Butyradlehyde:

The following information was generated from the
Hazardous Substances Data Bank (HSDB),
a database of the National Library of Medicine's TOXNET system
(http://toxnet.nlm.nih.gov) on October 30, 2006.

Query: The chemical name butyraldehyde was identified.
The following terms were added from ChemIDplus:
butyric aldehyde
butylaldehyde
butalyde
butaldehyde
butal
aldeide butirrica
aldehyde butyrique
CAS Registry Number: 123-72-8

1
NAME: BUTYRALDEHYDE

HSN: 2798

RN: 123-72-8

HUMAN HEALTH EFFECTS:

HUMAN TOXICITY EXCERPTS:
MAY ACT AS IRRITANT, /SRP: CNS DEPRESSANT/ ... [Budavari, S. (ed.). The
Merck Index - Encyclopedia of Chemicals, Drugs and Biologicals. Rahway,
NJ: Merck and Co., Inc., 1989., p. 242]**PEER REVIEWED**

MAY PRODUCE SKIN & EYE BURNS AFTER CONTACT. [National Fire Protection
Guide. Fire Protection Guide on Hazardous Materials. 10 th ed. Quincy, MA:
National Fire Protection Association, 1991., p. 49-44]**PEER REVIEWED**

BUTANAL HAD NO EFFECT ON THE RATE OF SISTER CHROMATID EXCHANGE IN HUMAN
LYMPHOCYTES IN VITRO. [OBE G, BEEK B; DRUG ALCOHOL DEPEND 4 (1-2): 91
(1979)]**PEER REVIEWED**

LOW INHALATION TOXICITY. GOOD WARNING PROPERTIES DUE TO PUNGENT ODOR.
[National Fire Protection Association. Fire Protection Guide on Hazardous
Materials. 7th ed. Boston, Mass.: National Fire Protection Association,

1978., p. 49-80]**PEER REVIEWED**

BUTYRALDEHYDE HAS BEEN TESTED FOR IRRITANT EFFECT ON HUMAN EYES @ VAPOR
CONCN IN AIR SUCH AS MIGHT OCCUR IN SMOG, & HAS BEEN FOUND
NONIRRITANT. ... IN SIX INSTANCES OF INDUSTRIAL CORNEAL INJURY FROM
BUTYRALDEHYDE RECOVERY IS SAID TO HAVE BEEN PROMPT & COMPLETE. [Grant,
W.M. Toxicology of the Eye. 3rd ed. Springfield, IL: Charles C. Thomas
Publisher, 1986., p. 165]**PEER REVIEWED**

Human immunological effects by inhalation: delayed hypersensitivity.
[Lewis, R.J. Sax's Dangerous Properties of Industrial Materials. 9th ed.
Volumes 1-3. New York, NY: Van Nostrand Reinhold, 1996., p. 607]**PEER
REVIEWED**

SKIN, EYE AND RESPIRATORY IRRITATIONS:
Eye, nose, skin, and throat irritant. [National Fire Protection Guide.
Fire Protection Guide on Hazardous Materials. 10 th ed. Quincy, MA:
National Fire Protection Association, 1991., p. 49-43]**PEER REVIEWED**

PROBABLE ROUTES OF HUMAN EXPOSURE:
NIOSH (NOES Survey 1981-1983) has statistically estimated that 5,392
workers (950 of these are female) are potentially exposed to butyraldehyde
in the US(1). Occupational exposure to butyraldehyde may occur through
inhalation and dermal contact with this compound at workplaces where
butyraldehyde is produced or used(SRC). Monitoring data indicate that the
general population may be exposed to butyraldehyde via inhalation of
ambient air containing butyraldehyde(SRC). [(1) NIOSH; National
Occupational Exposure Survey (NOES) (1983)]**PEER REVIEWED**

EMERGENCY MEDICAL TREATMENT:

EMERGENCY MEDICAL TREATMENT:

DATABASE SHOULD BE CONSULTED FOR ASSISTANCE IN THE DIAGNOSIS OR TREATMENT OF SPECIFIC CASES. The use of the POISINDEX(R) and MEDITEXT(R) databases is at your sole risk. The POISINDEX(R) and MEDITEXT(R) databases are provided "AS IS" and "as available" for use, without warranties of any kind, either expressed or implied. Micromedex makes no representation or warranty as to the accuracy, reliability, timeliness, usefulness or completeness of any of the information contained in the POISINDEX(R) and MEDITEXT(R) databases. ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE OR USE ARE HEREBY EXCLUDED. Micromedex does not assume any responsibility or risk for your use of the POISINDEX(R) or MEDITEXT(R) databases. <p>The following Overview, ***
ACETALDEHYDE ***, is relevant for this HSDB record chemical.

LIFE SUPPORT:

- This overview assumes that basic life support measures have been instituted.

CLINICAL EFFECTS:

0.2.1 SUMMARY OF EXPOSURE

0.2.1.1 ACUTE EXPOSURE

A) This agent is a skin and mucous membrane irritant which causes a burning sensation of the nose, throat, and eyes. Prolonged exposure to high concentrations may injure the corneal epithelium causing persistent lacrimation, photophobia, and foreign body sensation.

B) Fatalities, following inhalation, are due to anesthesia when prompt and pulmonary edema when delayed. Very large exposures may cause death due to respiratory paralysis.

C) Prolonged skin contact may cause dermal erythema and burns. Repeated exposures may cause dermatitis due to primary irritation or sensitization.

D) Sympathomimetic effects of acetaldehyde include tachycardia, hypertension, and increased respiration. Bradycardia and hypotension occur at higher levels of acetaldehyde exposure.

0.2.3 VITAL SIGNS

0.2.3.1 ACUTE EXPOSURE

A) Increased ventilation, hypertension, and tachycardia are sympathomimetic effects which may develop at low levels of exposure.

B) Higher levels produce bradycardia and hypotension.

0.2.4 HEENT

0.2.4.1 ACUTE EXPOSURE

A) Human eye irritation begins to occur at 50 ppm in the

air and becomes excessive at 200 ppm. Splash contacts produce painful but superficial corneal injury. Changes in auditory sensitivity were noted in one foreign study of vapor exposures.

0.2.5 CARDIOVASCULAR

0.2.5.1 ACUTE EXPOSURE

A) In humans, systemic poisoning can result in sympathomimetic effects of tachycardia and hypertension.

B) Ventricular dysrhythmias have occurred in halothane anesthetized animals given acetaldehyde.

0.2.6 RESPIRATORY

0.2.6.1 ACUTE EXPOSURE

A) Acetaldehyde is a pulmonary irritant and may cause bronchitis and pulmonary edema when inhaled. Very high concentrations may result in respiratory paralysis.

0.2.7 NEUROLOGIC

0.2.7.1 ACUTE EXPOSURE

A) High serum concentrations have caused narcosis in animals.

0.2.8 GASTROINTESTINAL

0.2.8.1 ACUTE EXPOSURE

A) Liquid acetaldehyde is an emetic.

0.2.9 HEPATIC

0.2.9.1 ACUTE EXPOSURE

A) Acetaldehyde can impair mitochondrial respiration in the liver, similar to effects seen with ethanol.

0.2.14 DERMATOLOGIC

0.2.14.1 ACUTE EXPOSURE

A) Prolonged contact causes erythema and burns. Repeated exposures may cause dermatitis.

0.2.20 REPRODUCTIVE HAZARDS

A) No human reproductive effects were found at the time of this review. Acetaldehyde was detected in 4 out of 8 samples of human breast milk. Embryotoxicity and malformations have been seen in animals.

0.2.21 CARCINOGENICITY

0.2.21.1 IARC CATEGORY

A) IARC Carcinogenicity Ratings for CAS75-07-0 (IARC, 2004):

1) IARC Classification

a) Listed as: Acetaldehyde

b) Carcinogen Rating: 2B

1) The agent (mixture) is possibly carcinogenic to humans. The exposure circumstance entails exposures that are possibly carcinogenic to humans. This category is used for agents, mixtures and exposure circumstances for which there is limited evidence of carcinogenicity in humans and less than sufficient evidence of carcinogenicity in experimental animals. It may also be used when there is inadequate evidence of carcinogenicity in humans but there is sufficient evidence of carcinogenicity in experimental animals. In some instances, an agent, mixture or exposure circumstance for which there is inadequate evidence of carcinogenicity in humans but limited evidence of carcinogenicity in experimental

animals together with supporting evidence from other relevant data may be placed in this group.

0.2.21.2 HUMAN OVERVIEW

A) Acetaldehyde has been implicated as a cocarcinogen in the workplace. There was an increased incidence of total cancers in acetaldehyde production workers as compared with the general population, although this study failed to adjust for confounders.

0.2.21.3 ANIMAL OVERVIEW

A) Acetaldehyde is a carcinogen in rats and hamsters.

0.2.22 GENOTOXICITY

A) Acetaldehyde has been active in short-term assays for DNA damage and repair, mutagenicity, chromosome aberrations, sister chromatid exchanges, micronucleus test, and oncogenic transformation (HSDB , 2001; RTECS , 2001).

LABORATORY:

A) No toxic levels have been established. For significant exposures, base-line liver and kidney function tests may be indicated.

B) Monitor vital signs and chest x-ray in all significant exposures.

C) Monitor for signs of CNS depression following significant exposures.

TREATMENT OVERVIEW:

0.4.2 ORAL EXPOSURE

A) GASTRIC LAVAGE: Consider after ingestion of a potentially life-threatening amount of poison if it can be performed soon after ingestion (generally within 1 hour). Protect airway by placement in Trendelenburg and left lateral decubitus position or by endotracheal intubation. Control any seizures first.

1) CONTRAINDICATIONS: Loss of airway protective reflexes or decreased level of consciousness in unintubated patients; following ingestion of corrosives; hydrocarbons (high aspiration potential); patients at risk of hemorrhage or gastrointestinal perforation; and trivial or non-toxic ingestion.

B) ACTIVATED CHARCOAL: Administer charcoal as a slurry (240 mL water/30 g charcoal). Usual dose: 25 to 100 g in adults/adolescents, 25 to 50 g in children (1 to 12 years), and 1 g/kg in infants less than 1 year old.

C) EMESIS: Ipecac-induced emesis is not recommended because of the potential for CNS depression.

D) ACUTE LUNG INJURY: Maintain ventilation and oxygenation and evaluate with frequent arterial blood gas or pulse oximetry monitoring. Early use of PEEP and mechanical ventilation may be needed.

E) Acetaldehyde in high concentrations may result in narcosis; patients should be monitored for possible coma and respiratory depression.

0.4.3 INHALATION EXPOSURE

A) INHALATION: Move patient to fresh air. Monitor for respiratory distress. If cough or difficulty breathing develops, evaluate for respiratory tract irritation, bronchitis, or pneumonitis. Administer oxygen and assist ventilation as required. Treat bronchospasm with inhaled

beta2 agonist and oral or parenteral corticosteroids.
B) ACUTE LUNG INJURY: Maintain ventilation and oxygenation and evaluate with frequent arterial blood gas or pulse oximetry monitoring. Early use of PEEP and mechanical ventilation may be needed.
C) Acetaldehyde in high concentrations may result in narcosis so patients should be monitored for possible coma and respiratory depression.

0.4.4 EYE EXPOSURE

A) DECONTAMINATION: Irrigate exposed eyes with copious amounts of room temperature water for at least 15 minutes. If irritation, pain, swelling, lacrimation, or photophobia persist, the patient should be seen in a health care facility.

0.4.5 DERMAL EXPOSURE

A) OVERVIEW

1) DECONTAMINATION: Remove contaminated clothing and wash exposed area thoroughly with soap and water. A physician may need to examine the area if irritation or pain persists.

RANGE OF TOXICITY:

A) 50 ppm for 15 minutes will cause eye irritation in the majority of subjects.
B) Fatalities have occurred in animals exposed to levels of 16,000 ppm for four hours.

ANTIDOTE AND EMERGENCY TREATMENT:

Basic treatment: Establish a patent airway. Suction if necessary. Watch for signs of respiratory insufficiency and assist ventilations if necessary. Aggressive airway management may be necessary. Administer oxygen by nonrebreather mask at 10 to 15 L/min. Anticipate seizures and treat if necessary ... . Monitor for shock and treat if necessary ... . Monitor for pulmonary edema and treat if necessary ... . For eye contamination, flush eyes immediately with water. Irrigate each eye continuously with normal saline during transport ... . Do not use emetics.

For ingestion, rinse mouth and administer 5 ml/kg up to 200 ml of water for dilution if the patient can swallow, has a strong gag reflex, and does not drool. Administer activated charcoal ... . /Aldehydes and related compounds/ [Bronstein, A.C., P.L. Currance; Emergency Care for Hazardous Materials Exposure. 2nd ed. St. Louis, MO. Mosby Lifeline. 1994., p. 234-35]**PEER REVIEWED**

Advanced treatment: Consider orotracheal or nasotracheal intubation for airway control in the patient who is unconscious or in respiratory arrest.

Intubation should be considered at the first sign of upper airway obstruction caused by edema. Positive pressure ventilation techniques with a bag-valve-mask device may be beneficial. Start an IV with D5W /SRP: "To keep open", minimal flow rate/. Use lactated Ringer's if signs of hypovolemia are present. Watch for signs of fluid overload. Treat seizures with diazepam ... . For hypotension with signs of hypovolemia, administer fluid cautiously. Consider vasopressors if patient is hypotensive with a normal fluid volume. Watch for signs of fluid overload ... . Consider drug therapy for pulmonary edema ... . Use proparacaine hydrochloride to assist eye irrigation ... . /Aldehydes and related compounds/ [Bronstein, A.C., P.L. Currance; Emergency Care for Hazardous Materials Exposure. 2nd ed. St. Louis, MO. Mosby Lifeline. 1994., p. 235]**PEER REVIEWED**

ANIMAL TOXICITY STUDIES:

NON-HUMAN TOXICITY EXCERPTS:

... Anesthesia /noted/ in rats at high levels of inhalation for propionaldehyde & butyraldehyde. The survivors recovered promptly. Autopsies showed principally evidence of bronchial & alveolar inflammation. ... Rats tolerated inhalation of 90 ppm of propionaldehyde, for 20 days, 6 hr/day, with no obvious pathology, although 1300 ppm for 6 days produced hepatic damage. [Clayton, G.D., F.E. Clayton (eds.) Patty's Industrial Hygiene and Toxicology. Volumes 2A, 2B, 2C, 2D, 2E, 2F: Toxicology. 4th ed. New York, NY: John Wiley & Sons Inc., 1993-1994., p. 306]**PEER REVIEWED**

... Acute toxicity of aldehydes in mice, guinea pigs, and rabbits /have been studied/. all animals exposed to high levels by inhalation developed fatal pulmonary edema. /Higher aliphatic aldehydes/ [Clayton, G.D., F.E. Clayton (eds.) Patty's Industrial Hygiene and Toxicology. Volumes 2A, 2B, 2C, 2D, 2E, 2F: Toxicology. 4th ed. New York, NY: John Wiley & Sons Inc., 1993-1994., p. 306]**PEER REVIEWED**

THE LIQUID APPLIED AS A DROP TO RABBIT EYES PROVED ... DAMAGING, GRADED 8

ON A SCALE OF 1 TO 10 AFTER TWENTY-FOUR HOURS. [Grant, W.M. Toxicology of the Eye. 3rd ed. Springfield, IL: Charles C. Thomas Publisher, 1986., p. 165]**PEER REVIEWED**

RESPIRATION AND HEART BEAT WERE INCR IN MALE RABBITS EXPOSED TO 10-20 PPM BUTYLALDEHYDE. [IKEDA A ET AL; KANAGAWA-KEN TAIKI OSEN CHOSA KENKYU HOKOKU 22: 193 (1980)]**PEER REVIEWED**

THE CHANGES IN EXCITABILITY AND CONDUCTION PROPERTIES OF FROG SCIATIC NERVE UNDER THE INFLUENCE OF BUTYRALDEHYDE WERE EXAMINED IN THE CONCN RANGE 0.01-1.00% (WT/VOL) AND AT 20, 25, 30, AND 35 DEG. IT IRREVERSIBLY REDUCED THE AMPLITUDE OF THE CMPD ACTION POTENTIAL OF THE NERVE AND DECR THE CONDUCTION VELOCITY UP TO THE COMPLETE BLOCK. [MARGINEANU DG ET AL; ARCH INT PHYSIOL BIOCHIM 89 (2): 159 (1981)]**PEER REVIEWED**

Butyraldehyde was found to be negative when tested for mutagenicity using the Salmonella/microsome preincubation assay, using the standard protocol approved by the National Toxicology Program (NTP). Butyraldehyde was tested in as many as 5 Salmonella typhimurium strains (TA1535, TA1537, TA97, TA98, and TA100) in the presence and absence of rat and hamster liver S-9, at doses of 0.100, 0.333, 1.000, 3.333, and 10.000 mg/plate. The highest ineffective dose tested in any Salmonella typhimurium strain was 10.000 mg/plate. [Mortelmans K et al; Environ Mutagen 8: 1-119 (1986)]**PEER REVIEWED**

NON-HUMAN TOXICITY VALUES:

LD50 Rat oral 5.89 g/kg [Budavari, S. (ed.). The Merck Index - Encyclopedia of Chemicals, Drugs and Biologicals. Rahway, NJ: Merck and Co., Inc., 1989., p. 242]**PEER REVIEWED**

LC50 Rat inhalation 60,000 ppm/0.5 hr [Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983., p. 324]**PEER REVIEWED**

LD50 Rat oral 2,490 mg/kg [Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons,

1978-1984., p. V4 384 (1978)]**PEER REVIEWED**

LD50 Rat ip 800 mg/kg [Lewis, R.J. Sax's Dangerous Properties of Industrial Materials. 9th ed. Volumes 1-3. New York, NY: Van Nostrand Reinhold, 1996., p. 607]**PEER REVIEWED**

LC50 Mouse inhalation 44,610 mg/cu m/2 hr [Lewis, R.J. Sax's Dangerous Properties of Industrial Materials. 9th ed. Volumes 1-3. New York, NY: Van Nostrand Reinhold, 1996., p. 607]**PEER REVIEWED**

LD50 Mouse ip 1140 mg/kg [Lewis, R.J. Sax's Dangerous Properties of Industrial Materials. 9th ed. Volumes 1-3. New York, NY: Van Nostrand Reinhold, 1996., p. 607]**PEER REVIEWED**

LD50 Mouse sc 2700 mg/kg [Lewis, R.J. Sax's Dangerous Properties of Industrial Materials. 9th ed. Volumes 1-3. New York, NY: Van Nostrand Reinhold, 1996., p. 607]**PEER REVIEWED**

LD50 Rabbit skin 3560 mg/kg [Lewis, R.J. Sax's Dangerous Properties of Industrial Materials. 9th ed. Volumes 1-3. New York, NY: Van Nostrand Reinhold, 1996., p. 607]**PEER REVIEWED**

METABOLISM/PHARMACOKINETICS:

PHARMACOLOGY:

ENVIRONMENTAL FATE & EXPOSURE:

ENVIRONMENTAL FATE/EXPOSURE SUMMARY:

Butyraldehyde's production and use in the manufacture of rubber accelerators, synthetic resins, solvents, and plasticizers may result in its release to the environment through various waste streams.

Butyraldehyde has been detected in emissions from fireplaces burning wood, and has been detected in gasoline and diesel vehicle emissions.

Butyraldehyde can also occur in trace amounts in tea leaves, certain oils, coffee aroma, and tobacco smoke. If released to air, a vapor pressure of 111 mm Hg at 25 deg C indicates butyraldehyde will exist solely as a vapor

in the ambient atmosphere. Vapor-phase butyraldehyde will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 16.4 hrs. Butyraldehyde absorbs light in the environmental UV spectrum and has the potential for direct photolysis. If released to soil, butyraldehyde is expected to have high mobility based upon an estimated Koc of 72. Volatilization from moist soil surfaces is expected to be an important fate process based upon a Henry's Law constant of 1.2X10-4 atm-cu m/mole. Butyraldehyde may volatilize from dry soil surfaces based upon its vapor pressure. If released into water, butyraldehyde is not expected to adsorb to suspended solids and sediment based upon the estimated Koc. Butyraldehyde is expected to biodegrade rapidly under both aerobic and anaerobic conditions. Under aerobic conditions, butyraldehyde, present at 100 mg/l, reached > 100% of its theoretical BOD in 2 weeks using an activated sludge inoculum at 30 mg/l and the Japanese MITI test. Under anaerobic conditions, butyraldehyde underwent 99% degradation using a serum bottle technique. Volatilization from water surfaces is expected to be an important fate process based upon this compound's Henry's Law constant. Estimated volatilization half-lives for a model river and model lake are 5.2 hrs and 5.3 days, respectively. An estimated BCF of 3 suggests the potential for bioconcentration in aquatic organisms is low. Butyraldehyde is not expected to chemically hydrolyze in the environment due to the lack of hydrolyzable functional groups. Occupational exposure to butyraldehyde may occur through inhalation and dermal contact with this compound at workplaces where butyraldehyde is produced or used. Monitoring data indicate that the general population may be exposed to butyraldehyde via inhalation of ambient air containing butyraldehyde. (SRC) **PEER REVIEWED**

PROBABLE ROUTES OF HUMAN EXPOSURE:

NIOSH (NOES Survey 1981-1983) has statistically estimated that 5,392

workers (950 of these are female) are potentially exposed to butyraldehyde in the US(1). Occupational exposure to butyraldehyde may occur through inhalation and dermal contact with this compound at workplaces where butyraldehyde is produced or used(SRC). Monitoring data indicate that the general population may be exposed to butyraldehyde via inhalation of ambient air containing butyraldehyde(SRC). [(1) NIOSH; National Occupational Exposure Survey (NOES) (1983)]**PEER REVIEWED**

NATURAL POLLUTION SOURCES:
REPORTED FOUND IN THE ESSENTIAL OILS FROM FLOWERS, FRUITS, LEAVES, OR BARK OF: MONARDA FISTULOSA, LITSEA CUBEBA, BULGARIAN CLARY SAGE, CAJEPUT, EUCALYPTUS CINEREA, EUCALYPTUS GLOBULUS, & OTHERS, AS WELL AS IN APPLE & STRAWBERRY AROMAS. [Fenaroli's Handbook of Flavor Ingredients. Volume 2. Edited, translated, and revised by T.E. Furia and N. Bellanca. 2nd ed. Cleveland: The Chemical Rubber Co., 1975., p. 77]**PEER REVIEWED**

Carbonyl compounds, such as butyraldehyde, are formed in the atmosphere by photochemical oxidation of emitted hydrocarbons and other reactive organic gases(1); during smog pollution episodes that occur in the Los Angeles, CA area, the primary source of butyraldehyde that exists in the atmosphere may result from this photochemical generation(1). Microbial degradation processes and plant volatiles can emit butyraldehyde to the atmosphere(2). Butyraldehyde can also occur in trace amounts in tea leaves, certain oils, coffee aroma, and tobacco smoke(3). [(1) Grosjean D, Swanson RD; Sci Total Environ 29: 65-85 (1983) (2) Graedel TE; Chemical Compounds in the Atmosphere. NY, NY: Academic Press p. 164 (1976) (3) Billing E; Kirk-Othmer Encycl Chem Technol 4th ed. NY, NY: John Wiley & Sons 4: 736-47 (1992)]**PEER REVIEWED**

ARTIFICIAL POLLUTION SOURCES:
Butyraldehyde's production and use as in the manufacture of rubber accelerators, synthetic resins, solvents, and plasticizers(1) may result in its release to the environment through various waste streams(SRC).

Butyraldehyde has been detected in emissions from fireplaces burning wood(2), and has been detected in gasoline and diesel vehicle emissions(3-5). Volatile emissions from poultry manure contain butyraldehyde(6). Butyraldehyde can be released to the atmosphere in emissions from animal waste, coffee mfg, fish meal mfg, petroleum processing, and tobacco smoke(5). [(1) Tomlin CDS, ed; The Pesticide Manual World Compendium. 11th ed, Surrey, England: British Crop Protection Council, p. 261 (1997) (2) Lipari F et al; Environ Sci Technol 18: 326-30 (1984) (3) Jonsson A et al; Environ Int 11: 383-92 (1985) (4) Lopez B et al; Pollut Atmos 1987: 113-23 (1987) (5) Graedel TE; Chemical Compounds in the Atmosphere. NY, NY: Academic Press p. 164 (1976) (6) Yasuhara A; J Chromatogr 387: 371-8 (1987)]**PEER REVIEWED**

ENVIRONMENTAL FATE:

TERRESTRIAL FATE: Based on a classification scheme(1), an estimated Koc value of 72(SRC), determined from a log Kow of 0.88(2) and a regression-derived equation(3), indicates that butyraldehyde is expected to have high mobility in soil(SRC). Volatilization of butyraldehyde from moist soil surfaces is expected to be an important fate process(SRC) given a Henry's Law constant of 1.2X10-4 atm-cu m/mole(4). The potential for volatilization of butyraldehyde from dry soil surfaces may exist(SRC) based upon a vapor pressure of 111 mm Hg(5). Butyraldehyde is expected to biodegrade rapidly under both aerobic(6) and anaerobic(7) conditions. Under aerobic conditions, butyraldehyde, present at 100 mg/l, reached > 100% of its theoretical BOD in 2 weeks using an activated sludge inoculum at 30 mg/l and the Japanese MITI test(6). Under anaerobic conditions, butyraldehyde underwent 99% degradation (7 day lag period) using the Hungate serum bottle technique(8). [(1) Swann RL et al; Res Rev 85: 17-28 (1983) (2) Hansch C et al; Exploring QSAR. Hydrophobic, Electronic, and Steric Constants. ACS Prof Ref Book. Heller SR, consult. ed., Washington, DC: Amer Chem Soc p. 9 (1995) (3) Lyman WJ et al; Handbook of Chemical Property Estimation Methods. Washington, DC: Amer

Chem Soc pp. 4-9 (1990) (4) Buttery RG et al; J Agric Food Chem 17: 385-9
(1969) (5) Daubert TE, Danner RP; Physical and Thermodynamic Properties of
Pure Chemicals: Data Compilation. Design Inst Phys Prop Data, Amer Inst
Chem Eng NY, NY: Hemisphere Pub Corp (1989) (6) CITI; Biodegradation and
Bioaccumulation Data of Existing Chemicals. Butyraldehyde (123-72-8).
Available from the Database Query page at
http://www.cerij.or.jp/ceri_en/index_e4.shtml as May 8, 2001. (7) Speece
RE; Environ Sci Technol 17: 416A-27A (1983) (8) Chou WL et al; Biotechnol
Bioeng Symp 8: 391-414 (1979)]**PEER REVIEWED**

AQUATIC FATE: Based on a classification scheme(1), an estimated Koc value
of 72(SRC), determined from a log Kow of 0.88(2) and a regression-derived
equation(3), indicates that butyraldehyde is not expected to adsorb to
suspended solids and sediment(SRC). Volatilization from water surfaces is
expected(3) based upon a Henry's Law constant of 1.2X10-4 atm-cu
m/mole(4). Using this Henry's Law constant and an estimation method(3),
volatilization half-lives for a model river and model lake are 5.2 hrs and
5.3 days, respectively(SRC). According to a classification scheme(5), an
estimated BCF of 3(SRC), from its log Kow(2) and a regression-derived
equation(6), suggests the potential for bioconcentration in aquatic
organisms is low(SRC). Butyraldehyde is expected to biodegrade rapidly
under both aerobic(7) and anaerobic(8) conditions. Under aerobic
conditions, butyraldehyde, present at 100 mg/l, reached > 100% of its
theoretical BOD in 2 weeks using an activated sludge inoculum at 30 mg/l
and the Japanese MITI test(7). Under anaerobic conditions, butyraldehyde
underwent 99% degradation (7 day lag period) using the Hungate serum
bottle technique(9). [(1) Swann RL et al; Res Rev 85: 17-28 (1983) (2)
Hansch C et al; Exploring QSAR. Hydrophobic, Electronic, and Steric
Constants. ACS Prof Ref Book. Heller SR, consult. ed., Washington, DC:
Amer Chem Soc p. 9 (1995) (3) Lyman WJ et al; Handbook of Chemical
Property Estimation Methods. Washington, DC: Amer Chem Soc pp. 4-9, 15-1

to 15-29 (1990) (4) Buttery RG et al; J Agric Food Chem 17: 385-9 (1969)
(5) Franke C et al; Chemosphere 29: 1501-14 (1994) (6) Meylan WM et al;
Environ Toxicol Chem 18: 664-72 (1999) (7) CITI; Biodegradation and
Bioaccumulation Data of Existing Chemicals. Butyraldehyde (123-72-8).
Available from the Database Query page at
http://www.cerij.or.jp/ceri_en/index_e4.shtml as May 8, 2001. (8) Speece
RE; Environ Sci Technol 17: 416A-27A (1983) (9) Chou WL et al; Biotechnol
Bioeng Symp 8: 391-414 (1979)]**PEER REVIEWED**

ATMOSPHERIC FATE: According to a model of gas/particle partitioning of
semivolatile organic compounds in the atmosphere(1), butyraldehyde, which
has a vapor pressure of 111 mm Hg at 25 deg C(2), is expected to exist
solely as a vapor in the ambient atmosphere(SRC). Vapor-phase
butyraldehyde is degraded in the atmosphere by reaction with
photochemically-produced hydroxyl radicals(SRC); the half-life for this
reaction in air is 16.4 hrs(SRC), calculated from its rate constant of
2.4X10-11 cu cm/molecule-sec at 25 deg C(3). Based upon analogy to
acetaldehyde and propionaldehyde, the direct photolysis rate constant for
butyraldehyde in air is about 4X10-5 sec-1(4), which corresponds to a
half-life of about 4.8 hours(SRC). [(1) Bidleman TF; Environ Sci Technol
22: 361-367 (1988) (2) Daubert TE, Danner RP; Physical and Thermodynamic
Properties of Pure Chemicals: Data Compilation. Design Inst Phys Prop
Data, Amer Inst Chem Eng NY, NY: Hemisphere Pub Corp (1989) (3) Atkinson
R; Chem Rev 85: 69-201 (1985) (4) Grosjean D, Swanson RD; Sci Total
Environ 29: 65-85 (1983)]**PEER REVIEWED**

ENVIRONMENTAL BIODEGRADATION:
AEROBIC: Butyraldehyde, present at 100 mg/l, reached > 100% of its
theoretical BOD in 2 weeks using an activated sludge inoculum at 30 mg/l
and the Japanese MITI test(1). Butyraldehyde had a 5-day theoretical BOD
of 28% using the AFNOR T test and an inoculum from 3 polluted surface
waters(2). Using a sewage inocula and standard dilution water,
butyraldehyde had a 5-day theoretical BOD of 43%(3). Theoretical BODs of

43.4, 59.8, and 68% were measured after 5, 10, and 50 days, respectively, using a sewage seed(4). A 5-day theoretical BOD of 106% was reported for a sewage inocula(5). Using an electrolytic respirometer and an activated sludge inocula, theoretical BODs of 46-57% were observed after 90-135 hr of incubation(6). Butyraldehyde is expected to biodegrade rapidly under aerobic conditions(SRC). [(1) CITI; Biodegradation and Bioaccumulation Data of Existing Chemicals. Butyraldehyde (123-72-8). Available from the Database Query page at http://www.cerij.or.jp/ceri_en/index_e4.shtml as May 8, 2001. (2) Dore M et al; Trib Cebedeau 28: 3-11 (1975) (3) Heukelekian H, Rand MC; J Water Pollut Control Assoc 27: 1040-53 (1955) (4) Ettinger MB; Ind Eng Chem 48: 256-9 (1956) (5) Stafford W, Northrup HJ; Amer Dyestuff Reporter 44: 355-9 (1955) (6) Urano K, Kato Z; J Hazardous Mater 13: 135-45 (1986)]**PEER REVIEWED**

ANAEROBIC: Butyraldehyde underwent 99% degradation (7 day lag period) under anaerobic conditions using the Hungate serum bottle technique(1). Degradation in anaerobic reactor (after 52 days of acclimation) was 82%(1). Butyraldehyde is considered amendable to anaerobic biodegradation(2). [(1) Chou WL et al; Biotechnol Bioeng Symp 8: 391-414 (1979) (2) Speece RE; Environ Sci Technol 17: 416A-27A (1983)]**PEER REVIEWED**

ENVIRONMENTAL ABIOTIC DEGRADATION:

The rate constant for the vapor-phase reaction of butyraldehyde with photochemically-produced hydroxyl radicals is 2.4X10-11 cu cm/molecule-sec at 25 deg C(1). This corresponds to an atmospheric half-life of about 16.4 hours at an atmospheric concentration of 5X10+5 hydroxyl radicals per cu cm(SRC). The rate constant for the reaction between photochemically produced hydroxyl radicals in water and butyraldehyde is 3.9X10+9 L/mole-sec(2); assuming that the concn of hydroxyl radicals in brightly sunlit natural water is 1X10-17 M, the half-life would be about 206 days(SRC). Butyraldehyde is not expected to chemically hydrolyze in the

environment due to the lack of hydrolyzable functional groups(3). Based upon analogy to acetaldehyde and propionaldehyde, the direct photolysis rate constant for butyraldehyde in air is about 4X10-5 sec-1(4), which corresponds to a half-life of about 4.8 hours(SRC). [(1) Atkinson R; Chem Rev 85: 69-201 (1985) (2) Buxton GV et al; J Phys Chem Ref Data 17: 706 (1988) (3) Lyman WJ et al; Handbook of Chemical Property Estimation Methods Washington, DC: Amer Chem Soc p. 7-4 (1990) (4) Grosjean D, Swanson RD; Sci Total Environ 29: 65-85 (1983)]**PEER REVIEWED**

ENVIRONMENTAL BIOCONCENTRATION:
An estimated BCF of 3 was calculated for butyraldehyde(SRC), using a log Kow of 0.88(1) and a regression-derived equation(2). According to a classification scheme(3), this BCF suggests the potential for bioconcentration in aquatic organisms is low(SRC). [(1) Hansch C et al; Exploring QSAR. Hydrophobic, Electronic, and Steric Constants. ACS Prof Ref Book. Heller SR, consult. ed., Washington, DC: Amer Chem Soc p. 9 (1995) (2) Meylan WM et al; Environ Toxicol Chem 18: 664-72 (1999) (3) Franke C et al; Chemosphere 29: 1501-14 (1994)]**PEER REVIEWED**

SOIL ADSORPTION/MOBILITY:
The Koc of butyraldehyde is estimated as 72(SRC), using a log Kow of 0.88(1) and a regression-derived equation(2). According to a classification scheme(3), this estimated Koc value suggests that butyraldehyde is expected to have high mobility in soil(SRC). [(1) Hansch C et al; Exploring QSAR. Hydrophobic, Electronic, and Steric Constants. ACS Prof Ref Book. Heller SR, consult. ed., Washington, DC: Amer Chem Soc p. 9 (1995) (2) Lyman WJ et al; Handbook of Chemical Property Estimation Methods. Washington, DC: Amer Chem Soc pp. 4-9 (1990) (3) Swann RL et al; Res Rev 85: 17-28 (1983)]**PEER REVIEWED**

VOLATILIZATION FROM WATER/SOIL:
The Henry's Law constant for butyraldehyde is 1.2X10-4 atm-cu m/mole(1). This Henry's Law constant indicates that butyraldehyde is expected to volatilize from water surfaces(2). Based on this Henry's Law constant, the

volatilization half-life from a model river (1 m deep, flowing 1 m/sec, wind velocity of 3 m/sec)(2) is estimated as 5.2 hours(SRC). The volatilization half-life from a model lake (1 m deep, flowing 0.05 m/sec, wind velocity of 0.5 m/sec)(2) is estimated as 5.3 days(SRC). Butyraldehyde's Henry's Law constant(1) indicates that volatilization from moist soil surfaces may occur(SRC). The potential for volatilization of butyraldehyde from dry soil surfaces may exist(SRC) based upon a vapor pressure of 111 mm Hg(3). [(1) Buttery RG et al; J Agric Food Chem 17: 385-9 (1969) (2) Lyman WJ et al; Handbook of Chemical Property Estimation Methods. Washington, DC: Amer Chem Soc pp. 15-1 to 15-29 (1990) (3) Daubert TE, Danner RP; Physical and Thermodynamic Properties of Pure Chemicals: Data Compilation. Design Inst Phys Prop Data, Amer Inst Chem Eng NY, NY: Hemisphere Pub Corp (1989)]**PEER REVIEWED**

ENVIRONMENTAL WATER CONCENTRATIONS:
DRINKING WATER: Butyraldehyde has reportedly been detected in drinking water samples collected in the US (concn or locations not reported)(1). [(1) Kopfler FC et al; Adv Environ Sci Technol 8(Fate Pollut Air Water Environ): 419-33 (1977)]**PEER REVIEWED**

SURFACE WATER: Butyraldehyde was qualitatively detected in Niagara River water flowing into Lake Ontario(1). [(1) Great Lakes Water Quality Board; An Inventory of Chemical Substances Identified in the Great Lakes Ecosystem, Volume 1 - Summary. Report to the Great Lakes Water Quality Board. Windsor Ontario, Canada p. 57 (1983)]**PEER REVIEWED**

SEAWATER: Seawater samples collected from the Straits of Florida on Feb 27, 1968 contained butyraldehyde levels ranging from a trace (0.005 mg/L) to 0.048 mg/L(1). [(1) Corwin JF; Bull Marine Sci 19: 504-9 (1969)]**PEER REVIEWED**

RAIN/SNOW: Butyraldehyde levels of 0-0.52 ug/mL (mean 0.07 ug/mL) have been detected in cloud water collected from Henninger Flats, CA(1); levels of 0-0.052 ug/mL have been detected in fog water collected from Pasadena,

CA(1). [(1) Grosjean D, Wright B; Atmos Environ 17: 2093-6 (1983)]**PEER REVIEWED**

EFFLUENT CONCENTRATIONS:
A butyraldehyde concn of 42 ppb was detected in an aqueous effluent from a coal gasification facility in Morgantown, WV(1). Butyraldehyde emission rates of 0.01-0.90 g/kg wood have been detected in emissions from fireplaces burning jack pine and red oak wood(2). Butyraldehyde was detected in 2 of 63 effluents (concn < 100 ppb) collected from chemical manufacturing plants across the US(3). The emission rate of butyraldehyde in the gas-phase from medium duty diesel trucks and from particle board/carpet degassing are 1,300 ug per km driven(4) and 0.047 mg/sq m-hr(5), respectively. [(1) Pellizzari ED et al; ASTM Spec Tech Publ, STP 686: 256-74 (1979) (2) Lipari F et al; Environ Sci Technol 18: 326-30 (1984) (3) Perry DL et al; Identification of Organic Compounds in Industrial Effluent Discharges. USEPA-600/4-79-016 (NTIS PB-294794) p. 44 (1979) (4) Schauer JJ et al; Environ Sci Technol 33: 1578-7 (1999) (5) Colombo A et al; Sci Tot Environ 91: 237-49 (1990)]**PEER REVIEWED**

ATMOSPHERIC CONCENTRATIONS:
URBAN/SUBURBAN: The gas-phase concn of butyraldehyde in ambient Los Angeles, CA air during photochemical pollution episodes (July-Oct 1980) ranged from 0 to 7 ppb with a median conc of about 1.5 ppb(1); particulate-phase conc during the same pollution episodes was 0 to 0.098 ug/cu m which was less than one percent total airborn conc(1). Air sample collected from Claremont, CA in Sept 1985 contained butyraldehyde levels of 0.2 to 0.8 ppb(2); sampling was not conducted during any smog/pollution episodes, therefore, airborn levels were smaller than reported above(1,2).
Butyraldehyde levels in Los Angeles, CA air in the fall of 1981 were 0-5 ppb(3). A field monitoring study along a highway in Raleigh, NC in May 1983 detected butyraldehyde levels of 2.88-7.29 ppb(4); the primary source of the butyraldehyde was considered to be exhaust from cars and trucks(4).
The concn of butyraldehyde in outdoor air near 4 residences during the

winter of 1993 and 9 residences during the summer of 1993 from greater Boston, MA area were 0.26 ppb (range, 0.0-0.51 ppb) and 0.13 ppb (range, 0.0-0.58 ppb), respectively(5). [(1) Grosjean D; Environ Sci Technol 16: 254-62 (1982) (2) Grosjean D; Atmos Environ 22: 1637-48 (1988) (3) Grosjean D, Fung K; J Air Pollut Control Assoc 34: 537-43 (1984) (4) Zweidinger RB et al; Environ Sci Technol 22: 956-62 (1988) (5) Reiss R et al; J Air Waste Manage Assoc 45: 811-22 (1995)]**PEER REVIEWED**

INDOOR: The concn of butyraldehyde in indoor air of 4 residences during the winter of 1993 and 9 residences during the summer of 1993 from greater Boston, MA area were 0.62 ppb (range, 0.37-0.98 ppb) and 0.56 ppb (range, 0.15-1.5 ppb), respectively(1). [(1) Reiss R et al; J Air Waste Manage Assoc 45: 811-22 (1995)]**PEER REVIEWED**

FOOD SURVEY VALUES:
Butyraldehyde has been qualitatively detected as a volatile component of raw chicken breast muscle(1) and fried chicken(2). [(1) Grey TC, Shrimpton DH; Brit Poultry Sci 8: 23-33 (1967) (2) Tang J et al; J Agric Food Chem 31: 1287-92 (1981)]**PEER REVIEWED**

MILK CONCENTRATIONS:
Butyraldehyde was qualitatively detected in 6 of 12 samples of human milk collected from volunteers in Bayonne, NJ, Jersey City, NJ, Bridgeville, PA, and Baton Rouge, LA(1). [(1) Pellizzari ED et al; Bull Environ Contam Toxicol 28: 322-8 (1982)]**PEER REVIEWED**

ENVIRONMENTAL STANDARDS & REGULATIONS:

TSCA REQUIREMENTS:
Pursuant to section 8(d) of TSCA, EPA promulgated a model Health and Safety Data Reporting Rule. The section 8(d) model rule requires manufacturers, importers, and processors of listed chemical substances and mixtures to submit to EPA copies and lists of unpublished health and safety studies. Butanal is included on this list. [40 CFR 716.120 (7/1/2000)]**PEER REVIEWED**

ATMOSPHERIC STANDARDS:
This action promulgates standards of performance for equipment leaks of Volatile Organic Compounds (VOC) in the Synthetic Organic Chemical Manufacturing Industry (SOCMI). The intended effect of these standards is to require all newly constructed, modified, and reconstructed SOCMI process units to use the best demonstrated system of continuous emission reduction for equipment leaks of VOC, considering costs, non air quality health and environmental impact and energy requirements. Butyraldehyde is produced, as an intermediate or a final product, by process units covered under this subpart. [40 CFR 60.489 (7/1/2000)]**PEER REVIEWED**

FDA REQUIREMENTS:
Butyraldehyde is a food additive permitted for direct addition to food for human consumption as a synthetic flavoring substance and adjuvant in accordance with the following conditions: a) they are used in the minimum quantity required to produce their intended effect, and otherwise in accordance with all the principles of good manufacturing practice, and 2) they consist of one or more of the following, used alone or in combination with flavoring substances and adjuvants generally recognized as safe in food, prior-sanctioned for such use, or regulated by an appropriate section in this part. [21 CFR 172.515 (4/1/2000)]**PEER REVIEWED**

Butyraldehyde is an indirect food additive for use only as a component of adhesives. [21 CFR 175.105 (4/1/2000)]**PEER REVIEWED**

CHEMICAL/PHYSICAL PROPERTIES:

MOLECULAR FORMULA:
C4-H8-O **PEER REVIEWED**

MOLECULAR WEIGHT:
72.11 [Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996., p. 261]**PEER REVIEWED**

COLOR/FORM:
COLORLESS LIQUID [National Fire Protection Guide. Fire Protection Guide on Hazardous Materials. 10 th ed. Quincy, MA: National Fire Protection Association, 1991., p. 49-44]**PEER REVIEWED**

Water-white liquid [Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 13th ed. New York, NY: John Wiley & Sons, Inc. 1997., p. 185]**PEER REVIEWED**

ODOR:
Characteristic, pungent, aldehyde odor [Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 13th ed. New York, NY: John Wiley & Sons, Inc. 1997., p. 185]**PEER REVIEWED**

BOILING POINT:
74.8 deg C [Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996., p. 261]**PEER REVIEWED**

MELTING POINT:
-99 deg C [Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996., p. 261]**PEER REVIEWED**

CRITICAL TEMPERATURE & PRESSURE:
Critical temperature: 263.95 deg C; Critical pressure: 30,003 mm Hg (4000 kPa) [Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present., p. V4 (1992) 740]**PEER REVIEWED**

DENSITY/SPECIFIC GRAVITY:
0.8016 @ 20 deg C/4 deg C [Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996., p. 261]**PEER REVIEWED**

HEAT OF COMBUSTION:
2479.34 kJ/mol @ 25 deg C (liquid) [Riddick, J.A., W.B. Bunger, Sakano T.K. Techniques of Chemistry 4th ed., Volume II. Organic Solvents. New York, NY: John Wiley and Sons., 1985., p. 330]**PEER REVIEWED**

HEAT OF VAPORIZATION:
33.68 kJ/mol @ 25 deg C [Riddick, J.A., W.B. Bunger, Sakano T.K. Techniques of Chemistry 4th ed., Volume II. Organic Solvents. New York, NY: John Wiley and Sons., 1985., p. 3309]**PEER REVIEWED**

OCTANOL/WATER PARTITION COEFFICIENT:
log Kow = 0.88 [Hansch, C., Leo, A., D. Hoekman. Exploring QSAR - Hydrophobic, Electronic, and Steric Constants. Washington, DC: American Chemical Society., 1995., p. 9]**PEER REVIEWED**

SOLUBILITIES:
Sol in ethanol, ether, ethyl acetate, acetone, toluene; sol in oils
[Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996., p. 261]**PEER REVIEWED**

SOL IN BENZENE [Lide, D.R. (ed). CRC Handbook of Chemistry and Physics. 72nd ed. Boca Raton, FL: CRC Press, 1991-1992., p. 3-149]**PEER REVIEWED**

In water, 7.10X10+4 mg/l @ 25 deg C [Yalkowsky SH, Dannenfelser RM; The AQUASOL dATAbASE of Aqueous Solubility. Fifth ed, Tucson,AZ: Univ Az, College of Pharmacy (1992)]**PEER REVIEWED**

SPECTRAL PROPERTIES:
Index of refraction: 1.379 @ 20 deg C/D [Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996., p. 261]**PEER REVIEWED**

MAX ABSORPTION (WATER): 225 NM (LOG E= 1.07); 282 NM (LOG E= 1.13) [Weast, R.C. (ed.). Handbook of Chemistry and Physics. 60th ed. Boca Raton, Florida: CRC Press Inc., 1979., p. C-217]**PEER REVIEWED**

IR: 333 (Sadtler Research Laboratories Prism Collection) [Lide, D.R., G.W.A. Milne (eds.). Handbook of Data on Organic Compounds. Volume I. 3rd ed. CRC Press, Inc. Boca Raton ,FL. 1994., p. V2 1749]**PEER REVIEWED**

UV: 1-33 (Organic Electronic Spectral Data, Phillips et al, John Wiley & Sons, New York) [Lide, D.R., G.W.A. Milne (eds.). Handbook of Data

on Organic Compounds. Volume I. 3rd ed. CRC Press, Inc. Boca Raton ,FL.
1994., p. V2 1749]**PEER REVIEWED**

NMR: 78 (Varian Associates NMR Spectra Catalogue) [Lide, D.R., G.W.A.
Milne (eds.). Handbook of Data on Organic Compounds. Volume I. 3rd ed. CRC
Press, Inc. Boca Raton ,FL. 1994., p. V2 1749]**PEER REVIEWED**

MASS: NIST 61771 (NIST/EPA/MCDC Mass Spectral Database 1990 version)
[Lide, D.R., G.W.A. Milne (eds.). Handbook of Data on Organic Compounds.
Volume I. 3rd ed. CRC Press, Inc. Boca Raton ,FL. 1994., p. V2 1749]**PEER
REVIEWED**

13C NMR: JJ 74 (Johnson and Jankowski; Carbon-13 NMR for Organic Chemists,
John Wiley and Sons, NY) [Lide, D.R., G.W.A. Milne (eds.). Handbook of
Data on Organic Compounds. Volume I. 3rd ed. CRC Press, Inc. Boca Raton
,FL. 1994., p. V2 1749]**PEER REVIEWED**

SURFACE TENSION:
29.9 dyn/cm @ 24 deg C [Riddick, J.A., W.B. Bunger, Sakano T.K. Techniques
of Chemistry 4th ed., Volume II. Organic Solvents. New York, NY: John
Wiley and Sons., 1985., p. 330]**PEER REVIEWED**

VAPOR DENSITY:
2.5 (AIR= 1) [National Fire Protection Guide. Fire Protection Guide on
Hazardous Materials. 10 th ed. Quincy, MA: National Fire Protection
Association, 1991., p. 325M-25]**PEER REVIEWED**

VAPOR PRESSURE:
111 mm Hg @ 25 deg C [Daubert, T.E., R.P. Danner. Physical and
Thermodynamic Properties of Pure Chemicals Data Compilation. Washington,
D.C.: Taylor and Francis, 1989., p.]**PEER REVIEWED**

VISCOSITY:
0.0043 Poise @ 20 deg C [Lewis, R.J., Sr (Ed.). Hawley's Condensed
Chemical Dictionary. 13th ed. New York, NY: John Wiley & Sons, Inc.
1997., p. 185]**PEER REVIEWED**

OTHER CHEMICAL/PHYSICAL PROPERTIES:
Wt/gal: 6.7 lb @ 20 deg C; Coefficient of expansion: 0.00114 @ 20 deg C

[Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 13th ed.
New York, NY: John Wiley & Sons, Inc. 1997., p. 185]**PEER REVIEWED**

Henry's Law constant = 1.15X10-4 atm-cu m/mole @ 25 deg C [Buttery RG et
al; J Agric Food Chem 17: 385-9 (1969)]**PEER REVIEWED**

/BUTYRALDEHYDE IS/ ... OXIDIZED VERY POORLY OR NOT AT ALL. [The Chemical
Society. Foreign Compound Metabolism in Mammals Volume 3. London: The
Chemical Society, 1975., p. 516]**PEER REVIEWED**

Hydroxyl radical reaction rate constant = 2.35X10-11 cu cm/molecule-sec @
25 deg C [Atkinson R; Chem Rev 85: 69-201 (1985)]**PEER REVIEWED**

CHEMICAL SAFETY & HANDLING:

DOT EMERGENCY GUIDELINES:

Fire or explosion: Highly flammable: Will be easily ignited by heat,
sparks or flames. Vapors may form explosive mixtures with air. Vapors may
travel to source of ignition and flash back. Most vapors are heavier than
air. They will spread along ground and collect in low confined areas
(sewers, basements, tanks). Vapor explosion hazard indoors, outdoors or in
sewers. Those substances labeled "P" may polymerize explosively when
heated or involved in a fire. Runoff to sewer may create fire or explosion
hazard. Containers may explode when heated. Many liquids are lighter than
water. [U.S. Department of Transportation. 2000 Emergency Response
Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government
Printing Office, 2000,p. G-129]**QC REVIEWED**

Health: May cause toxic effects if inhaled or absorbed through skin.
Inhalation or contact with material may irritate or burn skin and eyes.
Fire will produce irritating, corrosive and/or toxic gases. Vapors may
cause dizziness or suffocation. Runoff from fire control or dilution water
may cause pollution. [U.S. Department of Transportation. 2000 Emergency

Response Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government Printing Office, 2000,p. G-129]**QC REVIEWED**

Public safety: Call Emergency Response Telephone Number. ... Isolate spill or leak area immediately for at least 50 to lOO meters (160 to 330 feet) in all directions. Keep unauthorized personnel away. Stay upwind. Keep out of low areas. Ventilate closed spaces before entering. [U.S. Department of Transportation. 2000 Emergency Response Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government Printing Office, 2000,p. G-129]**QC REVIEWED**

Protective clothing: Wear positive pressure self-contained breathing apparatus (SCBA). Structural firefighters' protective clothing will only provide limited protection. [U.S. Department of Transportation. 2000 Emergency Response Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government Printing Office, 2000,p. G-129]**QC REVIEWED**

Evacuation: ... Fire: If tank, rail car or tank truck is involved in a fire, isolate for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions. [U.S. Department of Transportation. 2000 Emergency Response Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government Printing Office, 2000,p. G-129]**QC REVIEWED**

Fire: Caution: All these products have a very low flash point: Use of water spray when fighting fire may be inefficient. Small fires: Dry chemical, CO2, water spray or alcohol-resistant foam. Do not use dry chemical extinguishers to control fires involving nitromethane or nitroethane. Large fires: Water spray, fog or alcohol-resistant foam. Do not use straight streams. Move containers from fire area if you can do it without risk. Fire involving tanks or car/trailer loads: Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Cool containers with flooding quantities of water until well after fire is out.

Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire.

For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. [U.S. Department of Transportation. 2000 Emergency Response Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government Printing Office, 2000,p. G-129]**QC REVIEWED**

Spill or leak: Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). All equipment used when handling the product must be grounded. Do not touch or walk through spilled material. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. A vapor suppressing foam may be used to reduce vapors. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Use clean non-sparking tools to collect absorbed material. Large spills: Dike far ahead of liquid spill for later disposal. Water spray may reduce vapor; but may not prevent ignition in closed spaces. [U.S. Department of Transportation. 2000 Emergency Response Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government Printing Office, 2000,p. G-129]**QC REVIEWED**

First aid: Move victim to fresh air. Call 911 or emergency medical service. Apply artificial respiration if victim is not breathing. Administer oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. Wash skin with soap and water. Keep victim warm and quiet. Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. [U.S. Department of Transportation. 2000 Emergency Response Guidebook. RSPA P 5800.8 Edition.

Washington, D.C: U.S. Government Printing Office, 2000,p. G-129]**QC
REVIEWED**

SKIN, EYE AND RESPIRATORY IRRITATIONS:
Eye, nose, skin, and throat irritant. [National Fire Protection Guide.
Fire Protection Guide on Hazardous Materials. 10 th ed. Quincy, MA:
National Fire Protection Association, 1991., p. 49-43]**PEER REVIEWED**

FIRE POTENTIAL:
Highly flammable liquid. [Lewis, R.J. Sax's Dangerous Properties of
Industrial Materials. 9th ed. Volumes 1-3. New York, NY: Van Nostrand
Reinhold, 1996., p. 607]**PEER REVIEWED**

NFPA HAZARD CLASSIFICATION:
Health: 3. 3= Materials that, on short exposure, could cause serious
temporary or residual injury, including those requiring protection from
all bodily contact. Fire fighters may enter the area only if they are
protected from all contact with the material. Full protective clothing,
including self-contained breathing apparatus, coat, pants, gloves, boots,
and bands around legs, arms, and waist, should be provided. No skin
surface should be exposed. [Fire Protection Guide to Hazardous Materials.
12 ed. Quincy, MA: National Fire Protection Association, 1997., p.
325-24]**PEER REVIEWED**

Flammability: 3. 3= This degree includes Class IB and IC flammable liquids
and materials that can be easily ignited under almost all normal
temperature conditions. Water may be ineffective in controlling or
extinguishing fires in such materials. [Fire Protection Guide to Hazardous
Materials. 12 ed. Quincy, MA: National Fire Protection Association,
1997., p. 325-24]**PEER REVIEWED**

Reactivity: 0. 0= This degree includes materials that are normally stable,
even under fire exposure conditions, and that do not react with water.
Normal fire fighting procedures may be used. [Fire Protection Guide to
Hazardous Materials. 12 ed. Quincy, MA: National Fire Protection
Association, 1997., p. 325-24]**PEER REVIEWED**

FLAMMABLE LIMITS:
Lower: 1.9% by volume; Upper: 12.5% by volume. [Prager, J.C. Environmental Contaminant Reference Databook Volume 1. New York, NY: Van Nostrand Reinhold, 1995., p. 357]**PEER REVIEWED**

FLASH POINT:
-8 DEG F (-22 DEG C) (CLOSED CUP) [Fire Protection Guide to Hazardous Materials. 12 ed. Quincy, MA: National Fire Protection Association, 1997., p. 325-24]**PEER REVIEWED**

AUTOIGNITION TEMPERATURE:
425 DEG F [Fire Protection Guide to Hazardous Materials. 12 ed. Quincy, MA: National Fire Protection Association, 1997., p. 325-24]**PEER REVIEWED**

FIRE FIGHTING PROCEDURES:
Use dry chemical, foam, or carbon dioxide. Water may be ineffective but should be used to keep fire-exposed containers cool. Fight fire from protected location or maximum possible distance. [Prager, J.C. Environmental Contaminant Reference Databook Volume 1. New York, NY: Van Nostrand Reinhold, 1995., p. 357]**PEER REVIEWED**

Fight fire from protected location or maximum possible distance. Use dry chemical, foam, carbon dioxide. Water may be ineffective. Use water spray to keep fire-exposed containers cool. [Fire Protection Guide to Hazardous Materials. 12 ed. Quincy, MA: National Fire Protection Association, 1997., p. 49-32]**PEER REVIEWED**

FIREFIGHTING HAZARDS:
Flammable liquid. Forms explosive peroxides. Vapors are heavier than air and may travel to a source of ignition and flash back. Combustion may produce irritants and toxic gases. Closed containers may rupture violently when heated. [Fire Protection Guide to Hazardous Materials. 12 ed. Quincy, MA: National Fire Protection Association, 1997., p. 49-32]**PEER REVIEWED**

EXPLOSIVE LIMITS & POTENTIAL:
LOWER: 1.9%; UPPER: 12.5%; EXPLOSIVE PEROXIDES MAY BE FORMED IN THE AIR.

[Fire Protection Guide to Hazardous Materials. 12 ed. Quincy, MA:
National Fire Protection Association, 1997., p. 49-32]**PEER REVIEWED**

HAZARDOUS REACTIVITIES & INCOMPATIBILITIES:
Incompatible with oxidizing materials. [Lewis, R.J. Sax's Dangerous
Properties of Industrial Materials. 9th ed. Volumes 1-3. New York, NY: Van
Nostrand Reinhold, 1996., p. 607]**PEER REVIEWED**

Reacts vigorously with chlorosulfonic acid, /nitric acid/, oleum,
/sulfuric acid/. [Lewis, R.J. Sax's Dangerous Properties of Industrial
Materials. 9th ed. Volumes 1-3. New York, NY: Van Nostrand Reinhold,
1996., p. 607]**PEER REVIEWED**

Butyraldehyde mixed with chlorosulfonic acid, 70% nitric acid, oleum, or
96% sulfuric acid in closed containers causes the temperature, and
pressure to increase. [Prager, J.C. Environmental Contaminant Reference
Databook Volume 1. New York, NY: Van Nostrand Reinhold, 1995., p.
357]**PEER REVIEWED**

HAZARDOUS DECOMPOSITION:
When heated to decomposition it emits acrid smoke and fumes. [Lewis, R.J.
Sax's Dangerous Properties of Industrial Materials. 9th ed. Volumes 1-3.
New York, NY: Van Nostrand Reinhold, 1996., p. 607]**PEER REVIEWED**

HAZARDOUS POLYMERIZATION:
Hazardous polymerization may occur. [Fire Protection Guide to Hazardous
Materials. 12 ed. Quincy, MA: National Fire Protection Association,
1997., p. 49-32]**PEER REVIEWED**

PROTECTIVE EQUIPMENT & CLOTHING:
Wear special protective clothing and positive-pressure self-contained
breathing apparatus. [Prager, J.C. Environmental Contaminant Reference
Databook Volume 1. New York, NY: Van Nostrand Reinhold, 1995., p.
357]**PEER REVIEWED**

PREVENTIVE MEASURES:
THE BASIC VENTILATION METHODS ARE LOCAL AND EXHAUST VENTILATION AND
DILUTION OR GENERAL VENTILATION. [Sax, N.I. Dangerous Properties of

Industrial Materials. 4th ed. New York: Van Nostrand Reinhold, 1975., p. 499]**PEER REVIEWED**

SRP: Local exhaust ventilation should be applied wherever there is an incidence of point source emissions or dispersion of regulated contaminants in the work area. Ventilation control of the contaminant as close to its point of generation is both the most economical and safest method to minimize personnel exposure to airborne contaminants. **PEER REVIEWED**

SRP: The scientific literature for the use of contact lenses in industry 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 be worn. In any event, the usual eye protection equipment should be worn even when contact lenses are in place. **PEER REVIEWED**

SHIPMENT METHODS AND REGULATIONS:

No person may /transport,/ offer or accept a hazardous material for transportation in commerce unless that person is registered in conformance ... and the hazardous material is properly classed, described, packaged, marked, labeled, and in condition for shipment as required or authorized by ... /the hazardous materials regulations (49 CFR 171-177)./ [49 CFR 171.2 (7/1/2000)]**PEER REVIEWED**

The International Air Transport Association (IATA) Dangerous Goods Regulations are published by the IATA Dangerous Goods Board pursuant to IATA Resolutions 618 and 619 and constitute a manual of industry carrier regulations to be followed by all IATA Member airlines when transporting hazardous materials. [IATA. Dangerous Goods Regulations. 42nd Ed.

Montreal, Canada and Geneva, Switzerland: International Air Transport Association, Dangerous Goods Regulations, 2001., p. 128]**PEER REVIEWED**

The International Maritime Dangerous Goods Code lays down basic principles for transporting hazardous chemicals. Detailed recommendations for individual substances and a number of recommendations for good practice are included in the classes dealing with such substances. A general index of technical names has also been compiled. This index should always be consulted when attempting to locate the appropriate procedures to be used when shipping any substance or article. [IMDG; International Maritime Dangerous Goods Code; International Maritime Organization p.3196 (1998)]**PEER REVIEWED**

STORAGE CONDITIONS:

MATERIALS WHICH ARE TOXIC AS STORED OR WHICH CAN DECOMPOSE INTO TOXIC COMPONENTS ... SHOULD BE STORED IN A COOL WELL VENTILATED PLACE, OUT OF THE DIRECT RAYS OF THE SUN, AWAY FROM AREAS OF HIGH FIRE HAZARD, AND SHOULD BE PERIODICALLY INSPECTED. INCOMPATIBLE MATERIALS SHOULD BE ISOLATED ... . [Sax, N.I. Dangerous Properties of Industrial Materials. 4th ed. New York: Van Nostrand Reinhold, 1975., p. 499]**PEER REVIEWED**

Store in cool, dry, well ventilated location. Separate from oxidizing materials, amines, strong alkalies, acids, and other reactive hazards. Inside storage should be in a standard flammable liquids storage warehouse, room, or cabinet. Bulk storage should be blanketed with inert gas. [Fire Protection Guide to Hazardous Materials. 12 ed. Quincy, MA: National Fire Protection Association, 1997., p. 49-32]**PEER REVIEWED**

CLEANUP METHODS:

Contaminated wastewaters containing butyraldehyde are produced during the MFR of poly(vinyl butyral) and poly(vinyl formal ethylal). On tha basis of lab tests, a scheme for treating wastewater is recommended. After neutralization with sodium hydroxide or calcium oxide, the organic

fraction is distilled from the wastewater and incinerated. [Prager, J.C. Environmental Contaminant Reference Databook Volume 1. New York, NY: Van Nostrand Reinhold, 1995., p. 357-8]**PEER REVIEWED**

Eliminate all ignition sources. Stop or control the leak, if this can be done without undue risk. Use water spray to cool and disperse vapors and protect personnel. Control runoff and isolate discharged material for proper disposal. [Fire Protection Guide to Hazardous Materials. 12 ed. Quincy, MA: National Fire Protection Association, 1997., p. 49-32]**PEER REVIEWED**

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**

The following wastewater treatment technology has been investigated for butyraldehyde: Concentration process: Activated carbon. [Prager, J.C. Environmental Contaminant Reference Databook Volume 1. New York, NY: Van Nostrand Reinhold, 1995., p. 358]**PEER REVIEWED**

Butyraldehyde is a waste chemical stream constituent which may be subjected to ultimate disposal by controlled incineration. [USEPA; Engineering Handbook for Hazardous Waste Incineration p.2-4 (1981) EPA 68-03-3025]**PEER REVIEWED**

OCCUPATIONAL EXPOSURE STANDARDS:

OTHER OCCUPATIONAL PERMISSIBLE LEVELS:

Workplace Environmental Exposure Level (WEEL): 8-hr Time-weighted Average (TWA) 25 ppm. [American Industrial Hygiene Association. The AIHA 2001 Emergency Response Planning Guidelines and Workplace Environmental Exposure Level Guides Handbook. AIHA Press, Fairfax, VA. 2001., p. 37]**PEER REVIEWED**

MANUFACTURING/USE INFORMATION:

MAJOR USES:
For Butyraldehyde (USEPA/OPP Pesticide Code: 202500) there are 0 labels match. /SRP: Not registered for current use in the U.S., but approved pesticide uses may change periodically and so federal, state and local authorities must be consulted for currently approved uses./ [U.S. Environmental Protection Agency/Office of Pesticide Program's Chemical Ingredients Database on Butyraldehyde (123-72-8). Available from the Database Query page at http://www.cdpr.ca.gov/docs/epa/epamenu.htm as of May 24, 2001.]**PEER REVIEWED**

Chiefly in mfr of rubber accelerators, synthetic resins, solvents, plasticizers. [Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996., p. 261]**PEER REVIEWED**

SYNTHETIC FLAVORING IN FOODS [Fenaroli's Handbook of Flavor Ingredients. Volume 2. Edited, translated, and revised by T.E. Furia and N. Bellanca. 2nd ed. Cleveland: The Chemical Rubber Co., 1975., p. 77]**PEER REVIEWED**

Use to manufacture 1-butanol, 2-ethylhexanol, poly(vinyl butyral), 2-ethylhexanal, trimethylolpropane, methyl amyl ketone, and butyric acid. [Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present., p. V4 (1992) 740]**PEER REVIEWED**

/Mfr of/ high polymers [Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 13th ed. New York, NY: John Wiley & Sons, Inc. 1997., p. 185]**PEER REVIEWED**

MANUFACTURERS:
Aristech Chemical Corp., 210 Sixth Ave., Pittsburgh, PA 15222-2611, (412) 316-2747; Production site: Pasadena, TX 77501 [SRI International. 2000

Directory of Chemical Producers -- United States. SRI Consulting, Menlo Park: CA 2000, p. 500]**PEER REVIEWED**

BASF Corp., 3000 Continental Drive - North, Mount Olive, NJ 07828-1234, (973) 426-2600. Chemicals Division, Industrial Organics; Production site: Freeport, TX 77541 [SRI International. 2000 Directory of Chemical Producers -- United States. SRI Consulting, Menlo Park: CA 2000, p. 500]**PEER REVIEWED**

Celanese Ltd., Celanese Chemicals-Americas, 86 Morris Ave., Summit, NJ 07901, (972) 443-4000; Production sites: Bay City, TX 77414 [SRI International. 2000 Directory of Chemical Producers -- United States. SRI Consulting, Menlo Park: CA 2000, p. 500]**PEER REVIEWED**

Eastman Chemical Co., P.O. Box 511, Kingsport, TN 37662, (423) 224-0323. Texas Eastman Division; Production site: Longview, TX 75607 [SRI International. 2000 Directory of Chemical Producers -- United States. SRI Consulting, Menlo Park: CA 2000, p. 500]**PEER REVIEWED**

Union Carbide Corp., 39 Old Ridgebury Rd., Danbury, CT 06817-001, (203) 794-2000; Production sites: Taft, LA 70057; Texas City, TX 77590 [SRI International. 2000 Directory of Chemical Producers -- United States. SRI Consulting, Menlo Park: CA 2000, p. 500]**PEER REVIEWED**

METHODS OF MANUFACTURING:
From butyryl chloride; by redn of corresponding nitrile; by alkali aluminum hydride redn of methyl butyrate. Usually mfr by catalytic dehydrogenation of butanol, catalytic hydrogenation of crotonaldehyde, or by the oxo process from propene. [Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996., p. 261]**PEER REVIEWED**

BY DRY DISTILLATION OF CALCIUM BUTYRATE & CALCIUM FORMATE. [Fenaroli's Handbook of Flavor Ingredients. Volume 2. Edited, translated, and revised by T.E. Furia and N. Bellanca. 2nd ed. Cleveland: The Chemical Rubber Co., 1975., p. 77]**PEER REVIEWED**

The most widely used manufacturing technique for butyraldehyde is the oxo process, in which propylene, carbon monoxide, and hydrogen are combined with a suitable catalyst, usually a cobalt compound, at about 130-160 deg C and 100-200 atm pressure. Butyraldehyde can also be produced from 2-butenal (crotonaldehyde) formed by the Aldol condensation of acetaldehyde. This process was a major source of butyraldehyde until about 1970. [Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present., p. V4 (1992) 741]**PEER REVIEWED**

Propylene + synthesis gas (hydroformylation; coproduced with isobutylaldehyde) [Ashford, R.D. Ashford's Dictionary of Industrial Chemicals. London, England: Wavelength Publications Ltd., 1994., p. 162]**PEER REVIEWED**

GENERAL MANUFACTURING INFORMATION:
BUTYRALDEHYDE BECAME A COMMERCIAL CHEMICAL IN THE DECADE FOLLOWING WORLD WAR II [Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V4 376 (1978)]**PEER REVIEWED**

FORMULATIONS/PREPARATIONS:
USEPA/OPP Pesticide Code 202500; Trade Names: Butanal. [U.S. Environmental Protection Agency/Office of Pesticide Program's Chemical Ingredients Database on Butyraldehyde (123-72-8). Available from the Database Query page at http://www.cdpr.ca.gov/docs/epa/epamenu.htm as of May 24, 2001.]**PEER REVIEWED**

Grades: technical (93% minimum). [Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 13th ed. New York, NY: John Wiley & Sons, Inc. 1997., p. 185]**PEER REVIEWED**

98% LIQUID GRADE ... [CHEMCYCLOPEDIA 1986 p.64]**PEER REVIEWED**

Available commercially as a 55% aqueous solution [Ashford, R.D. Ashford's Dictionary of Industrial Chemicals. London, England: Wavelength Publications Ltd., 1994., p. 162]**PEER REVIEWED**

IMPURITIES:
DRY BUTYRALDEHYDE WILL UNDERGO SOME POLYERMIZATION DURING STORAGE TO FORM

PARABUTYRALDEHYDE. [Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V4 384 (1978)]**PEER REVIEWED**

CONSUMPTION PATTERNS:
(1988) 1-butanol and 2-ethylhexanol (92%); poly(vinyl butyral), 2-ethylhexanal, trimethylolpropane, methyl amyl ketone, and butyric acid (8%). [Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present., p. V4 (1992) 740]**PEER REVIEWED**

USED CHIEFLY AS AN INTERMEDIATE (1978 DATA) [Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V4 376 (1978)]**PEER REVIEWED**

U. S. PRODUCTION:
(1984) 5.64X10+11 g [USITC. SYN ORG CHEM-U.S. PROD/SALES 1984 p.255]**PEER REVIEWED**

(1991) 2.19X10+9 lbs [SRI. 1992 Directory of Chemical Producers-United States of America. Menlo Park, CA: SRI International, 1992., p. 509]**PEER REVIEWED**

(1989) Capacity, 9.63X10+5 tons [Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present., p. V4 (1992) 740]**PEER REVIEWED**

U. S. EXPORTS:
(1984) 3.77X10+7 g [BUREAU OF THE CENSUS. U.S. EXPORTS, SCHEDULE E, 1984 p.277]**PEER REVIEWED**

LABORATORY METHODS:

ANALYTIC LABORATORY METHODS:
A REVERSED-PHASE HIGH PERFORMANCE LIQUID CHROMATOGRAPHY SYSTEM WITH A LICHROSORB RP 18 COLUMN AND ACETONITRILE-WATER MOBILE PHASE HAS BEEN APPLIED TO THE DETERMINATION OF C1-C6 ALIPHATICS IN POLLUTED AIR. [KUWATA K ET AL; J CHROMATOGR SCI 17 (5): 264 (1979)]**PEER REVIEWED**

LOWER ALIPHATIC CARBONYL CMPD WERE DETERMINED BY GAS-LIQUID-SOLID

CHROMATOGRAPHY IN THE EXHAUST GASES FROM SOME ODOR SOURCES USING THE COLD-TRAPPING METHOD WITH LIQ ARGON. THE DETECTION LIMIT WAS APPROX 10 PPB. [HOSHIKA Y; ANALYST (LONDON) 106 (1263): 686 (1981)]**PEER REVIEWED**

CARBONYL CMPD INCL BUTYRALDEHYDE WERE IDENTIFIED BY GAS CHROMATOGRAPHY AND GAS CHROMATOGRAPHY-MASS SPECTROMETRY IN THE VAPOR GENERATED BY THERMAL DECOMP OF POLY(BUTYL METHACRYLATE), A SYNTHETIC RESIN. THE ALDEHYDES STARTED TO BE GENERATED @ ABOUT 100 DEG, AND 90% OF THE AMT WAS GENERATED FROM 200 TO 280 DEG. [OHNO K ET AL; TAIKI OSEN GAKKAISHI 14 (9): 382 (1979)]**PEER REVIEWED**

NIOSH Method 2539. Screening of Aldehydes by Gas Chromatography. This method is applicable to air samples. Detection limit = 0.4 mg/cu m. [U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health. NIOSH Manual of Analytical Methods. 4th ed. Methods A-Z & Supplements. Washington, DC: U.S. Government Printing Office, Aug 1994., p.]**PEER REVIEWED**

EPA Method 554. Determination of Carbonyl Compounds in Drinking Water by Dinitrophenylhydrazine Derivatization and High Performance Liquid Chromatography. This method is used for the determination of selected carbonyl compounds in finished drinking water or raw source water. Detection limit = 8.6 ug/l. [USEPA; EMMI. EPA's Environmental Monitoring Methods Index. Version 1.1. PC# 4082. Rockville, MD: Government Institutes (1997)]**PEER REVIEWED**

OSW Method 8315. Determination of Carbonyl Compounds by High Performance Liquid Chromatography (HPLC). This method is applicable to various matrices by derivatization with 2,4-dinitrophenylhydrazine (DNPH). Detection limit not specified. [USEPA; EMMI. EPA's Environmental Monitoring Methods Index. Version 1.1. PC# 4082. Rockville, MD: Government Institutes (1997)]**PEER REVIEWED**

OSW Method 8315A-LLE. Determination of Carbonyl Compounds by High Performance Liquid Chromatography (HPLC) Using Liquid-Liquid Extraction.
This method is applicable to the determination of free carbonyl compounds in various matrices by derivatization with 2,4-dinitrophenylhydrazine (DNPH). Detection limit = 7.8 ug/l. [USEPA; EMMI. EPA's Environmental Monitoring Methods Index. Version 1.1. PC# 4082. Rockville, MD: Government Institutes (1997)]**PEER REVIEWED**

OSW Method 8315A-LS: Determination of Carbonyl Compounds by High Performance Liquid Chromatography (HPLC) using Liquid-Solid Extraction.
This method is applicable to the determination of free carbonyl compounds in various matrices by derivatization with 2,4-dinitrophenylhydrazine (DNPH). Detection limit = 6.3 ug/l. [USEPA; EMMI. EPA's Environmental Monitoring Methods Index. Version 1.1. PC# 4082. Rockville, MD: Government Institutes (1997)]**PEER REVIEWED**

SAMPLING PROCEDURES:
OSW Method 0100. Sampling for Formaldehyde and Other Carbonyl Compounds in Indoor Air. This method provides procedures for the sampling of various carbonyl compounds in indoor air by derivatization with 2,4-dinitrophenylhydrazine (DNPH) in a silica gel cartridge. [USEPA; EMMI. EPA's Environmental Monitoring Methods Index. Version 1.1. PC# 4082. Rockville, MD: Government Institutes (1997)]**PEER REVIEWED**

SPECIAL REFERENCES:

SPECIAL REPORTS:
ENVIRONMENTAL HEALTH PERSPECTIVES; DHEW PUBLICATION NO 11,163,75.
TOXICOLOGY REVIEW.

SYNONYMS AND IDENTIFIERS:

SYNONYMS:
ALDEHYDE BUTYRIQUE (FRENCH) [U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry of Toxic Effects of Chemical

Substances (RTECS). National Library of Medicine's current MEDLARS file., p. 83/8212]**PEER REVIEWED**

ALDEIDE BUTIRRICA (ITALIAN) [U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry of Toxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS file., p. 83/8212]**PEER REVIEWED**

BUTAL [U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry of Toxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS file., p. 83/8212]**PEER REVIEWED**

BUTALDEHYDE [U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry of Toxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS file., p. 83/8212]**PEER REVIEWED**

BUTALYDE [U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry of Toxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS file., p. 83/8212]**PEER REVIEWED**

BUTANAL **PEER REVIEWED**

N-BUTANAL [U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry of Toxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS file., p. 83/8212]**PEER REVIEWED**

1-butanal [Verschueren, K. Handbook of Environmental Data of Organic

Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983., p. 323]**PEER REVIEWED**

N-BUTANAL (CZECH) [U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry of Toxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS file., p. 83/8212]**PEER REVIEWED**

BUTANALDEHYDE [U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry of Toxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS file., p. 83/8212]**PEER REVIEWED**

Butylaldehyde [Grant, W.M. Toxicology of the Eye. 3rd ed. Springfield, IL: Charles C. Thomas Publisher, 1986., p. 165]**PEER REVIEWED**

N-BUTYL ALDEHYDE [U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry of Toxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS file., p. 83/8212]**PEER REVIEWED**

BUTYRAL [U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry of Toxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS file., p. 83/8212]**PEER REVIEWED**

N-BUTYRALDEHYDE [U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry of Toxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS file., p. 83/8212]**PEER REVIEWED**

BUTYRALDEHYDE (CZECH) [U.S. Department of Health and Human Services,

Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry of Toxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS file., p. 83/8212]**PEER REVIEWED**

BUTYRALDEHYD (GERMAN) [U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry of Toxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS file., p. 83/8212]**PEER REVIEWED**

BUTYRIC ALDEHYDE [U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry of Toxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS file., p. 83/8212]**PEER REVIEWED**

BUTYRYLALDEHYDE **PEER REVIEWED**

Pesticide Code: 202500 [U.S. Environmental Protection Agency/Office of Pesticide Program's Chemical Ingredients Database on Butyraldehyde (123-72-8). Available from the Database Query page at http://www.cdpr.ca.gov/docs/epa/epamenu.htm as of May 24, 2001.]**PEER REVIEWED**

FEMA NUMBER 2219 [Fenaroli's Handbook of Flavor Ingredients. Volume 2. Edited, translated, and revised by T.E. Furia and N. Bellanca. 2nd ed. Cleveland: The Chemical Rubber Co., 1975., p. 77]**PEER REVIEWED**

NCI-C56291 [U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry of Toxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS file., p. 83/8212]**PEER REVIEWED**

FORMULATIONS/PREPARATIONS:
USEPA/OPP Pesticide Code 202500; Trade Names: Butanal. [U.S. Environmental

Protection Agency/Office of Pesticide Program's Chemical Ingredients Database on Butyraldehyde (123-72-8). Available from the Database Query page at http://www.cdpr.ca.gov/docs/epa/epamenu.htm as of May 24, 2001.]**PEER REVIEWED**

Grades: technical (93% minimum). [Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 13th ed. New York, NY: John Wiley & Sons, Inc. 1997., p. 185]**PEER REVIEWED**

98% LIQUID GRADE ... [CHEMCYCLOPEDIA 1986 p.64]**PEER REVIEWED**

Available commercially as a 55% aqueous solution [Ashford, R.D. Ashford's Dictionary of Industrial Chemicals. London, England: Wavelength Publications Ltd., 1994., p. 162]**PEER REVIEWED**

SHIPPING NAME/ NUMBER DOT/UN/NA/IMO:

UN 1129; Butyraldehyde

IMO 3.2; Butyraldehyde

ADMINISTRATIVE INFORMATION:

HAZARDOUS SUBSTANCES DATABANK NUMBER: 2798

LAST REVISION DATE: 20030214

LAST REVIEW DATE: Reviewed by SRP on 9/15/2001

UPDATE HISTORY:

Complete Update on 02/14/2003, 1 field added/edited/deleted.

Complete Update on 01/24/2003, 2 fields added/edited/deleted.

Field Update on 11/08/2002, 1 field added/edited/deleted.

Complete Update on 04/19/2002, 69 fields added/edited/deleted.

Field Update on 02/13/2002, 1 field added/edited/deleted.

Field Update on 01/14/2002, 1 field added/edited/deleted.

Field Update on 08/08/2001, 1 field added/edited/deleted.

Complete Update on 02/09/2000, 1 field added/edited/deleted.

Complete Update on 02/08/2000, 1 field added/edited/deleted.

Complete Update on 02/02/2000, 1 field added/edited/deleted.

Complete Update on 01/14/2000, 10 fields added/edited/deleted.

Field Update on 09/21/1999, 1 field added/edited/deleted.

Field Update on 05/17/1999, 1 field added/edited/deleted.

Field Update on 03/19/1999, 1 field added/edited/deleted.

Field Update on 06/02/1998, 1 field added/edited/deleted.

Field Update on 02/27/1998, 1 field added/edited/deleted.

Field Update on 05/01/1997, 2 fields added/edited/deleted.

Complete Update on 01/24/1996, 1 field added/edited/deleted.

Complete Update on 11/10/1995, 1 field added/edited/deleted.

Complete Update on 12/28/1994, 1 field added/edited/deleted.

Complete Update on 03/25/1994, 1 field added/edited/deleted.

Complete Update on 12/15/1993, 73 fields added/edited/deleted.

Field update on 12/26/1992, 1 field added/edited/deleted.

Complete Update on 04/03/1992, 17 fields added/edited/deleted.

Complete Update on 04/16/1990, 1 field added/edited/deleted.

Field update on 03/06/1990, 1 field added/edited/deleted.

Complete Update on 04/13/1989, 1 field added/edited/deleted.

Complete Update on 05/26/1987

RTECS:

Canadian Centre for Occupational Health and Safety

CCOHS RTECS Registry of Toxic Effects of Chemical Substances®

Data source: MDL Information Systems, Inc.

CHEMICAL IDENTIFICATION

RTECS Number	ES2275000
Chemical Name	Butyraldehyde
CAS Registry Number	123-72-8

Beilstein Reference No.	0506061
Reference	4-01-00-03229
Last Updated	200602
Data Items Cited	49
Molecular Formula	C4-H8-O
Molecular Weight	72.12
Wiswesser Line Notation	VH3
Compound Descriptor	Mutagen Human Primary Irritant

Synonyms/Trade Names

Aldehyde butyrique
Aldeide butirrica
Butal
Butaldehyde
Butalyde
Butanal
n-Butanal
Butanaldehyde
Butyl aldehyde
n-Butyl aldehyde
Butyral
Butyraldehyd
Butyric aldehyde
n-Butyraldehyde
NCI-C56291

HEALTH HAZARD DATA

SKIN/EYE IRRITATION DATA

Type of Test	Route of Exposure	Species Observed	Dose Data	Reaction Severity	Reference
Open irritation test	Administration onto the skin	Rodent - rabbit	410 mg	Mild	UCDS** Union Carbide Data Sheet. (Union Carbide Corp., 39 Old Ridgebury Rd., Danbury, CT 06817) Volume(issue)/page/year: 7/20/1965
Standard Draize test	Administration into the eye	Rodent - rabbit	20 mg/24H	Moderate	85JCAE "Prehled Prumyslove Toxikologie; Organicke Latky," Marhold, J., Prague, Czechoslovakia, Avicenum, 1986 Volume(issue)/page/year: -,270,1986

ACUTE TOXICITY DATA

Type of Test	Route of Exposure	Species Observed	Dose Data	Toxic Effects	Reference
LD50 - Lethal dose, 50	Oral	Rodent - rat	2490 mg/kg	Details of toxic effects not reported other	NTIS** National Technical Information

percent kill				than lethal dose value	Service. (Springfield, VA 22161) Formerly U.S. Clearinghouse for Scientific & Technical Information. Volume(issue)/page/year: OTS0516688
LCLo - Lowest published lethal concentration	Inhalation	Rodent - rat	8000 ppm/4H	Details of toxic effects not reported other than lethal dose value	NTIS** National Technical Information Service. (Springfield, VA 22161) Formerly U.S. Clearinghouse for Scientific & Technical Information. Volume(issue)/page/year: OTS0516688
LD50 - Lethal dose, 50 percent kill	Intraperitoneal	Rodent - rat	800 mg/kg	Details of toxic effects not reported other than lethal dose value	FCTXAV Food and Cosmetics Toxicology. (London, UK) V.1-19, 1963-81. For publisher information, see FCTOD7. Volume(issue)/page/year: 17,731,1979
LD50 - Lethal dose, 50 percent kill	Subcutaneous	Rodent - rat	10 gm/kg	Behavioral - general anesthetic	APTOA6 Acta Pharmacologica et Toxicologica. (Copenhagen, Denmark) V.1-59, 1945-86. For publisher information, see PHTOEH Volume(issue)/page/year: 6,299,1950
LC50 - Lethal concentration, 50 percent kill	Inhalation	Rodent - mouse	44610 mg/m3/2H	Details of toxic effects not reported other than lethal dose value	85GMAT "Toxicometric Parameters of Industrial Toxic Chemicals Under Single Exposure," Izmerov, N.F., et al., Moscow, Centre of International Projects, GKNT, 1982 Volume(issue)/page/year: -,30,1982
LD50 - Lethal dose, 50 percent kill	Intraperitoneal	Rodent - mouse	1140 mg/kg	Details of toxic effects not reported other than lethal dose value	FCTXAV Food and Cosmetics Toxicology. (London, UK) V.1-19, 1963-81. For publisher information, see FCTOD7. Volume(issue)/page/year: 17,731,1979
LD50 - Lethal dose, 50 percent kill	Subcutaneous	Rodent - mouse	2700 mg/kg	Behavioral - general anesthetic Kidney/Ureter/Bladder - hematuria	APTOA6 Acta Pharmacologica et Toxicologica. (Copenhagen, Denmark) V.1-59, 1945-86. For publisher information, see PHTOEH

					Volume(issue)/page/year: 6,299,1950
LD50 - Lethal dose, 50 percent kill	Administration onto the skin	Rodent - rabbit	3560 uL/kg	Details of toxic effects not reported other than lethal dose value	UCDS** Union Carbide Data Sheet. (Union Carbide Corp., 39 Old Ridgebury Rd., Danbury, CT 06817) Volume(issue)/page/year: 7/20/1965
LC50 - Lethal concentration, 50 percent kill	Inhalation	Mammal - species unspecified	38 gm/m3	Details of toxic effects not reported other than lethal dose value	GISAAA Gigiena i Sanitariya. For English translation, see HYSAAV. (V/O Mezhdunarodnaya Kniga, 113095 Moscow, USSR) V.1- 1936- Volume(issue)/page/year: 51(5),61,1986
LD50 - Lethal dose, 50 percent kill	Oral	Rodent - rat	5890 mg/kg	Sense Organs and Special Senses (Eye) - conjunctive irritation Behavioral - ataxia Lungs, Thorax, or Respiration - acute pulmonary edema	VCVGK* "Vrednie chemichescie veshestva, galogen I kislorod sodergashie organicheskie soedinenia". (Hazardous substances. Galogen and oxygen containing substances), Bandman A.L. et al., Chimia, 1994. Volume(issue)/page/year: -,373,1984
LC50 - Lethal concentration, 50 percent kill	Inhalation	Rodent - mouse	36000 mg/m3/2H	Sense Organs and Special Senses (Eye) - conjunctive irritation Behavioral - ataxia Lungs, Thorax, or Respiration - acute pulmonary edema	VCVGK* "Vrednie chemichescie veshestva, galogen I kislorod sodergashie organicheskie soedinenia". (Hazardous substances. Galogen and oxygen containing substances), Bandman A.L. et al., Chimia, 1994. Volume(issue)/page/year: -,373,1984
LC50 - Lethal concentration, 50 percent kill	Inhalation	Rodent - rat	6400 ppm/4H	Sense Organs and Special Senses (Eye) - conjunctive irritation Behavioral - ataxia Lungs, Thorax, or Respiration - acute pulmonary edema	VCVGK* "Vrednie chemichescie veshestva, galogen I kislorod sodergashie organicheskie soedinenia". (Hazardous substances. Galogen and oxygen containing substances), Bandman A.L. et al., Chimia, 1994. Volume(issue)/page/year: -,373,1984
TCLo - Lowest published toxic	Inhalation	Rodent - rat	600 ppm/10M	Lungs, Thorax, or Respiration - respiratory depression	VCVGK* "Vrednie chemichescie veshestva, galogen I kislorod

concentration					sodergashie organicheskie soedinenia". (Hazardous substances. Galogen and oxygen containing substances), Bandman A.L. et al., Chimia, 1994. Volume(issue)/page/year: -,373,1984
TCLo - Lowest published toxic concentration	Inhalation	Rodent - rabbit	200 mg/m3/40M	Lungs, Thorax, or Respiration - dyspnea	VCVGK* "Vrednie chemichescie veshestva, galogen I kislorod sodergashie organicheskie soedinenia". (Hazardous substances. Galogen and oxygen containing substances), Bandman A.L. et al., Chimia, 1994. Volume(issue)/page/year: -,373,1984
TCLo - Lowest published toxic concentration	Inhalation	Mammal - cat	5000 mg/m3	Gastrointestinal - changes in structure or function of salivary glands	VCVGK* "Vrednie chemichescie veshestva, galogen I kislorod sodergashie organicheskie soedinenia". (Hazardous substances. Galogen and oxygen containing substances), Bandman A.L. et al., Chimia, 1994. Volume(issue)/page/year: -,373,1984
TCLo - Lowest published toxic concentration	Inhalation	Human	13 mg/m3	Sense Organs and Special Senses (Eye) - conjunctive irritation	VCVGK* "Vrednie chemichescie veshestva, galogen I kislorod sodergashie organicheskie soedinenia". (Hazardous substances. Galogen and oxygen containing substances), Bandman A.L. et al., Chimia, 1994. Volume(issue)/page/year: -,373,1984
TCLo - Lowest published toxic concentration	Inhalation	Human	0.075 mg/m3	Brain and Coverings - other degenerative changes	VCVGK* "Vrednie chemichescie veshestva, galogen I kislorod sodergashie organicheskie soedinenia". (Hazardous substances. Galogen and oxygen containing substances), Bandman A.L. et al., Chimia, 1994. Volume(issue)/page/year: -,373,1984

OTHER MULTIPLE DOSE TOXICITY DATA

Type of Test	Route of Exposure	Species Observed	Dose Data	Toxic Effects	Reference
TDLo - Lowest published toxic dose	Oral	Rodent - rat	39 gm/kg/90D (intermittent)	Lungs, Thorax, or Respiration - other changes Biochemical - Enzyme inhibition, induction, or change in blood or tissue levels - transaminases Related to Chronic Data - death	NTIS** National Technical Information Service. (Springfield, VA 22161) Formerly U.S. Clearinghouse for Scientific & Technical Information. Volume(issue)/page/year: OTS0516688
TCLo - Lowest published toxic concentration	Inhalation	Rodent - rat	3100 ppm/6H/2W (intermittent)	Lungs, Thorax, or Respiration - dyspnea Liver - changes in liver weight Nutritional and Gross Metabolic - weight loss or decreased weight gain	NTIS** National Technical Information Service. (Springfield, VA 22161) Formerly U.S. Clearinghouse for Scientific & Technical Information. Volume(issue)/page/year: OTS0570659
TCLo - Lowest published toxic concentration	Inhalation	Rodent - rat	125 ppm/6H/13W (intermittent)	Sense Organs and Special Senses (Olfaction) - effect, not otherwise specified Blood - changes in serum composition (e.g. TP, bilirubin, cholesterol)	NTIS** National Technical Information Service. (Springfield, VA 22161) Formerly U.S. Clearinghouse for Scientific & Technical Information. Volume(issue)/page/year: OTS0538653
TDLo - Lowest published toxic dose	Oral	Rodent - mouse	78 gm/kg/90D (intermittent)	Liver - changes in liver weight Kidney/Ureter/Bladder - changes in bladder weight Nutritional and Gross Metabolic - weight loss or decreased weight gain	NTIS** National Technical Information Service. (Springfield, VA 22161) Formerly U.S. Clearinghouse for Scientific & Technical Information. Volume(issue)/page/year: OTS0516688
TCLo - Lowest published toxic concentration	Inhalation	Rodent - mouse	6400 ppm/6H/2W (intermittent)	Sense Organs and Special Senses (Eye) - effect, not otherwise specified Lungs, Thorax, or Respiration - dyspnea Related to Chronic Data - death	NTIS** National Technical Information Service. (Springfield, VA 22161) Formerly U.S. Clearinghouse for Scientific & Technical Information. Volume(issue)/page/year: OTS0570659
TCLo - Lowest published toxic concentration	Inhalation	Mammal - dog	3100 ppm/6H/2W (intermittent)	Sense Organs and Special Senses (Eye) - lacrimation Lungs, Thorax, or Respiration - dyspnea	NTIS** National Technical Information Service. (Springfield, VA 22161) Formerly U.S. Clearinghouse for

				Gastrointestinal - changes in structure or function of salivary glands	Scientific & Technical Information. Volume(issue)/page/year: OTS0570659
TCLo - Lowest published toxic concentration	Inhalation	Mammal - dog	2000 ppm/6H/14W (intermittent)	Sense Organs and Special Senses (Olfaction) - effect, not otherwise specified	NTIS** National Technical Information Service. (Springfield, VA 22161) Formerly U.S. Clearinghouse for Scientific & Technical Information. Volume(issue)/page/year: OTS0538653
TCLo - Lowest published toxic concentration	Inhalation	Rodent - rabbit	3100 ppm/6H/2W (intermittent)	Sense Organs and Special Senses (Eye) - lacrimation Lungs, Thorax, or Respiration - dyspnea Gastrointestinal - changes in structure or function of salivary glands	NTIS** National Technical Information Service. (Springfield, VA 22161) Formerly U.S. Clearinghouse for Scientific & Technical Information. Volume(issue)/page/year: OTS0570659
TCLo - Lowest published toxic concentration	Inhalation	Rodent - guinea pig	3100 ppm/6H/2W (intermittent)	Sense Organs and Special Senses (Eye) - lacrimation Lungs, Thorax, or Respiration - dyspnea Nutritional and Gross Metabolic - weight loss or decreased weight gain	NTIS** National Technical Information Service. (Springfield, VA 22161) Formerly U.S. Clearinghouse for Scientific & Technical Information. Volume(issue)/page/year: OTS0570659
TCLo - Lowest published toxic concentration	Inhalation	Rodent - rat	125 ppm/6H/13W (intermittent)	Sense Organs and Special Senses (Olfaction) - effect, not otherwise specified	VCVGK* "Vrednie chemichescie veshestva, galogen I kislorod sodergashie organicheskie soedinenia". (Hazardous substances. Galogen and oxygen containing substances), Bandman A.L. et al., Chimia, 1994. Volume(issue)/page/year: -,373,1994
TDLo - Lowest published toxic dose	Oral	Rodent - rat	15000 mg/kg/12D (intermittent)	Lungs, Thorax, or Respiration - changes in lung weight Gastrointestinal - ulceration or bleeding from stomach	VCVGK* "Vrednie chemichescie veshestva, galogen I kislorod sodergashie organicheskie soedinenia". (Hazardous substances. Galogen and oxygen containing substances), Bandman A.L. et al., Chimia, 1994. Volume(issue)/page/year: -,373,1994
TDLo -	Oral	Rodent -	15000	Lungs, Thorax, or	VCVGK* "Vrednie

Lowest published toxic dose		mouse	mg/kg/12D (intermittent)	Respiration - changes in lung weight Gastrointestinal - ulceration or bleeding from stomach	chemichescie veshestva, galogen I kislorod sodergashie organicheskie soedinenia". (Hazardous substances. Galogen and oxygen containing substances), Bandman A.L. et al., Chimia, 1994. Volume(issue)/page/year: -,373,1994
TCLo - Lowest published toxic concentration	Inhalation	Rodent - rat	50 mg/m3/110D (intermittent)	Lungs, Thorax, or Respiration - emphysema Liver - other changes Kidney/Ureter/Bladder - other changes	VCVGK* "Vrednie chemichescie veshestva, galogen I kislorod sodergashie organicheskie soedinenia". (Hazardous substances. Galogen and oxygen containing substances), Bandman A.L. et al., Chimia, 1994. Volume(issue)/page/year: -,373,1994
TCLo - Lowest published toxic concentration	Inhalation	Rodent - rabbit	50 mg/m3/110D (intermittent)	Lungs, Thorax, or Respiration - emphysema Liver - other changes Kidney/Ureter/Bladder - other changes	VCVGK* "Vrednie chemichescie veshestva, galogen I kislorod sodergashie organicheskie soedinenia". (Hazardous substances. Galogen and oxygen containing substances), Bandman A.L. et al., Chimia, 1994. Volume(issue)/page/year: -,373,1994
TCLo - Lowest published toxic concentration	Inhalation	Rodent - rat	0.5 mg/m3/120D (intermittent)	Liver - other changes Biochemical - Enzyme inhibition, induction, or change in blood or tissue levels - dehydrogenases	VCVGK* "Vrednie chemichescie veshestva, galogen I kislorod sodergashie organicheskie soedinenia". (Hazardous substances. Galogen and oxygen containing substances), Bandman A.L. et al., Chimia, 1994. Volume(issue)/page/year: -,373,1994

MUTATION DATA

Type of Test	Route of Exposure	Species Observed	Dose Data	Reference
Unscheduled DNA synthesis		Rodent - rat Liver	30 mmol/L	MUREAV Mutation Research. (Elsevier Science Pub. B.V., POB 211, 1000 AE Amsterdam, Netherlands) V.1- 1964-

				Volume(issue)/page/year: 323,121,1994
Sperm Morphology	Intraperitoneal	Rodent - mouse	30 mg/kg	MUREAV Mutation Research. (Elsevier Science Pub. B.V., POB 211, 1000 AE Amsterdam, Netherlands) V.1- 1964- Volume(issue)/page/year: 39,317,1977
Sperm Morphology	Oral	Rodent - mouse	15 gm/kg/50D	MUREAV Mutation Research. (Elsevier Science Pub. B.V., POB 211, 1000 AE Amsterdam, Netherlands) V.1- 1964- Volume(issue)/page/year: 39,317,1977
Sister chromatid exchange		Rodent - hamster Ovary	9 mg/L	EMMUEG Environmental and Molecular Mutagenesis. (Alan R. Liss, Inc., 41 E. 11th St., New York, NY 10003) V.10- 1987- Volume(issue)/page/year: 10(Suppl 10),1,1987
Mutation in mammalian somatic cells		Rodent - hamster Lung	3 mmol/L	MUTAEX Mutagenesis. (Oxford Univ. Press, Pinkhill House, Southfield Road, Eynsham, Oxford OX8 1JJ, UK) V.1- 1986- Volume(issue)/page/year: 4,277,1989
DNA damage		Mammal - species unspecified Lymphocyte	100 mmol/L	MUREAV Mutation Research. (Elsevier Science Pub. B.V., POB 211, 1000 AE Amsterdam, Netherlands) V.1- 1964- Volume(issue)/page/year: 283,131,1992

REVIEWS

TOXICOLOGY REVIEW	EVHPAZ EHP, Environmental Health Perspectives. (U.S. Government Printing Office, Supt of Documents, Washington, DC 20402) No.1- 1972- Volume(issue)/page/year: 11,163,1975

OCCUPATIONAL EXPOSURE LIMITS

OEL-RUSSIA: STEL 5 mg/m3, Skin, JUN2003

STATUS IN U.S.

EPA TSCA Section 8(b) CHEMICAL INVENTORY
EPA TSCA Section 8(d) unpublished health/safety studies
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JANUARY 2001
NIOSH CURRENT INTELLIGENCE BULLETIN #55, September 1991
NIOSH Analytical Method, 1994: Aldehydes, screening, 2539

END OF RECORD

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