRINKING WATER. THERE WERE NO ... LESIONS AT AUTOPSY & NO CHANGES IN PERIPHERAL BLOOD. [Peer Reviewed] *Browning, E. Toxicity of Industrial Metals. 2nd ed. New York: Appleton-Century-Crofts, 1969. 92*

3 BORIC ACID CAUSED HYPERTHERMIA IN LAB ANIMALS. [Peer Reviewed] *PHAM HUU CHANH ET AL; AGRESSOLOGIE 15 (1): 61-72 (1974)*

4 ... rumplessness, curled toe and facial palate defects /were observed/ in chicks /after/ injections of 2.5 mg. Rumplessness was common following treatment at 24 hr incubation while the facial and palate defects appear after treatment at 4 days. ... boric acid is metabolized differently when the rat becomes pregnant. The chemical begins to appear first in the spinal fluid. ... Boric acid or borax /given/ to pregnant rats at 350 ppm ... during pregnancy /produced no reduction in liveborn nor physical defects/. [Peer Reviewed] *Shepard, T.H. Catalog of Teratogenic Agents. 5th ed. Baltimore, MD: The Johns Hopkins University Press, 1986. 75*

5 Chronic, 2 yr dietary feeding in dogs and rats showed that boric acid was tolerated at 2000 ppm (350 ppm boron equivalent). Rats fed 1170 ppm levels (boron equivalent) showed growth depression, decreased food utilization efficiency, degeneration of gonads, and skin desquamation. ... Testicular degeneration occurred in both dogs and rats at this level, and rats became sterile ... but at 2000 ppm, there was no adverse effect on fertility, lactation, litter size, weight, and appearance. [Peer Reviewed] *Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 2985*

6 A 2 year toxicology and carcinogenesis study was conducted by feeding diets containing boric acid at concentrations of 0, 2,500, or 5,000 ppm to groups of 50 male and 50 female mice. .. Body weight gain was reduced in each sex after week 30; mean final body weights were 7% and 13% below control values for exposed male mice and 7% and 20% below those of controls for exposed female mice. No chemically related clinical signs were reported. At top dose, boric acid caused an increased incidence of testicular atrophy (control, 3/49; low dose, 6/50; high dose, 27/47) and interstitial cell hyperplasia (0/49;0/50;7/47) in male mice. The testicular atrophy was characterized by variable loss of spermatogonia, primary and secondary spermatocytes, spermatids, and spermatozoa from the seminiferous tubules. The seminiferous tubules contained primarily Sertoli cells and variable numbers of spermatogonia. In some mice, there were accumulations of interstitial cells, indicating hyperplasia. Under the conditions of these 2-year feed studies, there was no evidence of

hyperplasia. Under the conditions of these 2-year feed studies, there was no evidence of carcinogenicity of boric acid at doses of 2,500 or 5,000 ppm for male or female B6C3F1 mice. Testicular atrophy and interstitial cell hyperplasia were observed in high dose male mice. The decrease in survival of dosed male mice may have reduced the sensitivity of this study. [Peer Reviewed] *NTP; Toxicology and Carcinogenesis Studies of Boric Acid p.3 Report# 324 (1987) NIH Pub# 88-2580*

7 In rats, high boron levels at 1750 and 5250 ppm of borax and boric acid administered orally caused growth suppression, decreased food utilization efficiency, degeneration of gonads, and skin desquamation on the paws and tails. Both cmpd could be tolerated by rats and dogs at 350 ppm for two years. Rats fed either borax or boric acid at 1170 ppm were sterile, and testicular degeneration was observed in both rats and dogs fed this dosage. Both cmpd at 350 ppm had no adverse effect on fertility, lactation, litter size, weight, and appearance. [Peer Reviewed] *Weir RJ, Fisher RS; Toxicol Appl Pharmacol 23 (3): 351-64 (1972)*

8 Adult male German cockroaches were exposed to surface deposits of insecticides for 5 min in the central compartment of a three-compartment choice chamber illuminated at one end. They were then allowed access to the escape compartments and their distribution recorded over the subsequent 60 min. ... Boric acid deposits inhibited the movement of the cockroaches away form the light source. [Peer Reviewed] *Miall SM, Le Patourel GNJ; Pestic Sci 25 (1): 43-52 (1989)*

9 Twenty-six cows died after accidental exposure to boron fertilizer. Cows developed diarrhea, weakness, ataxia, signs of depression, and died, usually within a few hours. Seizure-like behavior was noticed in two cows, and two were suspected of aborting. High boron concentrations in tissues from affected cows confirmed ingestion of an appreciable amount of boron fertilier. In an attempt to confirm the diagnosis of boron poisoning, boron fertilizer was administered to goats. A kid goat given 3.6 g of fertilizer/kg of body weight developed clinical signs similar to those seen in the cattle. Boron compounds such as sodium borate and boric acid have been considered generally nontoxic, and reports of livestock toxicosis are uncommon. This case report suggests that these compounds may be palatable under certain circumstances leading to ingestion of toxic quantities. [Peer Reviewed] *Sisk DB et al; J Am Vet Med Assoc 193 (8): 943-5 (1988)*

10 The mutagenicity of borax and boric acid was examined in Salmonella typhimurium strains TA98 and TA100 by the preincubation method. No mutagenic activity of borax or boric acid was observed with or without S-9 rat liver enzymes. Experiments also were conducted to investigate the enhancement or inhibition of benzo(a)pyrene mutagenicity by the 2 compounds. Neither borax nor boric acid had any effect on the response of Salmonella typhimurium test to benzo(a)pyrene. [Peer Reviewed] *Benson WH et al; Environ Toxicol Chem 3 (2): 209-14 (1984)*

11 ... BORATES INDUCE RIBOFLAVIN DEPLETION IN SEVERAL ANIMAL SPECIES ... /BORATE/ [Peer Reviewed] *Gosselin, R.E., H.C. Hodge, R.P. Smith, and M.N. Gleason. Clinical Toxicology of Commercial Products. 4th ed. Baltimore: Williams and Wilkins, 1976.,p. II-82*

12 IN LAMBS, GI & PULMONARY DISORDERS HAVE BEEN REPORTED TO RESULT FROM GRAZING WHERE PASTURE SOILS ARE HIGH IN BORON CONTENT. /BORON AND ITS COMPOUNDS/ [Peer Reviewed] *Doull, J., C.D. Klaassen, and M. D. Amdur (eds.). Casarett and Doull's Toxicology. 2nd ed. New York: Macmillan Publishing Co., 1980. 440*

13 Chronic feeding to rats and dogs leads to accumulation in the testes, germ cell depletion and testicular atrophy. /Borate/ [Peer Reviewed] *Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, 1984.,p. III-67*

TOXICITY VALUES

Human Toxicity Values:

LD 37 mg boron/Kg as boric acid (ingestion); 210 mg boron/Kg as boric acid (dermal: infant) [Peer

LD 37 mg boron/Kg as boric acid (ingestion); 210 mg boron/Kg as boric acid (dermal: infant) [Peer Reviewed] *Nat'l Research Council Canada; Data Sheets On Selected Toxic Elements, p. 24 (1982) NRCC No. 19252*

Non-Human Toxicity Values:

1 LD Guinea pig 175 mg boron/Kg as boric acid (ingestion). [Peer Reviewed] *Nat'l Research Council Canada; Data Sheets On Selected Toxic Elements, p. 23 (1982) NRCC No. 19252*
2 LD50 Rat 900 mg B/kg [Peer Reviewed] *USEPA; Health Advisory for Boron (Draft) p.7 (1988)*
3 LD50 Mouse 466 mg B/kg [Peer Reviewed] *USEPA; Health Advisory for Boron (Draft) p.7 (1988)*

Ecotoxicity Values:

1 LC50 TROUT 100 PPM (SOFT WATER; EXPOSURE WAS INITIATED SUBSEQUENT TO FERTILIZATION & MAINTAINED THROUGH 4 DAYS POSTHATCHING) /CONDITIONS OF BIOASSAY NOT SPECIFIED/ [Peer Reviewed] *BIRGE WJ, BLACK JA; SENSITIVITY OF VERTEBRATE EMBRYOS TO BORON COMPOUNDS p. 1-77 (1977) NTIS# PB-267085*
2 LC50 TROUT 79 PPM (HARD WATER; EXPOSURE WAS INITIATED SUBSEQUENT TO FERTILIZATION & MAINTAINED THROUGH 4 DAYS POSTHATCHING) /CONDITIONS OF BIOASSAY NOT SPECIFIED/ [Peer Reviewed] *BIRGE WJ, BLACK JA; SENSITIVITY OF VERTEBRATE EMBRYOS TO BORON COMPOUNDS p. 1-77 (1977) NTIS# PB-267085*
3 LC50 CATFISH 155 PPM (SOFT WATER; EXPOSURE WAS INITIATED SUBSEQUENT TO FERTILIZATION & MAINTAINED THROUGH 4 DAYS POSTHATCHING) /CONDITIONS OF BIOASSAY NOT SPECIFIED/ [Peer Reviewed] *BIRGE WJ, BLACK JA; SENSITIVITY OF VERTEBRATE EMBRYOS TO BORON COMPOUNDS p. 1-77 (1977) NTIS# PB-267085*
4 LC50 CATFISH 22 PPM (HARD WATER; EXPOSURE WAS INITIATED SUBSEQUENT TO FERTILIZATION & MAINTAINED THROUGH 4 DAYS POSTHATCHING) /CONDITIONS OF BIOASSAY NOT SPECIFIED/ [Peer Reviewed] *BIRGE WJ, BLACK JA; SENSITIVITY OF VERTEBRATE EMBRYOS TO BORON COMPOUNDS p. 1-77 (1977) NTIS# PB-267085*
5 LC50 GOLDFISH 46 PPM (SOFT WATER; EXPOSURE WAS INITIATED SUBSEQUENT TO FERTILIZATION & MAINTAINED THROUGH 4 DAYS POSTHATCHING) /CONDITIONS OF BIOASSAY NOT SPECIFIED/ [Peer Reviewed] *BIRGE WJ, BLACK JA; SENSITIVITY OF VERTEBRATE EMBRYOS TO BORON COMPOUNDS p. 1-77 (1977) NTIS# PB-267085*
6 LC50 GOLDFISH 75 PPM (HARD WATER; EXPOSURE WAS INITIATED SUBSEQUENT TO FERTILIZATION & MAINTAINED THROUGH 4 DAYS POSTHATCHING) /CONDITIONS OF BIOASSAY NOT SPECIFIED/ [Peer Reviewed] *BIRGE WJ, BLACK JA; SENSITIVITY OF VERTEBRATE EMBRYOS TO BORON COMPOUNDS p. 1-77 (1977) NTIS# PB-267085*
7 LC50 Daphnia magna 133 (115-153) mg/l/48 hr /Static bioassay/ [Peer Reviewed] *Gersich FM; Environ Toxicol Chem 3 (1): 89-94 (1984)*

PHARMACOKINETICS

Absorption, Distribution and Excretion:

1 BORIC ACID IS READILY ABSORBED FROM GI TRACT, SEROUS CAVITIES, & ABRADED OR INFLAMED SKIN. IT DOES NOT PENETRATE INTACT SKIN. APPROX 50% OF GIVEN DOSE IS EXCRETED WITHIN 24 HR. DURING CHRONIC ADMIN, PLATEAU IN URINARY EXCRETION IS REACHED ONLY AFTER 2 WK. ... LARGE AMT OF BORIC ACID ARE LOCALIZED IN BRAIN, LIVER, & KIDNEY. ... INTRACYTOPLASMIC INCLUSIONS IN PANCREAS /HAVE BEEN NOTED/ IN FATAL CASES. [Peer Reviewed] *Goodman, L.S., and A. Gilman. (eds.) The Pharmacological Basis of Therapeutics. 5th ed. New York: Macmillan Publishing Co., Inc., 1975. 995*
2 SLOW EXCRETION ... CONTRIBUTES TO CUMULATION ... [Peer Reviewed] *Goodman, L.S., and A. Gilman. (eds.) The Pharmacological Basis of Therapeutics. 5th ed. New York: Macmillan Publishing Co., Inc., 1975. 994*
3 By studies in adult volunteers who were heavily exposed to 5% solution or to 10% boric acid ointment, they showed by analysis of the urine that no detectable boron was absorbed from

3 ointment, they showed by analysis of the urine that no detectable boron was absorbed from the intact skin. [Peer Reviewed] *Hayes, Wayland J., Jr. Pesticides Studied in Man. Baltimore/London: Williams and Wilkins, 1982. 62*

4 A single oral dose of 750 mg of boric acid was administered to each of six human volunteers. At least 93.9% of the dose was absorbed from the gatrointestinal tract, as measured by the recovery of boric acid in urine after 96 hours. [Peer Reviewed] *USEPA; Health Advisory for Boron (Draft) p.3 (1988)*

5 Eight male volunteers aged 22-28 years were infused intravenously with boric acid in sterile water (21 mg/ml) over 20 minutes. Urinary excretion of boron was 98.7% of the dose in 120 hours after treatment. This indicated nearly complete excretion of boron with no tendency for tissue accumulation. None of the volunteers registered any discomfort following iv infusion of boric acid solution. [Peer Reviewed] *Jansen JA et al; Arch Toxicol 55: 64-7 (1984) as cited in USEPA; Health Advisory for Boron (Draft) p.6 (1988)*

6 Using an in vitro technique it has been demonstrated that water emulsifying and hydrophobic ointments containing boric acid liberate only minute amounts (1-6%) within 24 hr compared with the nearly total liberation from a jelly. When an amount of boric acid containing ointment is swallowed, the absorption is only slightly delayed compared with a similar intake when dissolved in water, and in both cases nearly total excretion is found in the urine within 96 hr. The half-life is 21 hr (mean 7 adult men). The pharmacokinetics rule out the risk of cumulative poisoning with topical preparations containing low amounts of boric acid. The use of water emulsifying ointments containing up to 3% boric acid should be safe, even for repeated daily use in the napkin region. [Peer Reviewed] *Schou JS et al; Arch Toxicol Suppl 7: 232-5 (1984)*

7 Six male volunteers aged 30-58 years received single oral doses of boric acid. Three volunteers ingested 750 mg boric acid dissolved in 100 ml of water. Three other volunteers swallowed 24.95 g to 49.6 g of commercial water-emulsifing ointment containing 2.97% (wt/wt) boric acid The accumulated mean 96 hour excretion was 93.9% of the dose after ingestion of the solution and 92.4% after ingestion of the ointment. The initial urinary excretion rate was generally lower after ingestion of the ointment than after ingestion of solution. More than 50% of the ingested dose was excreted within the first 24 hr post-ingestion. No adverse health effects were reported for any of the individuals following a single ingestion of about 1.8 mg boron/kg during the 96 hour observation period. [Peer Reviewed] *Jansen JA et al; Food Chem Toxicol 22: 49-53 (1984) as cited in USEPA; Health Advisory for Boron (Draft) p.6 (1988)*

8 VAPORS /OF BORON HYDRIDES/ ARE ABSORBED BY LUNG, LIQUIDS OR DISSOLVED BORANES BY SKIN AND IN ANY FORM FROM DIGESTIVE TRACT. /BORON HYDRIDES/ [Peer Reviewed] *Thienes, C., and T.J. Haley. Clinical Toxicology. 5th ed. Philadelphia: Lea and Febiger, 1972. 202*

9 BORATES ARE RAPIDLY ABSORBED FROM MUCOUS MEMBRANES & ABRADED SKIN, BUT NOT FROM INTACT OR UNBROKEN SKIN. ... BORATE EXCRETION OCCURS MAINLY THROUGH KIDNEYS; ABOUT HALF IS EXCRETED IN 1ST 12 HR, & REMAINDER IS ELIMINATED OVER PERIOD OF 5 TO 7 DAYS. /BORATE/ [Peer Reviewed] *Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, 1984.,p. III-67*

Metabolism/Metabolites:

Boric acid is excreted unchanged in the urine. [QC Reviewed] *Hayes, Wayland J., Jr. Pesticides Studied in Man. Baltimore/London: Williams and Wilkins, 1982. 62*

Interactions:

1 BORIC ACID ENHANCED ACTION OF HYPNOTICS, BUT DEVOID OF ACTIVITY ITSELF. [Peer Reviewed] *PHAM HUU CHANH ET AL; AGRESSOLOGIE 15 (1): 61-72 (1974)*

2 The usefulness of N-acetylcysteine (NAC) as a chelating agent was studied for ... boric acid. Mature Sprague-Dawley rats were intoxicated; urinary excretion rates of intoxicant and total

Mature Sprague-Dawley rats were intoxicated; urinary excretion rates of intoxicant and total urine volume were determined during treatment. N-acetylcysteine proved to be the most effective agent at increasing the excretion of boron and was also able to reverse the oliguria associated with this chemical. [Peer Reviewed] *Banner W JR et al; Toxicol Appl Pharmacol 83 (1): 142-47 (1986)*

6.0 PHARMACOLOGY

Therapeutic Uses:

1 /Former use:/ The substance is included in rectal suppositories for hemorrhoids ... [Peer Reviewed] *Gilman, A. G., L. S. Goodman, and A. Gilman. (eds.). Goodman and Gilman's The Pharmacological Basis of Therapeutics. 6th ed. New York: Macmillan Publishing Co., Inc. 1980. 971*

2 Aqueous solutions of boric acid are used topically for ophthalmic irrigation to relieve tired or irritated eyes. [Peer Reviewed] *American Hospital Formulary Service-Drug Information 88. Bethesda, MD: American Society of Hospital Pharmacists, 1988 (Plus supplements). 1527*

3 Boric acid, borates and perborates have been used as mild antiseptics or bacteriostats in eyewashes, mouthwashes, burn dressings, and diaper rash powders; however, the effectiveness of boric acid has largely been discredited. [Peer Reviewed] *Seiler, H.G., H. Sigel and A. Sigel (eds.). Handbook on the Toxicity of Inorganic Compounds. New York, NY: Marcel Dekker, Inc. 1988. 131*

4 Boric acid ... /has been used/ medically as eye washes and as lotions and dressing on the skin without inducing local injury. ... Disturbances of vision ... observed in patients who had been poisoned by boric acid used as a wash or dressing for wounds. These disturbances were ... decrease of visual acuity to half normal, plus diplopia lasting for more than two weeks. [Peer Reviewed] *Grant, W.M. Toxicology of the Eye. 3rd ed. Springfield, IL: Charles C. Thomas Publisher, 1986. 150*

5 Astringent, antiseptic [Peer Reviewed] *The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 185*

6 MEDICATION (VET): ANTIBACTERIAL, ANTIFUNGAL AGENT; USED CHIEFLY IN AQUEOUS SOLN OR POWDERS FOR EXTERNAL USE. [QC Reviewed] *The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 185*

7 AS PRESERVATIVE IN OPHTHALMIC SOLN ... RETARDS GROWTH OF FUNGI BUT IS NOT BACTERICIDAL. ... 2% SOLN (PH 4.6) IS USEFUL VEHICLE FOR ALKALOIDAL DRUGS ... [QC Reviewed] *American Hospital Formulary Service-Drug Information 88. Bethesda, MD: American Society of Hospital Pharmacists, 1988 (Plus supplements). 1527*

8 IT IS NOW USUALLY COLORED TO PREVENT ERROR. ... MOST HOSPITALS LIMIT USE ... TO OPHTHALMIC OINTMENT. ... FEW COMMERCIAL DERMATOLOGICAL PREPN CONTAIN ... BORIC ACID TODAY. [QC Reviewed] *Gilman, A. G., L. S. Goodman, and A. Gilman. (eds.). Goodman and Gilman's The Pharmacological Basis of Therapeutics. 6th ed. New York: Macmillan Publishing Co., Inc. 1980. 971*

Drug Warning:

... The chronic use of boric acid in rectal suppositories and in vaginal deodorants carries the risk of intoxication. [Peer Reviewed] *Gilman, A. G., L. S. Goodman, and A. Gilman. (eds.). Goodman and Gilman's The Pharmacological Basis of Therapeutics. 6th ed. New York: Macmillan Publishing Co., Inc. 1980. 971*

7.0 ENVIRONMENTAL FATE/EXPOSURE POTENTIAL

POLLUTION SOURCES

Natural Occurring Sources:

1 Boron is widely distributed in the environment. ... Borax, kernite, and tourmaline are three of

1 Boron is widely distributed in the environment. ... Borax, kernite, and tourmaline are three of the more commonly mined boron minerals. /Boron/ [Peer Reviewed] *Seiler, H.G., H. Sigel and A. Sigel (eds.). Handbook on the Toxicity of Inorganic Compounds. New York, NY: Marcel Dekker, Inc. 1988. 130*
2 High levels of boron are most likely to occur in soil derived from marine sediments and arid soils. /Total boron/ [Peer Reviewed] *Brown, K.W., G. B. Evans, Jr., B.D Frentrup (eds.). Hazardous Waste Land Treatment. Boston, MA: Butterworth Publishers, 1983. 211*
3 OCCURS IN NATURE AS THE MINERAL SASSOLITE. [QC Reviewed] *The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 185*

ENVIRONMENTAL TRANSPORT

Soil Adsorption/Mobility:

Some boron is adsorbed by iron and aluminum hydroxy compounds and clay minerals. Finer textured soils retain added boron longer than do coarse, sandy soils. ... Boron sorption by clay minerals and iron and aluminum oxides is pH dependent, with maximum sorption in the range 7-9. The amount of boron adsorbed depends on the surface area of the clay or oxide and this sorption is only partially reversible ... /Boron/ [Peer Reviewed] *Brown, K.W., G. B. Evans, Jr., B.D. Frentrup (eds.). Hazardous Waste Land Treatment. Boston, MA: Butterworth Publishers, 1983. 211*

ENVIRONMENTAL CONCENTRATIONS

Water Concentrations:

1 Sea water: Boron is widely distributed in the environment ... 4.5 ug/g in ocean waters ... /Total boron/ [Peer Reviewed] *Seiler, H.G., H. Sigel and A. Sigel (eds.). Handbook on the Toxicity of Inorganic Compounds. New York, NY: Marcel Dekker, Inc. 1988. 130*
2 Surface water: Boron is widely distributed in the environment ... about 0.01 ug/g in freshwater. /Total boron/ [Peer Reviewed] *Seiler, H.G., H. Sigel and A. Sigel (eds.). Handbook on the Toxicity of Inorganic Compounds. New York, NY: Marcel Dekker, Inc. 1988. 130*

Sediment/Soil Concentrations:

Boron is widely distributed in the environment ... concn average 3-10 ug/g in soil ... /Total boron/ [Peer Reviewed] *Seiler, H.G., H. Sigel and A. Sigel (eds.). Handbook on the Toxicity of Inorganic Compounds. New York, NY: Marcel Dekker, Inc. 1988. 130*

Food Survey Values:

Most foods contain less the 6 ug boron/g, with many ... less than 0.5 ug B/g. Individual foods may contain more than 20 ug B/g. [Peer Reviewed] *Seiler, H.G., H. Sigel and A. Sigel (eds.). Handbook on the Toxicity of Inorganic Compounds. New York, NY: Marcel Dekker, Inc. 1988. 130*

HUMAN EXPOSURE

Average Daily Intake:

Total daily boron intake in normal human diets ranges from 2.1-4.3 mg boron/kg body weight (bw)/day. /Total boron/ [Peer Reviewed] *Zook EG, Lehman J; J Assoc Off Agric Chem 48: 850-5 (1965)*

Body Burdens:

Body Burdens:

1 In serum (children): Conventional reference range: < 7 mg/l; international recommended reference range: < 119 umol/l /From table, borate/ [Peer Reviewed] *Tietz, N.W. (ed.). Clinical Guide to Laboratory Tests. Philadelphia, PA: W.B. Saunders Co., 1983. 88*

2 In serum (male adult): Conventional reference range: < 2 mg/l; international recommended reference range: < 34 umol/l /From table, borate/ [Peer Reviewed] *Tietz, N.W. (ed.). Clinical Guide to Laboratory Tests. Philadelphia, PA: W.B. Saunders Co., 1983. 88*

3 In serum (toxic concn): Conventional reference range: > 20 mg/l; international recommended reference range: > 340 umol/l /From table, borate/ [Peer Reviewed] *Tietz, N.W. (ed.). Clinical Guide to Laboratory Tests. Philadelphia, PA: W.B. Saunders Co., 1983. 88*

8.0 EXPOSURE STANDARDS AND REGULATIONS

STANDARDS AND REGULATIONS

Allowable Tolerances:

1 Boric acid is exempted from the requirement of a tolerance when used as a sequestrant in accordance with good agricultural practice as inert (or occasionally active) ingredients in pesticide formulations applied to growing crops only. [Peer Reviewed] *40 CFR 180.1001(d) (7/1/88)*

2 Tolerances for total boron, calculated as elemental boron, are established as follows: 8 ppm in or on citrus fruits to cover residues from postharvest application of the fungicides borax & boric acid .... [Peer Reviewed] *40 CFR 180.271 (7/1/88)*

OCCUPATIONAL PERMISSIBLE LEVELS

Other Occupational Permissible Levels:

1-5 mg/cu m (USSR) /Borates/ [Peer Reviewed] *Seiler, H.G., H. Sigel and A. Sigel (eds.). Handbook on the Toxicity of Inorganic Compounds. New York, NY: Marcel Dekker, Inc. 1988. 136*

OTHER STANDARDS AND REGULATIONS

Federal Drinking Water Guidelines: EPA 600 ug/l /Boron/ *USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee (FSTRAC). Summary of State and Federal Drinking Water Standards and Guidelines (11/93)*

State Drinking Water Guidelines:

1 (ME) MAINE 620 ug/l /Boron/ *USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee (FSTRAC). Summary of State and Federal Drinking Water Standards and Guidelines (11/93)*

2 (MN) MINNESOTA 600 ug/l /Boron/ *USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee (FSTRAC). Summary of State and Federal Drinking Water Standards and Guidelines (11/93)*

3 (CA) CALIFORNIA 1000 ug/l /Boron/ *USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee (FSTRAC). Summary of State and Federal Drinking Water Standards and Guidelines (11/93)*

FIFRA Requirements:

1 Boric acid is exempted from the requirement of a tolerance when used as a sequestrant in accordance with good agricultural practice as inert (or occasionally active) ingredients in

accordance with good agricultural practice as inert (or occasionally active) ingredients in pesticide formulations applied to growing crops only. [Peer Reviewed] *40 CFR 180.1001(d) (7/1/88)*

2 Tolerances for total boron are established in or on citrus fruits to cover residues from postharvest application of the fungicides borax & boric acid .... [Peer Reviewed] *40 CFR 180.271 (7/1/88)*

FDA Requirements:

1 Boric acid is an indirect food additive for use only as a component of adhesives. [Peer Reviewed] *21 CFR 175.105 (4/1/88)*

2 Boric acid is used in the manufacture of paper and paperboard products used in food packaging for use in adhesives, sizes, and coatings. [Peer Reviewed] *21 CFR 181.30 (4/1/88)*

9.0 MONITORING AND ANALYSIS METHODS

Analytical Laboratory Methods:

1 EPA Method 200.7: An Inductively Coupled Plasma - Atomic Emission Spectrophotmetric method for the determination of dissolved, suspended, or total elements in drinking water, surface water, and domestic and industrial wastewaters, is described. Boron is analyzed at a wavelength of 249.773 nanometers and has an estimated detection limit of 5.0 ug/l. /Total boron/ [Peer Reviewed] *40 CFR 136 (7/1/88)*

2 The curcumin method is applicable for the determination of boron concentrations in the 0.10 to 1.0 mg/l range. When a sample of water containing boron is acidified and evaporated in the presence of circumin, a red colored product called rosocyanine is formed. The rosocyanin is taken up in a suitable solvent and the red color is compared with standards visually or photometrically. A synthetic sample contaning 240 ug boron/l, 40 ug arsenic/l, 250 mg beryllium/l, 20 ug selenium/l, and 6 ug vanadium/l in distilled water was analyzed in 30 laboratories by the curcumin method with a relative standard deviation of 22.8% and a relative error of 0%. /Total boron/ [Peer Reviewed] *Franson MA (Ed); Standard Methods for the Examination of Water and Wastewater p.274-6 (1985)*

3 The carmine method is suitable for the determination of boron concn in the 1 to 10 mg/l range. In the presence of boron, a soln of carmine or carminic acid in concn sulfuric acid changes from a bright red to a bluish red or blue, depending on the concn of boron present. The ions commonly found in water and wastewater do not interfere with this method. A synthetic sample containing 180 ug boron/l, 50 ug arsenic/l, 400 ug beryllium/l, and 50 ug selenium/l in distilled water was analyzed in nine laboratories by the carmine method with a relative standard deviation of 35.5% and a relative error of 0.6%. /Total boron/ [Peer Reviewed] *Franson MA (Ed); Standard Methods for the Examination of Water and Wastewater p.276-7 (1985)*

4 Method 305: Emission spectroscopy for the determination of boron in water and wastewater samples using an inductively coupled plasma source. The exact choice of emission line is related to sample matrix and instrumentation. A typically used emission line for boron in water is a wavelength of 249.8 nm, with an expected detection limit of 5.0 ug/l. /Total boron (from table)/ [Peer Reviewed] *Franson MA (Ed): Standard Methods for the Examination of Water and Wastewater p.181 (1985)*

5 Boric acid in deodorants and anti-perspirants is determined by titration with sodium hydroxide in presence of mannitol. [Peer Reviewed] *Association of Official Analytical Chemists. Official Methods of Analysis. 10th ed. and supplements. Washington, DC: Association of Official Analytical Chemists, 1965. New editions through13th ed. plus supplements, 1982.,p. 12/648 35.019*

6 Boric acid in face powder is determined by titration with sodium hydroxide in presence of mannitol. [Peer Reviewed] *Association of Official Analytical Chemists. Official Methods of Analysis. 10th ed. and supplements. Washington, DC: Association of Official Analytical Chemists, 1965. New editions through13th ed. plus supplements, 1982.,p. 12/651 35.036*

7 Boric acid in foods is determined by titration with sodium hydroxide in presence of mannitol.

7
[Peer Reviewed] *Association of Official Analytical Chemists. Official Methods of Analysis. 10th ed. and supplements. Washington, DC: Association of Official Analytical Chemists, 1965. New editions through13th ed. plus supplements, 1982.,p. 12/354 20.036*

8 Boric acid in foods is determined by spectrophotometric method at 555 nm. [Peer Reviewed] *Association of Official Analytical Chemists. Official Methods of Analysis. 10th ed. and supplements. Washington, DC: Association of Official Analytical Chemists, 1965. New editions through13th ed. plus supplements, 1982.,p. 12/355 20.037*

9 Boric acid in food is determined by atomic absorption spectrophotometric method. [Peer Reviewed] *Association of Official Analytical Chemists. Official Methods of Analysis. 10th ed. and supplements. Washington, DC: Association of Official Analytical Chemists, 1965. New editions through13th ed. plus supplements, 1982.,p. 12/355 20.042*

10 Boric acid in mineral waters is determined by titration in presence of manitol. [Peer Reviewed] *Association of Official Analytical Chemists. Official Methods of Analysis. 10th ed. and supplements. Washington, DC: Association of Official Analytical Chemists, 1965. New editions through13th ed. plus supplements, 1982.,p. 12/625 33.130*

11 Characteristic flame test ... can identify boron at levels as low as 0.2 ug in material adhering to a platinum wire loop. At least 26 colorimetric and 4 fluorescent reagents are known for qualitative identification ... with sensitivities of < 1 ug/ml and 0.04 ug (absolute), respectively. /Boron/ [Peer Reviewed] *Seiler, H.G., H. Sigel and A. Sigel (eds.). Handbook on the Toxicity of Inorganic Compounds. New York, NY: Marcel Dekker, Inc. 1988. 137*

12 Spectrophotometric methods include atomic absorption, flame emission, spark or arc emission, and ICAPES. ... Are capable of determining microgram or submicrogram quantities. A neutron activation technique using solid-state tract detectors ... to determine boron in biological material at levels below 0.1 ug/ml in 0.5 ul aliquots. /Boron/ [Peer Reviewed] *Seiler, H.G., H. Sigel and A. Sigel (eds.). Handbook on the Toxicity of Inorganic Compounds. New York, NY: Marcel Dekker, Inc. 1988. 137*

13 DETERMINATION OF BORON IN PLANTS BY EMISSION SPECTROGRAPHIC METHOD. /BORON/ [Peer Reviewed] *Association of Official Analytical Chemists. Official Methods of Analysis. 10th ed. and supplements. Washington, DC: Association of Official Analytical Chemists, 1965. New editions through13th ed. plus supplements, 1982.,p. 13/871 49.001*

14 DETERMINATION OF ACID-SOLUBLE BORON IN FERTILIZERS BY TITRATION. /BORON/ [Peer Reviewed] *Association of Official Analytical Chemists. Official Methods of Analysis. 10th ed. and supplements. Washington, DC: Association of Official Analytical Chemists, 1965. New editions through13th ed. plus supplements, 1982.,p. 13/21 2.114*

15 DETERMINATION OF BORON IN PLANTS BY COLORIMETRY. /BORON/ [Peer Reviewed] *Association of Official Analytical Chemists. Official Methods of Analysis. 10th ed. and supplements. Washington, DC: Association of Official Analytical Chemists, 1965. New editions through13th ed. plus supplements, 1982.,p. 13/46 3.102*

Clinical Laboratory Methods:

1 Boric acid is determined by ashing tissues in an alkaline medium at 600 deg C, dissolving in hydrochloric acid, centrifuging, mixing part of the supernatant with carminic acid in sulfuric acid and measuring the color at 575 nm after 1 hr. [Peer Reviewed] *Kobylecka K, Sadlik J; Krim Forensisch Wiss 41: 77-9 (1980)*

2 Spectrophotometric methods include atomic absorption, flame emission, spark or arc emission, and ICAPES. ... Are capable of determining microgram or submicrogram quantities. A neutron activation technique using solid-state tract detectors ... to determine boron in biological material at levels below 0.1 ug/ml in 0.5 ul aliquots. /Boron/ [Peer Reviewed] *Seiler, H.G., H. Sigel and A. Sigel (eds.). Handbook on the Toxicity of Inorganic Compounds. New York, NY: Marcel Dekker, Inc. 1988. 137*

3 Biological fluids may often be analyzed directly by inductively coupled plasma-atomic emission spectrometry. Many products require ashing with a fixative to remove organic material and to convert boron compounds to the borate form. ... The most frequently used extractant for both original or ashed materials is 2-ethyl-1,3-hexanediol in methylisobutyl ketone solvent. /Boron cmpd/ [Peer Reviewed] *Seiler, H.G., H. Sigel and A. Sigel (eds.).*

ketone solvent. /Boron cmpd/ [Peer Reviewed] *Seiler, H.G., H. Sigel and A. Sigel (eds.). Handbook on the Toxicity of Inorganic Compounds. New York, NY: Marcel Dekker, Inc. 1988. 137*

4 Boron is detectable in urine and sometimes in cerebrospinal fluid by the turmeric paper test (Boggs and Anrode, 1955), but quantitative techniques have been used to measure boron in blood. /Borate/ [Peer Reviewed] *Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, 1984.,p. III-68*

5 Plasma atomic emission spectrometry detection limit 0.001 mg boron/l; 0.012 mg boron/l (in urine). /Boron/ [Peer Reviewed] *Nat'l Research Council Canada; Data Sheets On Selected Toxic Elements, p. 23 (1982) NRCC No. 19252*

10.0 ADDITIONAL REFERENCES

Special Reports:

1 Siegel E, Wason S; Pediatr Clin North Am 33 (2): 363-67 (1986)

2 Nat'l Research Council Canada; Data Sheets on Selected Toxic Elements (1982) NRCC No. 19252

3 USEPA; Health Advisory for Boron (Draft) (1988)

4 USEPA/OWRS; Quality Criteria for Water 1986 Boron (1986) EPA 440/5-86-001

5 DHHS/ATSDR; Toxicological Profile for Boron (1992) ATSDR/TP-91/05

6 DHHS/NTP; Toxicology & Carcinogenesis Studies of Boric Acid in B6C3F1 Mice (Feed Studies) Technical Report Series No. 324 (1987) NIH Publication No. 88-2580

BORIC ACID

OHM/TADS - Oil and Hazardous Materials/Technical Assistance Data System

SUBSTANCES INCLUDED

Material name: BORIC ACID
Synonyms: BORACIC ACID ORTHOBORIC ACID
CAS number: 10043-35-3
Chemical formula: H3BO3
SIC CODE: 2295; 3269; 2851; 2841; 3999; 3323; 2834; 2844; 3269; 3299; 3679; 2879
Tradename(s):
Production sites: AMERICAN POTASH AND CHEMICAL CORP., TRONA, CA; STAUFFER CHEMICAL CO., SAN FRANCISCO, CA; U.S. BORAX AND CHEMICAL CORP., WILMINGTON, CA;
Species in mixture: 995-99.8% PURE
Hydrolysis product of: BORANES

COMMON USES

FIREPROOFING; PRESERVATIVE; PORCELAIN; ENAMELS; SOAPS; CARPETS; LEATHER; PHOTOGRAPHY; PRINTING; HOSPITALS; STEEL; VETERINARY; COSMETICS; CROCKERY; ARTIFICIAL GEMS; DYEING; PAINTING; ELECTRIC CONDENSERS; MEDICAL.

TRANSPORT/STORAGE/HANDLING

Transport:
Rail(%): 57.7
Barge(%): 5.0
Truck(%): 36.7

LABORATORY

Field detection limits (ppm): 1, BORON, (BNW 10063)
Laboratory detection limits (ppm): .1, BORON, (BNW 10061)

PHYSICOCHEMICAL PARAMETERS

Physical parameters:

Location/state of material: COLORLESS SOLID. WILL DISSOLVE.
Color in water: COLORLESS
Melting point (degrees C): 160
Melting characteristics: DECOMPOSES
Boiling point (degrees C): 300
Boiling characteristics: WATER
Specific gravity: 1.435

Chemical parameters:

Solubility (ppm 25 degrees C): 195
Reactivity:
Antagonistic materials: INCOMPATIBLE WITH ALKALI CARBONATES AND HYDROXIDES.
Water chemistry: ACID IS SOLUBLE TO 20,000 PPM, CALCIUM SALT TO 3000 PPM. LOWERS PH TO THE 5-6 RANGE WHERE IT BUFFERS.

5-6 RANGE WHERE IT BUFFERS.

FIRE/EXPLOSION/CORROSION HAZARDS

Fire hazard:

Standard codes: NFPA 2,-,-; CFR - NONE; USCG - NONE.
Toxic combustion products: TOXIC, WEAR SELF-CONTAINED BREATHING APPARATUS.
Personnel protection: ACID PROTECTIVE CLOTHING, GOGGLES AND SELF-CONTAINED BREATHING APPARATUS.

ENVIRONMENTAL HAZARDS

Pollution hazard:

Water pollution:

Persistency: NATURAL CALCIUM MAY SLOWLY PRECIPITATE OUT AS BORATE BUT NOT BELOW LEVELS TOXIC TO PLANTS.
Effect on water treatment process: TO PRODUCE A 50% INHIBITION OF THE 5 DAY OXYGEN UTILIZATION OF SYNTHETIC SEWAGE, > 1000 PPM OF BORIC ACID WAS REQUIRED. SIMILAR RESULTS WERE OBTAINED IN ONE STUDY WITH 480 PPM .
Water uses threatened: IRRIGATION
Industrial fouling potential: MAY PROVE MILDLY CORROSIVE

Air pollution: HIGH

Aquatic toxicity:

Freshwater toxicity text (Conc. in ppm):

Conc.	Expos (Hr)	Specie	Effect	Test Environment
18000	24	MOSQUITO FISH	TLM	TURBID 20-23 DEGREES. 5.4-7.3 PM
18,000-19,000	6	MINNOWS	MLD	DISTILLED
10500	48	MOSQUITO FISH	TLM	TURBID 20-23 DEGREES 5.4-7.3 PM
19,000-19,500	6	MINNOWS	MLD	HAR
5600	96	MOSQUITO FISH	TLM	TURBID 20-23 DEGREES 5.4-7.3 PM
2000		RAINBOW TROUT AND RUDD	HARMLESS	
6250	18	RUDD	DIED	
5000		RAINBOW TROUT AND RUDD	DARKENED SKIN	
6250	46	ROACH	DIED	
80,000	FEW MINUTES	RAINBOW TROUT	LOST BALANCE	
1939		RAINBOW TROUT	LD50	

Chronic aquatic toxicity limits (ppm): 12

Toxicity to animals:

Animal toxicity text (Value in mg of material/kg body wt):

Value	Time	Species	Param.	Route

Value	Time	Species	Param.	Route
3000		RAT	LD50	ORL
45		HMN	LDLO	ORL
8600		HMN	LDLO	SKN
2660		RAT	LD50	ORL
3450		MUS	LD50	ORL
>		DOG	LD50	ORL
1000				
5140		RAT	LD50	ORL

Toxicity to plants:

Irrigable plants (ppm): .75
Chronic plant toxicity (ppm): .5
Species threatened: PLANTS, ALFALFA AND VEGETABLES TOLERATE 2-4 MG/L, POTATOES, CORN, TOMATOES, PEAS AND GRAIN 1-2 MG/L, FRUIT, ESPECIALLY. CITRUS FRUIT, NO MORE THAN .5-1 MG/L .

RANGE OF TOXICITY

General sensation: ODORLESS
Direct human ingestion (mg/kgwt): 20

HUMAN HEALTH HAZARDS

Acute hazard level: LETHAL DOSE OF 1.2 TO 3.45 G/KG BODY WEIGHT DEPENDING ON ANIMAL SPECIES. 250-330 MG/KG LETHAL TO HUMANS ; HIGH HAZARD TO IRRIGABLE CORPS.
Chronic hazard level: MODERATE CHRONIC TOXICANT VIA ALL ROUTES. 2500 MG/L IN ANIMAL DRINKING WATER INHIBITS GROWTH. TOXIC TO PLANTS.
Public health hazard: NOT CONSIDERED HIGHLY TOXIC. COMBUSTION PRODUCTS ARE TOXIC.
Action levels: NOTIFY AIR AUTHORITY IF FIRE DEVELOPES AND THREATENS TO SPREAD TOXIC COMBUSTION PRODUCT. PREVENT DUST FROM SUSPENDING IN AIR.
Etiologic potential: BORISM

CLEANUP PROCEDURES

In situ amelioration: ADD LIME TO PRECIPITATE CALCIUM BORATE. NEUTRALIZE WITH SODIUM BICARBONATE. SEEK PROFESSIONAL ENVIRONMENTAL ENGINEERING ASSISTANCE THROUGH EPA'S ENVIRONMENTAL RESPONSE TEAM (ERT), EDISON, NJ, 24-HOUR NO. 201-321-6660.
Countermeasure material availability: LIME - CEMENT PLANTS; NAHCO3 - GROCERY DISTRIBUTORS, LARGE BAKERIES.
Disposal method(s): ADD SLOWLY TO LARGE VOLUME AGITATED SOLUTION OF SODA ASH-SLAKED LIME. ADD NEUTRALIZED SOLUTION TO EXCESS RUNNING WATER AND ROUTE TO SEWAGE PLANT.
Disposal notification(s): CONTACT LOCAL SEWAGE AUTHORITY

DATA ADEQUACY EVALUATION

FAIR. POSITIVE RESPONSE .

BORIC ACID

CHRIS - Chemical Hazard Response Information System

OVERVIEW

Material name:

BORIC ACID
CHRIS Code BAC

Common synonyms:

Orthoboric acid
Boracic acid

Characteristics:

Solid White Odorless
Sinks and mixes with water.

Emergency actions:

Stop discharge if possible. Keep people away.
Avoid contact with solid.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire:

Not flammable.

Exposure:

CALL FOR MEDICAL AID.

SOLID
Irritating to skin and eyes.
If swallowed will cause nausea or vomiting.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

Water pollution:

Dangerous to aquatic life in high concentrations.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

RESPONSE TO DISCHARGE

Issue warning-water contaminant Should be removed Chemical and physical treatment

LABEL

Category: None
Class: Not pertinent

CHEMICAL DESIGNATIONS

CG compatibility class: Not listed
Formula: H(3)BO(3)
IMO/UN designation: Not listed
DOT id no.: Data not available
CAS registry no.: 10043-35-3

OBSERVABLE CHARACTERISTICS

Physical state: Solid
Color: White
Odor: None

HEALTH HAZARDS

Personal protective equipment: Chemical goggles
Symptoms following exposure: Although no adverse effects have been reported from inhaling boric acid dust, it is absorbed through mucous membranes. Ingestion of 5 grams or more may irritate gastrointestinal tract and affect central nervous system. Contact with dust or aqueous solutions may irritate eyes; no chronic effects have been recognized, but continued contact should be avoided. Dust and solutions are absorbed through burns and open wounds but not through unbroken skin.
Treatment of exposure: INHALATION: remove from contaminated atmosphere. INGESTION: obtain medical attention as soon as possible; if the patient is conscious, induce vomiting by giving warm salty water (2 tablespoons of table salt to a pint of water) or warm soapy water; if this measure is unsuccessful, vomiting may be induced by tickling the back of the patient's throat with a finger; vomiting should be encouraged about three times or until the vomitus is clear; additional water may be given to wash out the stomach. EYES: immediately flush the eyes with large quantities of running water for a minimum of 15 min.; hold the eyelids apart during the irrigation to ensure flushing of the entire surface of the eye and lids with water; obtain medical attention as soon as possible; continue the irrigation for an additional 15 min. if the physician is not available. SKIN: immediately flush affected area with water; remove contaminated clothing under the shower; continue washing with water-do not attempt to neutralize with chemical agents; obtain medical attention unless burn is minor.
Threshold limit value: 10 mg/m(3) (as boric oxide)
Short term inhalation limits: 20 mg/m(3) as basic oxide
Toxicity by ingestion: Grade 2; oral rat LD(50) = 2,660 mg/kg
Late toxicity: Data not available
Vapor (gas) irritant characteristics: Data not available
Liquid or solid irritant characteristics: Data not available
Odor threshold: Odorless
IDLH value: Data not available

FIRE HAZARDS

Flash point: Not flammable

Flash point: Not flammable
Flammable limits in air: Not flammable
Fire extinguishing agents: Not pertinent
Fire extinguishing agents NOT to be used: Not pertinent
Special hazards of combustion products: Data not available
Behavior in fire: Data not available
Ignition temperature: Not pertinent
Electrical hazard: Not pertinent
Burning rate: Not pertinent
Adiabatic flame temperature: Data not available
Stoichiometric air to fuel ratio: Data not available
Flame temperature: Data not available

CHEMICAL REACTIVITY

Reactivity with water: No reaction
Reactivity with common materials: Data not available
Stability during transport: Stable
Neutralizing agents for acids and caustics: Not pertinent
Polymerization: Not pertinent
Inhibitor of polymerization: Not pertinent
Molar ratio (reactant to product): Data not available
Reactivity group: Data not available

WATER POLLUTION

Aquatic toxicity: 1800 ppm/24 hr/mosquito fish/TLm/fresh water
Waterfowl toxicity: Data not available
Biological oxygen demand (BOD): None
Food chain concentration potential: None

SHIPPING INFORMATION

Grades of purity: Radio, 99.98%; Technical, 99.9%; N.F., 99.5%
Storage temperature: Ambient
Inert atmosphere: No requirement
Venting: Open

HAZARD CLASSIFICATIONS

Code of federal regulations: Not listed

NAS hazard rating for bulk water transportation: Not listed

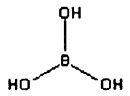
NFPA hazard classification: Not listed

PHYSICAL AND CHEMICAL PROPERTIES

Physical state at 15 degrees C. and 1 ATM: Solid
Molecular weight: 61.83
Boiling point at 1 ATM: Not pertinent (decomposes)
Freezing point: Not pertinent
Critical temperature: Not pertinent
Critical pressure: Not pertinent
Specific gravity: 1.51 at 14 degrees C (solid)

Specific gravity: 1.51 at 14 degrees C (solid)
Liquid surface tension: Not pertinent
Liquid water interfacial tension: Not pertinent
Vapor (gas) specific gravity: Not pertinent
Ratio of specific heats of vapor (gas): Not pertinent
Latent heat of vaporization: Not pertinent
Heat of combustion: Not pertinent
Heat of decomposition: Not pertinent
Heat of solution: -157 Btu/lb = -87 cal/g = -3.7 X 10(5) J/kg
Heat of polymerization: Not pertinent
Heat of fusion: Data not available
Limiting value: Data not available
REID vapor pressure: Data not available

TR-324
Toxicology and Carcinogenesis Studies of Boric Acid (CAS No. 10043-35-3) in B6C3F1 Mice (Feed Studies)



Chemical Formula: H_3BO_3 - 3D Structure

Boric acid is a component of cosmetics and pharmaceuticals and is also used in numerous industrial processes. Earlier long-term studies did not demonstrate a carcinogenic effect in Sprague-Dawley rats. Because of potential widespread human exposure, corroborative evidence was sought in a second species. Toxicology and carcinogenesis studies were conducted by feeding technical-grade boric acid (99.7% pure) to groups of male and female B6C3F1 mice for 14 days, 13 weeks, and 2 years.

In the 14-day studies (five mice per group), mortality occurred in mice fed 25,000 ppm, 50,000 ppm, or 100,000 ppm boric acid; hyperplasia and/or dysplasia of the forestomach was also seen in these dose groups. No compound-related gross pathologic or histopathologic effects were seen in male or female mice exposed at concentrations up to 12,500 ppm in feed. In the 13-week studies, groups of 10 male and 10 female mice were fed boric acid at concentrations up to 20,000 ppm; 8 male mice and 1 female mouse receiving 20,000 ppm and 1 male receiving 10,000 ppm boric acid died before the end of the studies. Male and female mice receiving 20,000 ppm boric acid weighed 23% and 18% less, respectively, than did the controls at the end of the studies. Testicular atrophy in 8/10 male mice, hyperkeratosis and acanthosis of the stomach in 8/10 male and female mice, and extramedullary hematopoiesis of the spleen in all male and female mice receiving 20,000 ppm boric acid indicated that the testis, stomach, and spleen were potential target organs in the 2-year studies. Based on these results, 2-year toxicology and carcinogenesis studies were conducted by feeding diets containing boric acid at concentrations of 0, 2,500, or 5,000 ppm to groups of 50 male and 50 female mice.

Survival of high dose male mice after week 63 and of low dose mice after week 84 was lower than that of the controls (final survival: control, 41; low dose, 30; high dose, 22), which may have reduced the sensitivity of the carcinogenicity study; the numbers of female mice (33; 33; 37) that survived to the end of the studies were considered adequate for toxicologic evaluation. Body weight gain was reduced in each sex after week 30; mean final body weights were 7% and 13% below control values for exposed male mice and 7% and 20% below those of controls for exposed female mice. No chemically related clinical signs were reported.

At the top dose, boric acid caused an increased incidence of testicular atrophy (control, 3/49; low dose, 6/50; high dose, 27/47) and interstitial cell hyperplasia (0/49; 0/50; 7/47) inmale mice. The testicular atrophy was characterized by variable loss of spermatogonia, primary and secondary spermatocytes, spermatids, and spermatozoa from the seminiferous tubules. The seminiferous tubules contained primarily Sertoli cells and variable numbers of spermatogonia. In some mice, there were accumulations of interstitial cells, indicating hyperplasia.

In low dose male mice, there were increased incidences of hepatocellular carcinomas (5/50; 12/50; 8/49) and hepatocellular adenomas or carcinomas (combined) (14/50; 19/50; 15/49) and an increased incidence of subcutaneous tissue fibromas, sarcomas, fibrosarcomas, or neurofibrosarcomas (combined) (2/50; 10/50; 2/50). No increased incidence of subcutaneous tissue neoplasms was seen in male mice receiving 5,000 ppm. Because the incidence of subcutaneous tissue tumors is variable in historical controls, because there was no corresponding increase in the high dose male mice, and because the incidence of hepatocellular tumors was not significant by the incidental tumor test and was within the historical control range, neither of these tumors was considered to be related to the administration of boric acid.

Boric acid was not mutagenic in the Salmonella/microsome assay with *Salmonella typhimurium* strains TA98, TA100, TA1535, or TA1537. Boric acid was negative in the mouse lymphoma L5178Y/TK$^{+/-}$ assay and did not induce sister-chromatid exchanges or chromosomal aberrations in Chinese hamster ovary cells.

All assays were preformed with and without metabolic activation.

The data, documents, and pathology materials from the 2-year studies of boric acid were audited at the NTP Archives. The audit findings show that the conduct of the studies is documented adequately and support the data and results given in this Technical Report.

Under the conditions of these 2--year feed studies, there was *no evidence of carcinogenicity* of boric acid at doses of 2,500 or 5,000 ppm for male or female B6C3F1 mice. Testicular atrophy and interstitial cell hyperplasia were observed in high dose male mice. The decrease in survival of dosed male mice may have reduced the sensitivity of this study.

Synonyms: orthoboric acid; boracic acid

Target Organs & Incidences from 2-year Studies

Report Date: October 1987

NTIS# PB88-213475

Target Organs and Levels of Evidence for NTP Technical Report Number 324
Produced from Chemtrack Database 07/23/96

CHEMICAL/ CAS NUMBER	PEER REVIEW DATE	PRIMARY USES	ROUTE/EXPOSURE LEVELS	STUDY LABORATORY
BORIC ACID 10043-35-3	03/26/86	WEATHERPROOFING WOOD. FIREPROOFING FABRICS. PRINTING AND DYEING. ASTRINGENT. ANTISEPTIC. IN COSMETIC POWDERS. IN MANUFACTURE OF CEMENTS, CROCKERY, GLASS, LEATHER, CARPETS, HATS AND SOAPS. (TDB)	Dosed-Feed 0,2500,5000 PPM/50 PER GROUP	T.S.I. Mason Laboratories, Inc.

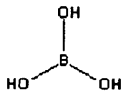
LEVELS OF EVIDENCE OF CARCINOGENICITY--ORGAN/TISSUE (NEOPLASM):

MM: NO EVIDENCE

NON-NEOPLASTIC LESIONS: TESTES: ATROPHY 3/49 6/50 27/47; HYPERPLASIA, INTERSTITIAL 0/49 0/50 7/47

FM: NO EVIDENCE

TR-324
Toxicology and Carcinogenesis Studies of Boric Acid (CAS No. 10043-35-3) in B6C3F1 Mice (Feed Studies)



Chemical Formula: H_3BO_3 - 3D Structure

Boric acid is a component of cosmetics and pharmaceuticals and is also used in numerous industrial processes. Earlier long-term studies did not demonstrate a carcinogenic effect in Sprague-Dawley rats. Because of potential widespread human exposure, corroborative evidence was sought in a second species. Toxicology and carcinogenesis studies were conducted by feeding technical-grade boric acid (99.7% pure) to groups of male and female B6C3F1 mice for 14 days, 13 weeks, and 2 years.

In the 14-day studies (five mice per group), mortality occurred in mice fed 25,000 ppm, 50,000 ppm, or 100,000 ppm boric acid; hyperplasia and/or dysplasia of the forestomach was also seen in these dose groups. No compound-related gross pathologic or histopathologic effects were seen in male or female mice exposed at concentrations up to 12,500 ppm in feed. In the 13-week studies, groups of 10 male and 10 female mice were fed boric acid at concentrations up to 20,000 ppm; 8 male mice and 1 female mouse receiving 20,000 ppm and 1 male receiving 10,000 ppm boric acid died before the end of the studies. Male and female mice receiving 20,000 ppm boric acid weighed 23% and 18% less, respectively, than did the controls at the end of the studies. Testicular atrophy in 8/10 male mice, hyperkeratosis and acanthosis of the stomach in 8/10 male and female mice, and extramedullary hematopoiesis of the spleen in all male and female mice receiving 20,000 ppm boric acid indicated that the testis, stomach, and spleen were potential target organs in the 2-year studies. Based on these results, 2-year toxicology and carcinogenesis studies were conducted by feeding diets containing boric acid at concentrations of 0, 2,500, or 5,000 ppm to groups of 50 male and 50 female mice.

Survival of high dose male mice after week 63 and of low dose mice after week 84 was lower than that of the controls (final survival: control, 41; low dose, 30; high dose, 22), which may have reduced the sensitivity of the carcinogenicity study; the numbers of female mice (33; 33; 37) that survived to the end of the studies were considered adequate for toxicologic evaluation. Body weight gain was reduced in each sex after week 30; mean final body weights were 7% and 13% below control values for exposed male mice and 7% and 20% below those of controls for exposed female mice. No chemically related clinical signs were reported.

At the top dose, boric acid caused an increased incidence of testicular atrophy (control, 3/49; low dose, 6/50; high dose, 27/47) and interstitial cell hyperplasia (0/49; 0/50; 7/47) inmale mice. The testicular atrophy was characterized by variable loss of spermatogonia, primary and secondary spermatocytes, spermatids, and spermatozoa from the seminiferous tubules. The seminiferous tubules contained primarily Sertoli cells and variable numbers of spermatogonia. In some mice, there were accumulations of interstitial cells, indicating hyperplasia.

In low dose male mice, there were increased incidences of hepatocellular carcinomas (5/50; 12/50; 8/49) and hepatocellular adenomas or carcinomas (combined) (14/50; 19/50; 15/49) and an increased incidence of subcutaneous tissue fibromas, sarcomas, fibrosarcomas, or neurofibrosarcomas (combined) (2/50; 10/50; 2/50). No increased incidence of subcutaneous tissue neoplasms was seen in male mice receiving 5,000 ppm. Because the incidence of subcutaneous tissue tumors is variable in historical controls, because there was no corresponding increase in the high dose male mice, and because the incidence of hepatocellular tumors was not significant by the incidental tumor test and was within the historical control range, neither of these tumors was considered to be related to the administration of boric acid.

Boric acid was not mutagenic in the Salmonella/microsome assay with *Salmonella typhimurium* strains TA98, TA100, TA1535, or TA1537. Boric acid was negative in the mouse lymphoma L5178Y/TK$^{+/-}$ assay and did not induce sister-chromatid exchanges or chromosomal aberrations in Chinese hamster ovary cells.

All assays were preformed with and without metabolic activation.

The data, documents, and pathology materials from the 2-year studies of boric acid were audited at the NTP Archives. The audit findings show that the conduct of the studies is documented adequately and support the data and results given in this Technical Report.

Under the conditions of these 2--year feed studies, there was *no evidence of carcinogenicity* of boric acid at doses of 2,500 or 5,000 ppm for male or female B6C3F1 mice. Testicular atrophy and interstitial cell hyperplasia were observed in high dose male mice. The decrease in survival of dosed male mice may have reduced the sensitivity of this study.

Synonyms: orthoboric acid; boracic acid

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FM: NO EVIDENCE

Boric Acid, CAS No. 10043-35-3

RACB88034
NTIS # PB90253808

Abstract

The potential reproductive toxicity of boric acid (BA) in CD- 1 (Swiss) mice was evaluated using the Reproductive Assessment by Continuous Breeding (RACB) Protocol. Male and female Swiss (CD-l) mice were exposed to BA at concentrations of 0, 1000, 4500, or 9000 ppm in the feed; this produced estimated consumption levels of approximately 152, 636, and 1262 mg/kg body weight.

During 14 weeks of cohabitation with continuous access to a BA-containing diet, no litters of dead or live pups were produced by 9000 ppm cohabited pairs. Among the litters born to pairs fed BA at 4500 ppm, live litter size and pup body weight were significantly reduced in comparison to controls. All aspects of fertility were unaffected at 1000 ppm BA.

A crossover mating trial (Task 3) at the end of the continuous cohabitation phase, using the middle dose group, confirmed the male as the affected sex, with observed fertility rates of: O ppm male x O ppm female, 74%; 4500 ppm male x O ppm female, 5%; and O ppm male x 4500 ppm female, 65%. The mating index was 79%, 30%. and 70% for the same groups. Additionally, adjusted body weights, for pups born from the mating of control male x 4500 ppm female, were significantly decreased from controls (P At sacrifice, after 27 weeks of BA exposure, the F_0 males fed 9000 ppm BA had significantly lower body weight and reproductive organ weights (testes, combined caput and corpus epididymis. and cauda epididymis) and significantly fewer spermatozoa in the cauda epididymis. Males fed 4500 ppm BA also had significantly lower testes, epididymis, prostate weight. and fewer spermatozoa in the cauda epididymis. Organ weights were unaffected at 1000 ppm BA for the F_0 males.

The germinal epithelium of F_0 males in the 9000 ppm group was atrophied and consisted mostly of Sertoli cells with occasional spermatogonia. The 4500 ppm group had fewer spermatids than in the controls; multinucleate giant cells were observed.

Sperm concentration per mg cauda was dramatically reduced in 9000 ppm males (2.8±1.7 x 103) compared to controls (519±36 x 103). Motility was difficult to quantify due to extremely low sperm concentrations. In 4500 ppm males, both sperm concentration (146.9±26.5 x 103) and sperm motility (53.3± 8.2%) were lower than in controls (519±36 x 103 sperm with 78.1±3.0% motility). Males fed 1000 ppm BA had normal sperm concentrations with reduced motility (69.0±4.5%).

At necropsy, F_0 female body weight was significantly decreased in the high dose group. The F_0 females in the 4500 ppm group had significantly decreased kidney/adrenals and liver weights.

The F_1 mice exposed to dietary BA (O and 1000 ppm), beginning at conception, had normal fertility. The adjusted mean body weight of F_2 pups was decreased. However. the number of live pups per litter, the proportion of pups born alive, sex of pups born alive, and unadjusted weights of pups born alive, were not significantly changed by BA exposure. At necropsy, F_1 males had normal reproductive organ weights and sperm motility. However. BA treatment decreased sperm concentrations in F_1 males (585.6±32.5 x 103 in controls vs. 442.6±51.2 x 103). Female F_1 mice had significantly greater uterus and kidney/adrenal weights than controls.

This study confirms that BA is a reproductive toxicant in mice, primarily through an effect in the male. The 1000 ppm dose approached a No Observed Adverse Effects Level (NOAEL) for the adult reproductive system, as well as for the developing reproductive system. .

AMMONIUM BROMIDE

HSDB - Hazardous Substances Data Bank

0.0 ADMINISTRATIVE INFORMATION

Hazardous Substances Data Bank Number: 207
Last Revision Date: 970501
Update History:

1 Field Update on 05/01/97, 2 fields added/edited/deleted.
2 Field Update on 02/07/97, 1 field added/edited/deleted.
3 Field Update on 01/18/96, 1 field added/edited/deleted.
4 Field Update on 11/09/95, 1 field added/edited/deleted.
5 Field Update on 08/23/95, 1 field added/edited/deleted.
6 Field Update on 05/26/95, 1 field added/edited/deleted.
7 Field Update on 12/19/94, 1 field added/edited/deleted.
8 Field Update on 11/03/94, 1 field added/edited/deleted.
9 Field Update on 11/02/94, 1 field added/edited/deleted.
10 Complete Update on 06/28/94, 1 field added/edited/deleted.
11 Complete Update on 03/25/94, 1 field added/edited/deleted.
12 Complete Update on 05/25/93, 1 field added/edited/deleted.
13 Field update on 12/11/92, 1 field added/edited/deleted.
14 Complete Update on 10/10/90, 1 field added/edited/deleted.
15 Field update on 12/29/89, 1 field added/edited/deleted.
16 Complete Update on 04/24/87, 41 fields added/edited/deleted.

1.0 SUBSTANCE IDENTIFICATION

Name of Substance: AMMONIUM BROMIDE
CAS Registry Number: 12124-97-9
Molecular Formula: BR-H4-N [QC Reviewed]
Wiswesser Line Notation: .Z&..E [Peer Reviewed] *U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry ofToxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS fi*
RTECS Number: NIOSH/BO9170000
OHM-TADS Number: 7800123

2.0 MANUFACTURING/USE INFORMATION

Methods of Manufacturing:

1 PASSAGE OF BROMINE IN AQUEOUS SOLUTION OVER IRON FILINGS FORMING A SOLUTION OF FERRIC & FERROUS BROMIDE, WHICH IS THEN TREATED WITH AMMONIA [Peer Reviewed] *SRI*
2 GMELIN'S, AMMONIUM (8TH ED) 23, 203-218 (1936); RICHARDS, "AMMONIUM BROMIDE" IN MELLOR'S VOL VIII, SUPPLEMENT I, NITROGEN (PART 1) 433-447 (1964). [QC Reviewed] *The Merck Index. 9th ed. Rahway, New Jersey: Merck & Co., Inc., 1976. 70*
3 ACTION OF HYDROBROMIC ACID ON AMMONIUM HYDROXIDE WITH SUBSEQUENT CRYSTALLIZATION. GRADES: TECHNICAL; PURE; CP; NF. [QC Reviewed] *Hawley, G.G. The Condensed Chemical Dictionary. 9th ed. New York: Van Nostrand Reinhold Co., 1977. 49*
4 Reaction of ammonia & hydrobromic acid or, more economically, by the reaction of ammonia and bromine [QC Reviewed] *KIRK-OTHMER ENCYC CHEM TECH 3RD ED*

4
and bromine [QC Reviewed] *KIRK-OTHMER ENCYC CHEM TECH 3RD ED 1978-PRESENT V2 p.524*

Formulations/Preparations:

1 Grades: Technical; Pure; C.P.; N.F. [QC Reviewed] *HAWLEY. CONDENSED CHEM DICTNRY 10TH ED 1981 p.58*

2 /Available as/ technical photograde; -4 mesh particle size, 99.9% purity grade; 35-55% solution & 99%granular grades; dry technical, 38-45% solution grades; chemical pure, chemically very pure & ACS grades [QC Reviewed] *CHEMCYCLOPEDIA 1986 p.164*

Manufacturers:

1 Dow Chemical USA, Hq, 2020 Dow Center, Midland, MI 48674, (517) 636-1000; Production site: Main Street, Midland, MI 48667 [Not Reviewed] *SRI. 1989 Directory of Chemical Producers - United States of America. Menlo Park, CA: SRI International, 1989. 460*

2 Rhone-Poulenc, Inc, Hq, 52 Vanderbilt Avenue, New York NY 10017, (201) 297-0100; Specialty Group, CN 5266, Princeton, NJ 08543; Production site: Manistee, MI 49660 [Not Reviewed] *SRI. 1989 Directory of Chemical Producers - United States of America. Menlo Park, CA: SRI International, 1989. 460*

Other Manufacturing Information:

INCOMPATIBILITIES: ACIDS, ACID SALTS, SPIRIT NITROUS ETHER, ALKALOIDS; SALTS OF LEAD, MERCURY, SILVER. [Peer Reviewed] *The Merck Index. 9th ed. Rahway, New Jersey: Merck & Co., Inc., 1976. 70*

Major Uses:

1 ANALYTICAL CHEMISTRY; TEXTILE FINISHING; FIRE RETARDANT [Peer Reviewed] *Hawley, G.G. The Condensed Chemical Dictionary. 9th ed. New York: Van Nostrand Reinhold Co., 1977. 49*

2 MFR OF PHOTOGRAPHIC EMULSIONS; IN METAL TREATMENT; CATALYST IN PRODN OF DIPHENYLAMINE [Peer Reviewed] *SRI*

3 MEDICATION: /PRC: FORMER USE/: SEDATIVE; PROCESS ENGRAVING & LITHOGRAPHY; FIREPROOFING OF WOOD; CORROSION INHIBITORS [QC Reviewed] *The Merck Index. 9th ed. Rahway, New Jersey: Merck & Co., Inc., 1976. 70*

U.S. Production:

1 (1972) ND [Peer Reviewed] *SRI*
2 (1975) ND [Peer Reviewed] *SRI*
3 (1986) ND [QC Reviewed]

U.S. Imports:

1 (1972) ND [Peer Reviewed] *SRI*
2 (1975) ND [Peer Reviewed] *SRI*
3 (1986) ND [QC Reviewed]

U.S. Exports:

1 (1972) ND [Peer Reviewed] *SRI*
2 (1975) ND [Peer Reviewed] *SRI*
3 (1986) ND [QC Reviewed]

3.0 CHEMICAL AND PHYSICAL PROPERTIES

Color/Form:

1 CUBIC, COLLOIDAL CRYSTALS [Peer Reviewed] *Weast, R.C. (ed.). Handbook of Chemistry and Physics. 60th ed. Boca Raton, Florida: CRC Press Inc., 1979.,p. B-53*

Chemistry and Physics. 60th ed. Boca Raton, Florida: CRC Press Inc., 1979.,p. B-53

2 WHITE CRYSTALS OR GRANULES [Peer Reviewed] *The Merck Index. 9th ed. Rahway, New Jersey: Merck & Co., Inc., 1976. 70*

3 COLORLESS CRYSTALS OR YELLOWISH-WHITE CRYSTALLINE MASS [Peer Reviewed] *National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978.,p. 49-47*

Odor: ODORLESS [QC Reviewed] *The Merck Index. 9th ed. Rahway, New Jersey: Merck & Co., Inc., 1976. 70*
Taste: SALINE TASTE, PUNGENT [QC Reviewed] *The Merck Index. 9th ed. Rahway, New Jersey: Merck & Co., Inc., 1976. 70*
Boiling Point: 235 DEG C (VACUUM) [Peer Reviewed] *Weast, R.C. (ed.). Handbook of Chemistry and Physics. 60th ed. Boca Raton, Florida: CRC Press Inc., 1979.,p. B-53*
Melting Point: 452 DEG C SUBLIMES [QC Reviewed] *Weast, R.C. (ed.). Handbook of Chemistry and Physics. 60th ed. Boca Raton, Florida: CRC Press Inc., 1979.,p. B-53*
Molecular Weight: 97.96 [Peer Reviewed] *The Merck Index. 9th ed. Rahway, New Jersey: Merck & Co., Inc., 1976. 70*
Corrosivity: AT FIRE TEMP CORRODES METALS [Peer Reviewed] *National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978.,p. 49-57*
Density/Specific Gravity: 2.429 @ 25 DEG C [Peer Reviewed] *The Merck Index. 9th ed. Rahway, New Jersey: Merck & Co., Inc., 1976. 70*
pH: SLIGHTLY ACID TO LITMUS [Peer Reviewed] *Osol, A. and J.E. Hoover, et al. (eds.). Remington's Pharmaceutical Sciences. 15th ed. Easton, Pennsylvania: Mack Publishing Co., 1975. 1008*
Solubilities:

1 PRACTICALLY INSOL IN ETHYL ACETATE [Peer Reviewed] *The Merck Index. 9th ed. Rahway, New Jersey: Merck & Co., Inc., 1976. 70*

2 SOL IN ACETONE, ETHER, AMMONIA, IN WATER, 97 G/100 CC @ 25 DEG C, 145.6 G/100 CC @ 100 DEG C; IN ALCOHOL, 10 G/100 CC @ 78 DEG C [QC Reviewed] *Weast, R.C. (ed.). Handbook of Chemistry and Physics. 60th ed. Boca Raton, Florida: CRC Press Inc., 1979.,p. B-53*

3 water solubility = 7.64X10+5 mg/l @ 20 deg C [QC Reviewed] *Dean JA; Lange's Handbook of Chemistry 13th Ed New York, NY: McGraw-Hill Book Co (1985)*

Spectral Properties: INDEX OF REFRACTION: 1.712 @ 25 DEG C [QC Reviewed] *Weast, R.C. (ed.) Handbook of Chemistry and Physics. 60th ed. Boca Raton, Florida: CRC Press Inc., 1979.,p. B-53*
Vapor Pressure: 1 MM HG @ 198.3 DEG C [Peer Reviewed] *Sax, N.I. Dangerous Properties of Industrial Materials. 4th ed. New York: Van Nostrand Reinhold, 1975. 388*
Other Chemical/Physical Properties:

SLIGHTLY HYGROSCOPIC [Peer Reviewed] *The Merck Index. 9th ed. Rahway, New Jersey: Merck & Co., Inc., 1976. 70*

4.0 SAFETY AND HANDLING

FIRE FIGHTING INFORMATION

Fire Fighting Procedures:

ATTACK FIRES FREELY WITH WATER. WATER SPRAY WILL EFFECTIVELY REDUCE FUME & IRRITANT GASES. [QC Reviewed] *National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978.,p. 49-48*

PREVENTIVE MEASURES

Protective Equipment and Clothing:

IN FIRE CONDITIONS WEAR SELF-CONTAINED BREATHING APPARATUS; WEAR GOGGLES IF EYE PROTECTION NOT PROVIDED. [QC Reviewed] *National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978.,p. 49-48*

OTHER SAFETY AND HANDLING

Stability/Shelf Life:

SLOWLY BECOMES YELLOW IN AIR [Peer Reviewed] *The Merck Index. 9th ed. Rahway, New Jersey: Merck & Co., Inc., 1976. 70*

Storage Conditions:

1 KEEP WELL CLOSED. [Peer Reviewed] *The Merck Index. 9th ed. Rahway, New Jersey: Merck & Co., Inc., 1976. 70*

2 PROTECT AGAINST PHYSICAL DAMAGE. STORE IN DRY LOCATION. SEPARATE FROM ACIDS AND ALKALIS. [QC Reviewed] *National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978.,p. 49-48*

3 IN GENERAL, MATERIALS...TOXIC AS STORED OR WHICH CAN DECOMP INTO TOXIC COMPONENTS...SHOULD BE STORED IN COOL...VENTILATED PLACE, OUT OF...SUN, AWAY FROM...FIRE HAZARD...BE PERIODICALLY INSPECTED & MONITORED. INCOMPATIBLE MATERIALS SHOULD BE ISOLATED... [QC Reviewed] *Sax, N.I. Dangerous Properties of Industrial Materials. 4th ed. New York: Van Nostrand Reinhold, 1975. 388*

5.0 TOXICITY/BIOMEDICAL EFFECTS

TOXICITY EXCERPTS

Human Toxicity Excerpts:

1 SEE BROMIDE SALTS. SYSTEMIC EFFECTS OF BROMIDE ION ARE CHIEFLY MENTAL: DROWSINESS, IRRITABILITY, ATAXIA, VERTIGO, CONFUSION, MANIA, HALLUCINATIONS, & COMA. OTHER EFFECTS INCLUDE SKIN RASHES, NEUROLOGICAL SIGNS, SENSORY DISTURBANCES, & INCR SPINAL FLUID PRESSURES. /BROMIDE SALTS/ [Peer Reviewed] *Gosselin, R.E., H.C. Hodge, R.P. Smith, and M.N. Gleason. Clinical Toxicology of Commercial Products. 4th ed. Baltimore: Williams and Wilkins, 1976.,p. II-6*

2 SEE BROMIDE SALTS. ACUTE ORAL POISONING IS RARE BECAUSE SINGLE DOSES ARE USUALLY PROMPTLY REJECTED BY VOMITING, BUT 1 OZ HAS BEEN SWALLOWED & ABSORBED SUFFICIENTLY TO CAUSE DEATH. /BROMIDE SALTS/ [Peer Reviewed] *Gosselin, R.E., H.C. Hodge, R.P. Smith, and M.N. Gleason. Clinical Toxicology of Commercial Products. 4th ed. Baltimore: Williams and Wilkins, 1976.,p. II-8*

3 SEE BROMIDE SALTS. BLOOD LEVEL OF 125 MG/100 ML IS...MINIMUM INTOXICATING LEVEL. /BROMIDE SALTS/ [Peer Reviewed] *Gosselin, R.E., H.C. Hodge, R.P. Smith, and M.N. Gleason. Clinical Toxicology of Commercial Products. 4th ed. Baltimore: Williams and Wilkins, 1976.,p. II-8*

4 THE THERAPEUTIC AND TOXIC EFFECTS ALL DERIVE FROM THE REPLACEMENT OF CHLORIDE BY BROMIDE IN BODY FLUIDS. /BROMIDE SALTS/ [Peer Reviewed]

4
CHLORIDE BY BROMIDE IN BODY FLUIDS. /BROMIDE SALTS/ [Peer Reviewed] *Goodman, L.S., and A. Gilman. (eds.) The Pharmacological Basis of Therapeutics. 5th ed. New York: Macmillan Publishing Co., Inc., 1975. 126*

5 CASE REPORTS OF 8 PT WITH BROMIDE INTOXICATION PRESENTED. TOXIC SIGNS AND SYMPTOMS ARE USUALLY SEEN WHEN SERUM BROMIDE LEVELS EXCEEDS 80 MG/100 ML. [QC Reviewed] *BOLMAN WM ET AL; BROMIDE ABUSE: A CONTINUING PROBLEM; AM J PSYCHIATRY 131(AUG) 913 (1974)*

6 THE CASE OF AN INFANT WITH HYPOTONIA AND NEUROLOGIC DEPRESSION IS PRESENTED. BROMIDE WAS DIAGNOSED. BROMISM WAS CAUSED WHEN THE MOTHER INGESTED PRESCRIBED LIQ BROMIDE MIXT CONTAINING 71 G OF AMMONIUM BROMIDE & 72 G OF POTASSIUM BROMIDE/PINT, OR 0.3 G OF TOTAL BROMIDE/ML. [QC Reviewed] *MANGURTEN HH, BAN R; J PEDIATR 85(3) 426 (1974)*

PHARMACOKINETICS

Absorption, Distribution and Excretion:

...BROMIDE SALTS ARE RAPIDLY ABSORBED FROM LOWER PART OF SMALL INTESTINE. ... BROMIDE IS WIDELY DISTRIBUTED THROUGHOUT EXTRACELLULAR FLUIDS INCLUDING SECRETIONS & TRANSUDATES. ...NOT FOUND IN FAT OR BLOOD PROTEINS. ... RENAL EXCRETION OF BROMIDE IS VERY SLOW. /BROMIDES/ [Peer Reviewed] *American Hospital Formulary Service. Volumes I and II. Washington, DC: American Society of Hospital Pharmacists, to 1984.,p. 28:12*

Biological Half-Life:

BROMIDE ION IS PROPORTIONATELY REABSORBED TO A SLIGHTLY GREATER EXTENT THAN CHLORIDE BY THE RENAL TUBULES, SO THAT IT HAS A HALF-LIFE OF ABOUT 12 DAYS. /BROMIDE SALTS/ [Peer Reviewed] *Goodman, L.S., and A. Gilman. (eds.) The Pharmacological Basis of Therapeutics. 5th ed. New York: Macmillan Publishing Co., Inc., 1975. 126*

6.0 PHARMACOLOGY

Therapeutic Uses:

.../PRC: FORMERLY/ USED AS ANTICONVULSANTS AND SEDATIVE... /BROMIDES/ [Peer Reviewed] *Goodman, L.S., and A. Gilman. (eds.) The Pharmacological Basis of Therapeutics. 5th ed. New York: Macmillan Publishing Co., Inc., 1975. 126*

Minimum/Potential Fatal Human Dose:

SEE BROMIDE SALTS. TOXICITY RATINGS: 3. 3= MODERATELY TOXIC: PROBABLE ORAL LETHAL DOSE (HUMAN) 0.5-5 G/KG, BETWEEN 1 OZ & 1 PINT (OR 1 LB) FOR 70 KG PERSON (150 LB). /BROMIDE SALTS/ [Peer Reviewed] *Gosselin, R.E., H.C. Hodge, R.P. Smith, and M.N. Gleason. Clinical Toxicology of Commercial Products. 4th ed. Baltimore: Williams and Wilkins, 1976.,p. II-8*

Drug Warning:

1 BROMIDES ARE CONTRAINDICATED IN PT WITH IMPAIRED RENAL FUNCTION, CEREBRAL ARTERIOSCLEROSIS, OR ORGANIC BRAIN DAMAGE. /BROMIDES/ [Peer Reviewed] *American Hospital Formulary Service. Volumes I and II. Washington, DC: American Society of Hospital Pharmacists, to 1984.,p. 28:12*

2 Food and Environmental Agents: Effect on Breast-Feeding: Bromide (photographic laboratory): Potential absorption and bromide transfer into milk. /from Table 7/ [QC

laboratory): Potential absorption and bromide transfer into milk. /from Table 7/ [QC Reviewed] *Report of the American Academy of Pediatrics Committee on Drugs in Pediatrics 93 (1): 142 (1994)*

3 Maternal Medication Usually Compatible with Breast-Feeding: Bromide: Rash, weakness, absence of cry with maternal intake of 5.4 g/d. /from Table 6/ [QC Reviewed] *Report of the American Academy of Pediatrics Committee on Drugs in Pediatrics 93 (1): 140 (1994)*

9.0 MONITORING AND ANALYSIS METHODS

Analytical Laboratory Methods:

1 A METHOD IS PRESENTED FOR DETERMINING AMMONIUM BROMIDE IN PHARMACEUTICAL PREPARATIONS BY COLORIMETRY IN PRESENCE OF SODIUM, POTASSIM, & CALCIUM. [QC Reviewed] *KRZEK J; ANKSMAN J; A COLORIMETRIC METHOD FOR DETERMINING AMMONIUM BROMIDE IN THE PRESENCE OF SODIUM, POTASSIUM, AND CALCIUM BROMIDE IN CERTAIN PHARMACEUTICAL PREPARATIONS; ACTA POL PHARM 35 (3): 329 (1978)*

2 AMMONIUM BROMIDE DETERMINED BY TITRATION. [QC Reviewed] *Association of Official Analytical Chemists. Official Methods of Analysis. 10th ed. and supplements. Washington, DC: Association of Official Analytical Chemists, 1965. New editions through13th ed. plus supplements, 1982.,p. 13/598 36.061*

Ammonium bromide

RTECS - Registry of Toxic Effects of Chemical Substances

1.0 SUBSTANCE IDENTIFICATION

RTECS Number: BO9155000
Chemical Name: Ammonium bromide
CAS Number: 12124-97-9
Molecular Formula: Br-H4-N
Molecular Weight: 97.96
Wiswesser Notation: .Z&..E
Last Revision Date: 1997

2.0 SYNONYM(S)/TRADENAME(S)

Hydrobromic acid monoammoniate

3.0 HEALTH HAZARD DATA

ACUTE TOXICITY

LD50/LC50 - LETHAL DOSE/CONC 50% KILL

Rat

LD50 - ROUTE: Oral; **DOSE:** 2700 mg/kg *CODEN: GTPZAB Bibliographic Data: Gigiena Truda i Professional'nye Zabolevaniya. Labor Hygiene and Occupational Diseases. (V/O Mezhdunarodnaya Kniga, 113095 Moscow, USSR) V.1-36, 1957-1992. For publisher information, see MTPEEI CODEN Reference: 33(10):57,1989*
TOXIC EFFECTS:
Sense Organs and Special Senses (Nose, Eye, Ear, and Taste) - Other changes
Behavioral - Somnolence (general depressed activity)
Lung, Thorax, or Respiration - Other changes

Mouse

LD50 - ROUTE: Intraperitoneal; **DOSE:** 559 mg/kg *CODEN: GTPZAB Bibliographic Data: Gigiena Truda i Professional'nye Zabolevaniya. Labor Hygiene and Occupational Diseases. (V/O Mezhdunarodnaya Kniga, 113095 Moscow, USSR) V.1-36, 1957-1992. For publisher information, see MTPEEI CODEN Reference: 33(10):57,1989*
LD50 - ROUTE: Oral; **DOSE:** 2860 mg/kg *CODEN: GTPZAB Bibliographic Data: Gigiena Truda i Professional'nye Zabolevaniya. Labor Hygiene and Occupational Diseases. (V/O Mezhdunarodnaya Kniga, 113095 Moscow, USSR) V.1-36, 1957-1992. For publisher information, see MTPEEI CODEN Reference: 33(10):57,1989*
TOXIC EFFECTS:
Sense Organs and Special Senses (Nose, Eye, Ear, and Taste) - Other changes
Behavioral - Somnolence (general depressed activity)
Lung, Thorax, or Respiration - Other changes

Guinea Pig

LD50 - ROUTE: Intraperitoneal; **DOSE:** 535 mg/kg *CODEN: GTPZAB Bibliographic Data: Gigiena Truda i Professional'nye Zabolevaniya. Labor Hygiene and Occupational Diseases. (V/O Mezhdunarodnaya Kniga, 113095 Moscow, USSR) V.1-36, 1957-1992. For publisher information, see MTPEEI CODEN Reference: 33(10):57,1989*

5.0 NIOSH DOCUMENTS

National Occupational Exposure Survey 1983: Hazard Code 81702; Number of Industries 24; Total Number of Facilities 1338; Number of Occupations 26; Total Number of Employees 16770; Total Number of Female Employees 3784

7.0 STATUS IN U.S.

1 EPA TSCA Section 8(b) CHEMICAL INVENTORY
2 EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, SEPTEMBER 1997

AMMONIUM BROMIDE

OHM/TADS - Oil and Hazardous Materials/Technical Assistance Data System

SUBSTANCES INCLUDED

Material name: AMMONIUM BROMIDE
Synonyms: HYDROBROMIC ACID, MONOAMMONIATE
CAS number: 12124-97-9
Chemical formula: NH4BR
SIC CODE: 2819
Tradename(s):
Production sites: DOW CHEMICAL U.S.A., MIDLAND, MI; MORTON-NORWICH PRODUCTS, INC., MORTON CHEMICAL CO., DIVISION, MANISTEE, MI; NORTHWEST INDUST., INC., VELSICOL CHEMICAL CORP., SUBSIDIARY, ST. LOUIS, MI.
Species in mixture: TECHNICAL; PURE; C.P.; N.F.

COMMON USES

MANUFACTURE OF PHOTOGRAPHIC FILMS, PLATES, AND PAPERS; IN PROCESS ENGRAVING AND LITHOGRAPHY; FIRE PROOFING OF WOOD; IN CORROSION INHIBITORS; SEDATIVES.

TRANSPORT/STORAGE/HANDLING

Transport:
Rail(%): 47.9
Barge(%): 42.7
Truck(%): 9.2
Storage:
General storage procedures: KEEP CONTAINERS TIGHTLY CLOSED IN A WELL-VENTILATED AREA AWAY FROM FOOD PRODUCTS. KEEP AWAY FROM HEAT AND WATER.
Handling:
General handling procedures: AVOID CONTACT WITH THE MATERIAL. WEAR PROTECTIVE CLOTHING INCLUDING RUBBER GLOVES, BOOTS, SAFETY GOGGLES, AND A NIOSH APPROVED RESPIRATOR.

LABORATORY

Field detection limits (ppm): .2, TEST WITH RED LITMUS PAPER FOR AMMONIUM .
Laboratory detection limits (ppm): 1, TEST WITH MANGANESE SULFATE AND SILVER NITRATE FOR AMMONIUM .

PHYSICOCHEMICAL PARAMETERS

Physical parameters:

Location/state of material: YELLOWISH, WHITE OR COLORLESS CRYSTALS WILL DISSOLVE VERY QUICKLY.
Color in water: COLORLESS
Melting point (degrees C): 452
Melting characteristics: SUBLIMES
Specific gravity: 2.43
Vapor pressure (mm Hg):
Vapor pressure text: 1 MM HG AT 198.3 DEGREES CELSIUS.

Vapor pressure text: 1 MM HG AT 198.3 DEGREES CELSIUS.

Chemical parameters:

Solubility (ppm 25 degrees C): 970000
Solubility characteristics: VERY SOLUBLE IN WATER, 970,000 PPM AT 25 DEGREES CELSIUS.
Reactivity:
Binary reactants: IN ACIDS HYDROGEN BROMIDE IS RELEASED, IN ALKALIS AMMONIA IS RELEASED.
Water chemistry: WILL GIVE ACID SOLUTION

FIRE/EXPLOSION/CORROSION HAZARDS

Fire hazard:
Flammability: NONCOMBUSTIBLE
Standard codes: TSCA; NOT LISTED IATA; NOT LISTED CFR 49; CFR 14 CAB CODE 8; NOT LISTED AAR; NOT LISTED NFPA.
Toxic combustion products: DISSOCIATES INTO AMMONIA AND HYDROGEN BROMIDE.
Extinguishing methods: USE APPROPRIATE MEDIA TO SUPPRESS EXPOSURE FIRE. USE SELF-CONTAINED BREATHING APPARATUS TO PROTECT AGAINST THE BROMIDE FUMES. CARE MUST BE TAKEN TO CONTAIN RUNOFF.
Personnel protection: PROTECT AGAINST BOTH INHALATION AND CONTACT WITH THE SKIN. WEAR PROTECTIVE CLOTHING INCLUDING NIOSH APPROVED RUBBER GLOVES AND BOOTS, SAFETY GOGGLES OR FACE MASK, AND A RESPIRATOR WHOSE CANISTER IS SPECIFICALLY APPROVED FOR THIS MATERIAL. USE A SELF-CONTAINED BREATHING APPARATUS WHEN MATERIAL IS EXPOSED TO HIGH TEMPERATURES.

ENVIRONMENTAL HAZARDS

Pollution hazard:

Water pollution:
Persistency: NONPERSISTENT
Effect on water treatment process: IF NEUTRALIZED AND DILUTED IS AMENABLE TO BIOLOGICAL TREATMENT AT MUNICIPAL SEWAGE TREATMENT PLANT.
Water uses threatened: ALL USERS OF DOWNSTREAM WATER SHOULD MONITOR FOR WATER CONCENTRATIONS.
Industrial fouling potential: POTENTIAL BELIEVED HIGH DUE TO THE CORROSIVENESS OF HYDROGEN BROMIDE THAT MAY BE FOUND IN THE BOILER FEED OR COOLING WATERS.
Air pollution: WHEN AMMONIUM BROMIDE DISSOCIATES AT HIGH TEMPERATURES, THE GASES RELEASED ARE RESPIRATORY, EYE AND SKIN IRRITANTS.
Food chain:
Food chain concentration: NEGATIVE. AMMONIUM COMPOUNDS ARE BIODEGRADABLE AND WILL NOT ACCUMULATE IN THE FOODCHAIN.

Aquatic toxicity:

Freshwater toxicity text (Conc. in ppm):

Conc.	Expos (Hr)	Specie	Effect	Test Environment
302.4	96	MOSQUITOFISH	TLM	TURBID WATER, EST.

RANGE OF TOXICITY

Irritation levels:
Irrigation levels text: AS AMMONIUM ION

Irrigation levels text: AS AMMONIUM ION
Direct contact: IRRITATING TO THE RESPIRATORY TRACT, EYES, AND SKIN .
General sensation: SYSTEMIC EFFECTS OF BROMIDE ION ARE CHIEFLY MENTAL, DROWSINESS, IRRITABILITY, ATAXIA, VERTIGO, CONFUSION, MANIA, HALLUCINATIONS, COMA. ALSO POSSIBLE ARE SKIN RASHES, NEUROLOGICAL SIGNS, SENSORY DISTURBANCES, AND INCREASED SPINAL FLUID PRESSURES. HYDROGEN BROMIDE IS IRRITATING TO THE RESPIRATORY TRACT, CAUSING MARKED INFLAMATION AND EDEMA OF PULMONARY ALVEOLI. BURNS MAY BE SEVERE.

HUMAN HEALTH HAZARDS

Acute hazard level: AMMONIUM BROMIDE IS MODERATELY TOXIC BY INGESTION AND INHALATION. ACUTE ORAL POISONING IS RARE BECAUSE SINGLE DOSES ARE USUALLY PROMPTLY REJECTED BY VOMITING, BUT 1 OUNCE HAS BEEN SWALLOWED AND ABSORBED SUFFICIENTLY TO CAUSE DEATH. A BLOOD LEVEL OF 125 MG/100 ML IS REGARDED AS THE MINIMUM INTOXICATION LEVEL .
Public health hazard: THE HYDROGEN BROMIDE PRODUCED WHEN IN CONTACT WITH ACIDS OR HIGH TEMPERATURES IS CORROSIVE TO TISSUE. THE AMMONIUM BROMIDE IS MODERATELY TOXIC BY INGESTION, USUALLY BEING VOMITED BEFORE ACUTE POISONING CAN TAKE PLACE.
Action levels: AVOID CONTACT WITH THE SPILLED CARGO. STAY UPWIND. NOTIFY LOCAL AIR, WATER, AND FIRE AUTHORITIES OF THE ACCIDENT. EVACUATION MAY NOT BE NECESSARY UNLESS THERE IS A DANGER OF FIRE, WITH THE SUBSEQUENT RELEASE OF IRRITATING AND POISONOUS GASES.

CLEANUP PROCEDURES

In situ amelioration: DAM STREAM IF POSSIBLE TO REDUCE THE FLOW AND PREVENT FURTHER DISSIPATION BY WATER MOVEMENT. DUE TO HIGH SOLUBILITY, DREDGING WILL BE FRUITLESS UNLESS CONDUCTED IMMEDIATELY. IF POSSIBLE, PUMP WATER INTO A SUITABLE CONTAINER, NEUTRALIZE TO PH 7 WITH HYDROCHLORIC ACID. AFTER DILUTION, SOLUTION MAY BE FLUSHED TO SEWAGE TREATMENT PLANT IF ALLOWED BY LOCAL ORDINANCE. AN ALTERNATE METHOD IS TO PUMP THE WATER INTO A SUITABLE CONTAINER, AND UNDER CONTROLLED CONDITIONS ADD SULFURIC ACID TO PH 6-7, FILTER OUT SOLIDS, PASS THROUGH AN ION EXCHANGE MEDIA THEN NEUTRALIZE TO PH 7 WITH SODIUM HYDROXIDE. FOR MORE DETAILS SEE ENVIREX MANUAL, EPA 600/2-77-227 . SEEK PROFESSIONAL ENVIRONMENTAL ENGINEERING ASSISTANCE THROUGH EPA'S ENVIRONMENTAL RESPONSE TEAM (ERT), EDISON, NJ, 24-HOUR NO. 201-321-6660.
Beach/shore restoration: CLOSE BEACH AND SHORE TO THE PUBLIC UNTIL MATERIAL HAS BEEN REMOVED.
Countermeasure material availability: PUMPS - FIRE STATIONS, ARMY CORPS OF ENGINEERS.
Disposal method(s): AFTER THE MATERIAL HAS BEEN CONTAINED, REMOVE WITH CONTAMINATED SOIL AND PLACE IN IMPERVIOUS CONTAINERS. MATERIAL MAY BE BURIED IN A CHEMICAL WASTE LANDFILL. IF NEUTRALIZED AND DILUTED, AMENABLE TO BIOLOGICAL TREATMENT AT A MUNICIPAL SEWAGE TREATMENT PLANT.
Disposal notification(s): NOTIFY LOCAL AND STATE HEALTH AUTHORITIES, LOCAL SOLID WASTE DISPOSAL AUTHORITIES, SUPPLIER AND SHIPPER OF THE MATERIAL.

DATA ADEQUACY EVALUATION

FAIR

Antimony oxide

RTECS - Registry of Toxic Effects of Chemical Substances

1.0 SUBSTANCE IDENTIFICATION

RTECS Number: CC5650000
Chemical Name: Antimony oxide
CAS Number: 1309-64-4
Molecular Formula: O3-Sb2
Molecular Weight: 291.50
Wiswesser Notation: .SB2.O3
Substance Investigated as: Tumorigen, Mutagen, Primary Irritant, Reproductive Effector
Last Revision Date: 1997

2.0 SYNONYM(S)/TRADENAME(S)

1 A 1582
2 A 1588LP
3 Amspec-KR
4 Antimonious oxide
5 Antimony sesquioxide
6 Antimony trioxide
7 Antimony trioxide production (ACGIH)
8 Antimony White
9 Antimony(3+) oxide
10 Antox
11 AP 50
12 AT 3 AT 3 (fireproofing agent) Atox F Atox S
13 C.I. 77052
14 C.I. Pigment White 11
15 Chemetron fire shield
16 Dechlorane A-O
17 Diantimony trioxide
18 Exitelite
19 Fireshield FSPO 405
20 Flowers of antimony
21 NCI-C55152
22 Nyacol A 1510LP
23 Nyacol A 1530
24 Patox C
25 Patox H
26 Patox L
27 Patox M
28 Patox S
29 Stibiox MS
30 Thermoguard B
31 Thermoguard L
32 Thermoguard S
33 Timonox
34 Timonox White Star
35 Twinkling star
36 Weisspiessglanz (German)

35
36 Weisspiessglanz (German)
37 White star

3.0 HEALTH HAZARD DATA

ACUTE TOXICITY

LDLO/LCLO - LOWEST PUBLISHED LETHAL DOSE/CONC

Rabbit

LDLo - ROUTE: Subcutaneous; **DOSE:** 2500 ug/kg *CODEN: HBAMAK Bibliographic Data: "Abdernalden's Handbuch der Biologischen Arbeitsmethoden." (Leipzig, Ger. Dem. Rep.) CODEN Reference: 4:1289,1935*

LDLo - ROUTE: Skin; **DOSE:** 2 gm/kg *CODEN: NTIS** Bibliographic Data: National Technical Information Service. (Springfield, VA 22161) Formerly U.S. Clearinghouse for Scientific & Technical Information. CODEN Reference: OTS0555447*

Dog

LDLo - ROUTE: Intravenous; **DOSE:** 3 mg/kg *CODEN: HBAMAK Bibliographic Data: "Abdernalden's Handbuch der Biologischen Arbeitsmethoden." (Leipzig, Ger. Dem. Rep.) CODEN Reference: 4:1289,1935*

LD50/LC50 - LETHAL DOSE/CONC 50% KILL

Rat

LD50 - ROUTE: Intraperitoneal; **DOSE:** 3250 mg/kg *CODEN: EQSSDX Bibliographic Data: Environmental Quality and Safety, Supplement. (Stuttgart, Fed. Rep. Ger.) V.1-5, 1975-76. Discontinued. CODEN Reference: 1:1,1975*

LD50 - ROUTE: Oral; **DOSE:** >34600 mg/kg *CODEN: NTIS** Bibliographic Data: National Technical Information Service. (Springfield, VA 22161) Formerly U.S. Clearinghouse for Scientific & Technical Information. CODEN Reference: OTS0555447*

TOXIC EFFECTS:

Behavioral - Somnolence (general depressed activity)

Skin and Appendages - Hair

LD50 - ROUTE: Subcutaneous; **DOSE:** 7904 mg/kg *CODEN: GISAAA Bibliographic Data: Gigiena i Sanitariya. For English translation, see HYSAAV (V/O Mezhdunarodnaya Kniga, 113095 Moscow, USSR) V.1- 1936- CODEN Reference: 38(1):99,1973*

Mouse

LD50 - ROUTE: Intraperitoneal; **DOSE:** 172 mg/kg *CODEN: 85GMAT Bibliographic Data: "Toxicometric Parameters of Industrial Toxic Chemicals Under Single Exposure," Izmerov, N.F., et al., Moscow, Centre of International Projects, GKNT, 1982 CODEN Reference: -,23,1982*

OTHER LD/LC - OTHER LETHAL DOSE/CONC

Mammal - Unspecified Species

LD - ROUTE: Subcutaneous; **DOSE:** >120 mg/kg *CODEN: GTPZAB Bibliographic Data: Gigiena Truda i Professional'nye Zabolevaniya. Labor Hygiene and Occupational Diseases. (V/O Mezhdunarodnaya Kniga, 113095 Moscow, USSR) V.1-36, 1957-1992. For publisher information, see MTPEEI CODEN Reference: 8(7):25,1964*

IRRITATION

EYE - STANDARD DRAIZE TEST

Rabbit

ROUTE: Eyes; **DOSE:** 100 mg; **REACTION:** Mild *CODEN: NTIS** Bibliographic Data: National Technical Information Service. (Springfield, VA 22161) Formerly U.S. Clearinghouse for Scientific & Technical Information. CODEN Reference: OTS0555447*

REPRODUCTIVE EFFECTS

Rat

ROUTE: Inhalation; **DOSE:** 82 ug/m3; **DURATION:** female 1-21D of pregnancy
CODEN: GISAAA Bibliographic Data: Gigiena i Sanitariya. For English translation, see HYSAAV. (V/O Mezhdunarodnaya Kniga, 113095 Moscow, USSR) V.1- 1936- CODEN Reference: 52(10):85,1987
TOXIC EFFECTS:
Effects on Fertility - Pre-implantation mortality (e.g., reduction in number of implants per female; total number of implants per corpora lutea)
Effects on Embryo or Fetus - Fetotoxicity (except death, e.g., stunted fetus)
ROUTE: Inhalation; **DOSE:** 270 ug/m3; **DURATION:** female 1-21D of pregnancy
CODEN: GISAAA Bibliographic Data: Gigiena i Sanitariya. For English translation, see HYSAAV. (V/O Mezhdunarodnaya Kniga, 113095 Moscow, USSR) V.1- 1936- CODEN Reference: 52(10):85,1987
TOXIC EFFECTS:
Effects on Fertility - Post-implantation mortality (e.g., dead and or resorbed implants per total number of implants)
Effects on Embryo or Fetus - Fetal death
ROUTE: Inhalation; **DOSE:** 270 ug/m3/24H; **DURATION:** female 1-21D of pregnancy
CODEN: GISAAA Bibliographic Data: Gigiena i Sanitariya. For English translation, see HYSAAV. (V/O Mezhdunarodnaya Kniga, 113095 Moscow, USSR) V.1- 1936- CODEN Reference: 54(4):68,1989
TOXIC EFFECTS:
Effects on Fertility - Pre-implantation mortality (e.g., reduction in number of implants per female; total number of implants per corpora lutea)
Effects on Fertility - Post-implantation mortality (e.g., dead and or resorbed implants per total number of implants)
Effects on Embryo or Fetus - Fetal death
ROUTE: Intratesticular; **DOSE:** 23320 ug/kg; **DURATION:** male 1D prior to mating
CODEN: JRPFA4 Bibliographic Data: Journal of Reproduction and Fertility. (Biochemical Soc. Book Depot, POB 32, Commerce Way, Colchester, Essex CO2 8HP, UK) V.1- 1960- CODEN Reference: 7:21,1964
TOXIC EFFECTS:
Paternal Effects - Spermatogenesis (including genetic material, sperm morphology, motility, and count)
Paternal Effects - Testes, epididymis, sperm duct

GENETIC EFFECTS

DNA REPAIR

Bacteria - B Subtilis

DOSE: 50 mmol/L *CODEN: MUREAV Bibliographic Data: Mutation Research. (Elsevier Science Pub. B.V., POB 211, 1000 AE Amsterdam, Netherlands) V.1- 1964- CODEN Reference: 77:109,1980*

SISTER CHROMATID EXCHANGE

Hamster

CELL TYPE: lung; **DOSE:** 90 ug/L *CODEN: MUREAV Bibliographic Data: Mutation Research. (Elsevier Science Pub. B.V., POB 211, 1000 AE Amsterdam, Netherlands) V.1- 1964- CODEN Reference: 264:163,1991*

TUMORIGENIC EFFECTS

Rat

ROUTE: Inhalation; **DOSE:** 4 mg/m3/1Y intermittent *CODEN: PESTC* Bibliographic Data: Pesticide & Toxic Chemical News. (Food Chemical News, Inc., 400 Wyatt Bldg., 777 14th St., NW, Washington, DC 20005) V.1- 1972- CODEN Reference: 8:16,1980*
TOXIC EFFECTS:
Tumorigenic - Equivocal tumorigenic agent by RTECS criteria
Lung, Thorax, or Respiration - Tumors
Liver - Tumors
ROUTE: Inhalation; **DOSE:** 1600 ug/m3/52W intermittent *CODEN: AIHAM* Bibliographic Data: Annual Meeting of American Industrial Hygiene Association. (Akron, OH) For publisher information, see AIHAAP. CODEN Reference: 20:1,1980*
TOXIC EFFECTS:
Tumorigenic - Neoplastic by RTECS criteria
Liver - Tumors
Skin and Appendages - Tumors
ROUTE: Inhalation; **DOSE:** 50 mg/m3/7H/52W intermittent *CODEN: JTEHD6 Bibliographic Data: Journal of Toxicology and Environmental Health. (Hemisphere Pub., 1025 Vermont Ave., NW, Washington, DC 20005) V.1- 1975/76- CODEN Reference: 18:607,1986*
TOXIC EFFECTS:
Tumorigenic - Carcinogenic by RTECS criteria
Lung, Thorax, or Respiration - Tumors
ROUTE: Inhalation; **DOSE:** 4200 ug/m3/52W intermittent *CODEN: AIHAM* Bibliographic Data: Annual Meeting of American Industrial Hygiene Association. (Akron, OH) For publisher information, see AIHAAP. CODEN Reference: 20:1,1980*
TOXIC EFFECTS:
Tumorigenic - Carcinogenic by RTECS criteria
Lung, Thorax, or Respiration - Tumors
Liver - Tumors

OTHER MULTIPLE DOSE TOXICITY DATA

Rat

ROUTE: Inhalation; **DOSE:** 72 ug/m3/24H/17W continuous *CODEN: GISAAA Bibliographic Data: Gigiena i Sanitariya. For English translation, see HYSAAV. (V/O Mezhdunarodnaya Kniga, 113095 Moscow, USSR) V.1- 1936- CODEN Reference: 54(4):68,1989*
TOXIC EFFECTS:
Blood - Pigmented or nucleated red blood cells
Biochemical - True cholinesterase
Biochemical - Lipids including transport
ROUTE: Subcutaneous; **DOSE:** 25688 mg/kg/13W intermittent *CODEN: GISAAA Bibliographic Data: Gigiena i Sanitariya. For English translation, see HYSAAV. (V/O Mezhdunarodnaya Kniga, 113095 Moscow, USSR) V.1- 1936- CODEN Reference: 38(1):99,1973*
TOXIC EFFECTS:
Cardiac - Other changes

Cardiac - Other changes

Guinea Pig

ROUTE: Inhalation; **DOSE:** 45 mg/m3/10W intermittent *CODEN: JIHTAB Bibliographic Data: Journal of Industrial Hygiene and Toxicology. (Cambridge, MA) V.18-31, 1936-49. For publisher information, see AEHLAU. CODEN Reference: 27:256,1945*

TOXIC EFFECTS:

Lung, Thorax, or Respiration - Fibrosis, focal (pneumoconiosis)

Liver - Fatty liver degeneration

Others - Death

4.0 STANDARDS AND REGULATIONS

1 OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV
2 OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGIH TLV
3 OEL-ARAB Republic of Egypt:TWA 0.5 mg(Sb)/m3 JAN 1993
4 OEL-AUSTRALIA:STEL 0.5 ppm JAN 1993
5 OEL-AUSTRALIA:TWA 0.5 mg(Sb)/m3 JAN 1993
6 OEL-AUSTRIA:TWA 0.5 mg(Sb)/m3 JAN 1993
7 OEL-BELGIUM:STEL 0.5 ppm JAN 1993
8 OEL-BELGIUM:TWA 0.5 mg(Sb)/m3 JAN 1993
9 OEL-DENMARK:TWA 0.5 mg(Sb)/m3 JAN 1993
10 OEL-FINLAND:.TWA (0.5 mg(Sb)/m3) JAN 1993
11 OEL-FRANCE:TWA 0.5 mg(Sb)/m3 JAN 1993
12 OEL-GERMANY:TWA 0.5 mg(Sb)/m3 (total dust) JAN 1993
13 OEL-GERMANY;Carcinogen JAN 1993
14 OEL-HUNGARY:STEL 0.5 mg(Sb)/m3 JAN 1993
15 OEL-POLAND:TWA 0.5 mg(Sb)/m3 JAN 1993
16 OEL-RUSSIA:STEL 1 mg/m3 JAN 1993
17 OEL-RUSSIA:TWA 0.2 mg(Sb)/m3;STEL 0.5 mg(Sb)/m3 JAN 1993
18 OEL-SWEDEN:TWA 0.5 mg(Sb)/m3 JAN 1993
19 OEL-SWITZERLAND:TWA 0.1 mg/m3;Carcinogen JAN 1993
20 OEL-SWITZERLAND:TWA 0.5 mg(Sb)/m3 JAN 1993
21 OEL-THE NETHERLANDS:TWA 0.5 mg(Sb)/m3 JAN 1993
22 OEL-THE PHILIPPINES:TWA 0.5 mg(Sb)/m3 JAN 1993
23 OEL-TURKEY:TWA 0.5 mg(Sb)/m3 JAN 1993
24 OEL-UNITED KINGDOM:TWA 0.5 mg(Sb)/m3 JAN 1993
25 OSHA PEL (Construc):8H TWA 0.5 mg(Sb)/m3 *CODEN: CFRGBR Bibliographic Data: Code of Federal Regulations. (U.S. Government Printing Office, Supt. of Documents, Washington, DC 20402) CODEN Reference: 29:1926.55,1994*
26 OSHA PEL (Fed Cont):8H TWA 0.5 mg(Sb)/m3 *CODEN: CFRGBR Bibliographic Data: Code of Federal Regulations. (U.S. Government Printing Office, Supt. of Documents, Washington, DC 20402) CODEN Reference: 41:50-204.50,1994*
27 OSHA PEL (Gen Indu):8H TWA 0.5 mg(Sb)/m3 *CODEN: CFRGBR Bibliographic Data: Code of Federal Regulations. (U.S. Government Printing Office, Supt. of Documents, Washington, DC 20402) CODEN Reference: 29:1910.1000,1994*
28 OSHA PEL (Shipyard):8H TWA 0.5 mg(Sb)/m3 *CODEN: CFRGBR Bibliographic Data: Code of Federal Regulations. (U.S. Government Printing Office, Supt. of Documents, Washington, DC 20402) CODEN Reference: 29:1915.1000,1993*

5.0 NIOSH DOCUMENTS

1 NIOSH REL TO ANTIMONY-air:10H TWA 0.5 mg(Sb)/m3
2 National Occupational Exposure Survey 1983: Hazard Code M2263; Number of Industries 72; Total Number of Facilities 7476; Number of Occupations 76; Total Number of Employees 209773; Total Number of Female Employees 56911

209773; Total Number of Female Employees 56911

3 National Occupational Hazard Survey 1974: Hazard Code M2263; Number of Industries 31; Total Number of Facilities 1540; Number of Occupations 53; Total Number of Employees 28957

6.0 REVIEWS

1 ACGIH TLV-Suspected human carcinogen *CODEN: DTLVS* Bibliographic Data: The Threshold Limit Values (TLVs) and Biological Exposure Indices (BEIs) booklet issues by American Conference of Governmental Industrial Hygienists (ACGIH), Cincinnati, OH, 1996 CODEN Reference: TLV/BEI,1996*

2 ACGIH TLV-TWA 0.5 mg(Sb)/m3 (Sb2O3 handling/use) *CODEN: DTLVS* Bibliographic Data: The Threshold Limit Values (TLVs) and Biological Exposure Indices (BEIs) booklet issues by American Conference of Governmental Industrial Hygienists (ACGIH), Cincinnati, OH, 1996 CODEN Reference: TLV/BEI,1996*

3 IARC Cancer Review:Animal Sufficient Evidence *CODEN: IMEMDT Bibliographic Data: IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man. (WHO Publications Centre USA, 49 Sheridan Ave., Albany, NY 12210) V.1- 1972- CODEN Reference: 47:291,1989*

4 IARC Cancer Review:Group 2B *CODEN: IMEMDT Bibliographic Data: IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man. (WHO Publications Centre USA, 49 Sheridan Ave., Albany, NY 12210) V.1- 1972- CODEN Reference: 47:291,1989*

5 IARC Cancer Review:Human Inadequate Evidence *CODEN: IMEMDT Bibliographic Data: IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man. (WHO Publications Centre USA, 49 Sheridan Ave., Albany, NY 12210) V.1- 1972- CODEN Reference: 47:291,1989*

7.0 STATUS IN U.S.

1 EPA GENETOX PROGRAM 1988, Positive: B subtilis rec assay
2 EPA TSCA Section 8(b) CHEMICAL INVENTORY
3 EPA TSCA Section 8(d) unpublished health/safety studies
4 EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, SEPTEMBER 1997
5 On EPA IRIS database