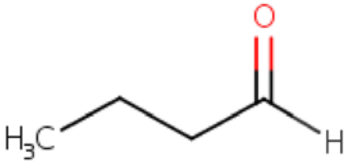
BUTYRALDEHYDE

CASRN: 123-72-8
UNII: H21352682A



FULL RECORD DISPLAY
Displays all fields in the record.
For other data, click on the Table of Contents

Human Health Effects:

Human Toxicity Excerpts:

/HUMAN EXPOSURE STUDIES/ Three Asian subjects who reported experiencing severe facial flushing in response to ethanol ingestion were subjects of patch testing to aliphatic alcohols and aldehydes. An aqueous suspension of 75% (v/v) of each alcohol and aldehyde was prepared and 25 uL was used to saturate ashless grade filter paper squares which were then placed on the forearm of each subject. Patches were covered with Parafilm and left in place for 5 minutes when the patches were removed and the area gently blotted. Sites showing erythema during the next 60 minutes were considered positive. All three subjects displayed positive responses to ethyl, propyl, butyl, and pentyl alcohols. Intense positive reactions, with variable amounts of edema, were observed for all the aldehydes tested (valeraldehyde as well as acetaldehyde, propionaldehyde, and butyraldehyde). [United Nations Environment Programme: Screening Information Data Sheets on n-Valeraldehyde (110-62-3) (October 2005) Available from, as of January 15, 2009: http://www.chem.unep.ch/irptc/sids/OECDSIDS/sidspub.html] **PEER REVIEWED**

[United Nations Environment Programme: Screening Information Data Sheets on n-Valeraldehyde (110-62-3) (October 2005) Available from, as of January 15, 2009: http://www.chem.unep.ch/irptc/sids/OECDSIDS/sidspub.html] **PEER REVIEWED**

/SIGNS AND SYMPTOMS/ 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**

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

/SIGNS AND SYMPTOMS/ May produce skin and 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**

[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**

/SIGNS AND SYMPTOMS/ Butyraldehyde is extremely destructive of tissues of the mucosal membranes and upper respiratory tract, as well as of tissues of the eyes and skin. Inhalation may be fatal as a result of spasm, inflammation, and edema of the larynx and bronchi, chemical pneumonia, and pulmonary edema. Signs and symptoms of overexposure are a burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, and vomiting. Medical conditions might be aggravated by continuous exposure.[Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V5:978] **PEER REVIEWED**

[Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V5:978] **PEER REVIEWED**

/CASE REPORTS/ Butyraldehyde has been tested for irritant effect on human eyes at vapor concn in air such as might occur in smog, and has been found nonirritant. ... In six instances of industrial corneal injury from butyraldehyde recovery is said to have been prompt and complete.[Grant, W.M. Toxicology of the Eye. 3rd ed. Springfield, IL: Charles C. Thomas Publisher, 1986., p. 165] **PEER REVIEWED**

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

/EPIDEMIOLOGY STUDIES/ Exposure to butyraldehyde may be implicated in observed associations between the occurrence of respiratory epithelium cancer in workers and lung cancer associated with high-temperature cooking. However, coexposures with other more reactive aldehydes do not support a role for butyraldehyde acting alone.[Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V5:978] **PEER REVIEWED**

[Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V5:978] **PEER REVIEWED**

/GENOTOXICITY/ 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** PubMed Abstract

[OBE G, BEEK B; DRUG ALCOHOL DEPEND 4 (1-2): 91 (1979)] **PEER REVIEWED** PubMed Abstract

/GENOTOXICITY/ ...It produces DNA strand breaks in DNA PM2 in conjunction with copper chloride, but not alone, and cross-links with proteins, inducing unscheduled DNA synthesis in rat hepatocytes, but not human hepatocytes. ...[Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V5:978] **PEER REVIEWED**

[Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V5:978] **PEER REVIEWED**

/OTHER TOXICITY INFORMATION/ The saturated aldehydes by inhalation show decreasing toxicity with increasing chain length in the order acetaldehyde, propionaldehyde, isobutyraldehyde, n-butyraldehyde, n-valeraldehyde and isovaleraldehye.[Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, 1984., p. II-186] **PEER REVIEWED**

[Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, 1984., p. II-186] **PEER REVIEWED**

Skin, Eye and Respiratory Irritations:

Irritating to skin, eyes and respiratory system.[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 49-35] **PEER REVIEWED**

[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 49-35] **PEER REVIEWED**

...Eye or skin contact may cause burns and possible permanent damage. High exposure can cause dizziness and lightheadedness. Higher exposures can cause pulmonary edema, a medical emergency that can be delayed for several hours. This can cause death... Prolonged or repeated skin exposure may cause skin disorders.[Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 2002. 4th ed.Vol 1 A-H Norwich, NY: Noyes Publications, 2002., p. 428] **PEER REVIEWED**

`[Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 2002. 4th ed.Vol 1 A-H Norwich, NY: Noyes Publications, 2002., p. 428] **PEER REVIEWED**`

Medical Surveillance:

Consider chest x-ray following acute overexposure.[Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 2002. 4th ed.Vol 1 A-H Norwich, NY: Noyes Publications, 2002., p. 428] **PEER REVIEWED**

`[Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 2002. 4th ed.Vol 1 A-H Norwich, NY: Noyes Publications, 2002., p. 428] **PEER REVIEWED**`

Probable Routes of Human Exposure:

NIOSH (NOES Survey 1981-1983) has statistically estimated that 5,392 workers (950 of these were female) were 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. Monitoring data indicate that the general population may be exposed to butyraldehyde via inhalation of ambient air, ingestion of food and drinking water, and dermal contact with consumer products containing this compound(SRC).[(1) NIOSH; NOES. National Occupational Exposure Survey conducted from 1981-1983. Estimated numbers of employees potentially exposed to specific agents by 2-digit standard industrial classification (SIC). Available at http://www.cdc.gov/noes/ as of Feb 2009.] **PEER REVIEWED**

`[(1) NIOSH; NOES. National Occupational Exposure Survey conducted from 1981-1983. Estimated numbers of employees potentially exposed to specific agents by 2-digit standard industrial classification (SIC). Available at http://www.cdc.gov/noes/ as of Feb 2009.] **PEER REVIEWED**`

Butyraldehyde was found in 10 of 15 personal air samples at a mean concentration of 0.68 ppb from samples taken in Helsinki, tested May to Sep 1997(1).[(1) Jurvelin JA et al; J Air Waste Manage Assoc 53: 560-73 (2003)] **PEER REVIEWED**

`[(1) Jurvelin JA et al; J Air Waste Manage Assoc 53: 560-73 (2003)] **PEER REVIEWED**`

Body Burden:

Butyraldehyde was detected not quantified 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** PubMed Abstract

`[(1) Pellizzari ED et al; Bull Environ Contam Toxicol 28: 322-8 (1982)] **PEER REVIEWED**`
`PubMed Abstract`

Emergency Medical Treatment:

Emergency Medical Treatment:

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The following Overview, *** ACETALDEHYDE ***, is relevant for this HSDB record chemical.

Life Support:

o 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 (International Agency for Research on Cancer (IARC), 2016; International Agency for Research on Cancer, 2015; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2010; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2010a; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2008; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2007; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2006; 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 the head down 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 gases and/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 an inhaled beta2-adrenergic agonist. Consider systemic corticosteroids in patients with significant bronchospasm.

B) ACUTE LUNG INJURY: Maintain ventilation and oxygenation and evaluate with frequent arterial blood gases and/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: Remove contact lenses and irrigate exposed eyes with copious amounts of room temperature 0.9% saline or water for at least 15 minutes. If irritation, pain, swelling, lacrimation, or photophobia persist after 15 minutes of irrigation, the patient should be seen in a healthcare facility.

0.4.5 DERMAL EXPOSURE

A) OVERVIEW

1) DECONTAMINATION: Remove contaminated clothing and jewelry and place them in plastic bags. Wash exposed areas with soap and water for 10 to 15 minutes with gentle sponging to avoid skin breakdown. A physician may need to examine the area if irritation or pain persists (Burgess et al, 1999).

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.

[Rumack BH POISINDEX(R) Information System Micromedex, Inc., Englewood, CO, 2017; CCIS Volume 172, edition expires May, 2017. Hall AH & Rumack BH (Eds): TOMES(R) Information System Micromedex, Inc., Englewood, CO, 2017; CCIS Volume 172, edition expires May, 2017.] **PEER REVIEWED**

Antidote and Emergency Treatment:

Immediate first aid: Ensure that adequate decontamination has been carried out. If patient is not breathing, start artificial respiration, preferably with a demand-valve resuscitator, bag-valve-mask device, or pocket mask, as trained. Perform CPR as necessary. Immediately flush contaminated eyes with gently flowing water. Do not induce vomiting. If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain an open airway and prevent aspiration. Keep patient quiet and maintain normal body temperature. Obtain medical attention. /Aldehydes and Related Compounds/[Currance, P.L. Clements, B., Bronstein, A.C. (Eds).; Emergency Care For Hazardous Materials Exposure. 3Rd edition, Elsevier Mosby, St. Louis, MO 2005, p. 266] **PEER REVIEWED**

[Currance, P.L. Clements, B., Bronstein, A.C. (Eds).; Emergency Care For Hazardous Materials Exposure. 3Rd edition, Elsevier Mosby, St. Louis, MO 2005, p. 266] **PEER REVIEWED**

Basic treatment: Establish a patent airway (oropharyngeal or nasopharyngeal airway, if needed). 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 0.9% saline (NS) 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/[Currance, P.L. Clements, B., Bronstein, A.C. (Eds).; Emergency Care For Hazardous Materials Exposure. 3Rd edition, Elsevier Mosby, St. Louis, MO 2005, p. 266-7] **PEER REVIEWED**

[Currance, P.L. Clements, B., Bronstein, A.C. (Eds).; Emergency Care For Hazardous Materials Exposure. 3Rd edition, Elsevier Mosby, St. Louis, MO 2005, p. 266-7] **PEER REVIEWED**

Advanced treatment: Consider Consider orotracheal or nasotracheal intubation for airway control in the patient who is unconscious, has severe pulmonary edema, or is in severe respiratory distress. 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. Consider drug therapy for pulmonary edema ... . Consider administering a beta agonist such as albuterol for severe bronchospasm ... . Start IV administration of D5W /SRP: "To keep open", minimal flow rate/. Use 0.9% saline (NS) or lactated Ringer's (LR) if signs of hypovolemia are present. 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 ... . Treat seizures with diazepam or lorazepam ... . Use proparacaine hydrochloride to assist eye irrigation ... . /Aldehydes and Related Compounds/[Currance, P.L. Clements, B., Bronstein, A.C. (Eds).; Emergency Care For Hazardous Materials Exposure. 3Rd edition, Elsevier Mosby, St. Louis, MO 2005, p. 267] **PEER REVIEWED**

[Currance, P.L. Clements, B., Bronstein, A.C. (Eds).; Emergency Care For Hazardous Materials Exposure. 3Rd edition, Elsevier Mosby, St. Louis, MO 2005, p. 267] **PEER REVIEWED**

Animal Toxicity Studies:

Non-Human Toxicity Excerpts:

/LABORATORY ANIMALS: Acute Exposure/ 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**

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

/LABORATORY ANIMALS: Acute Exposure/ Respiration and heart beat were increased in male rabbits exposed to 10 to 20 ppm butylaldehyde.[IKEDA A ET AL; KANAGAWA-KEN TAIKI OSEN CHOSA KENKYU HOKOKU 22: 193 (1980)] **PEER REVIEWED**

[IKEDA A ET AL; KANAGAWA-KEN TAIKI OSEN CHOSA KENKYU HOKOKU 22: 193 (1980)] **PEER REVIEWED**

/LABORATORY ANIMALS: Acute Exposure/ Inhalation exposures to more than 6000 ppm produce bronchial and alveolar edema in rodents that can be fatal in some species...[Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V5:978] **PEER REVIEWED**

[Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V5:978] **PEER REVIEWED**

/LABORATORY ANIMALS: Acute Exposure/...Dermal or eye contact [in rodents] is moderately to severely irritating.[Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V5:978] **PEER REVIEWED**

[Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V5:978] **PEER REVIEWED**

/LABORATORY ANIMALS: Subchronic or Prechronic Exposure/ Groups of male and female F344 rats and B6C3F1mice received butyraldehyde in corn oil by gavage at dose levels of 75, 150, 300, 600, or 1200 mg/kg bw/day. Animals were dosed 5 days per week for 13 weeks. All animals in the 1200 mg/kg bw/day groups displayed decreased body weight gain. Among rats, a dose-related increase in mortality was observed. Nasal cavity lesions were noted in all dose groups in rats; stomach lesions were observed in the 1200 and 600 mg/kg bw/day groups. Among mice, nasal lesions were noted in animals that received 300 mg/kg bw/day and greater; stomach lesions were observed in the high dose group. The LOAEL for rats 75 mg/kg bw/day and the NOAEL for mice is 150 mg/kg bw/day.[United Nations Environment Programme: Screening Information Data Sheets on n-Valeraldehyde (110-62-3) (October 2005) Available from, as of January 15, 2009: http://www.chem.unep.ch/irptc/sids/OECDSIDS/sidspub.html] **PEER REVIEWED**

[United Nations Environment Programme: Screening Information Data Sheets on n-Valeraldehyde (110-62-3) (October 2005) Available from, as of January 15, 2009: http://www.chem.unep.ch/irptc/sids/OECDSIDS/sidspub.html] **PEER REVIEWED**

/LABORATORY ANIMALS: Subchronic or Prechronic Exposure/ ...Beagle dogs were exposed by inhalation to n-butyraldehyde vapor at concentrations of 0, 125, 500, and 2000 ppm for 6 hr/day, five days a week, for 14 weeks. Dogs exposed to 125 and 500 ppm displayed goblet cell hyperplasia within the nasal mucosa; dogs in the 2000 ppm treatment group displayed hyperplasia, inflammation, and squamous metaplasia of the nasal tissues. Therefore, the LOAEC is 125 ppm.[United Nations Environment Programme: Screening Information Data Sheets on n-Valeraldehyde (110-62-3) (October 2005) Available from, as of January 15, 2009: http://www.chem.unep.ch/irptc/sids/OECDSIDS/sidspub.html] **PEER REVIEWED**

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/LABORATORY ANIMALS: Subchronic or Prechronic Exposure/ A 12-week inhalation study in male and female rats employing ... doses of 0, 1, 10, and 50 ppm (145 mg/cu m) n-butyraldehyde did not result in any adverse effects on the nasal, olfactory, or respiratory epithelial tissues resulting in a NOAEC of 50 ppm.[United Nations Environment Programme: Screening Information Data Sheets on n-Valeraldehyde (110-62-3) (October 2005) Available from, as of January 15, 2009: http://www.chem.unep.ch/irptc/sids/OECDSIDS/sidspub.html] **PEER REVIEWED**

[United Nations Environment Programme: Screening Information Data Sheets on n-Valeraldehyde (110-62-3) (October 2005) Available from, as of January 15, 2009: http://www.chem.unep.ch/irptc/sids/OECDSIDS/sidspub.html] **PEER REVIEWED**

/LABORATORY ANIMALS: Subchronic or Prechronic Exposure/ Male and female F344 rats were exposed by inhalation to n-butyraldehyde vapor at concentrations of 0, 125, 500, or 2000 ppm (0, 363, 1450, or 5800 mg/cu m) for 6 hr/day, 5 days per week, for 13 weeks. Animals in all treatment groups displayed a significant increase in the incidence of squamous metaplasia of the nasal cavity. No other treatment-related lesions were noted. Reproductive organs and tissues examined at the end of the study were normal upon gross and microscopic examination. This study resulted in a LOAEC of 125 ppm.[United Nations Environment Programme: Screening Information Data Sheets on n-Valeraldehyde (110-62-3) (October 2005) Available from, as of January 15, 2009: http://www.chem.unep.ch/irptc/sids/OECDSIDS/sidspub.html] **PEER REVIEWED**

[United Nations Environment Programme: Screening Information Data Sheets on n-Valeraldehyde (110-62-3) (October 2005) Available from, as of January 15, 2009: http://www.chem.unep.ch/irptc/sids/OECDSIDS/sidspub.html] **PEER REVIEWED**

/LABORATORY ANIMALS: Subchronic or Prechronic Exposure/ Subchronic exposure of guinea pigs, mice, rats, and beagles at concentrations that ranged from 500 to 6400 ppm resulted in mortality and decreased body/kidney weights in all test species. Species differences were observed at the lower exposure concentrations and the effects ranged from lower monocyte counts and altered chemistry to nasal epithelium lesions.[Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V5:978] **PEER REVIEWED**

[Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V5:978] **PEER REVIEWED**

/LABORATORY ANIMALS: Subchronic or Prechronic Exposure/ Male and female Sprague-Dawley rats were exposed 6 hr/day, 5 d/week for 13 weeks to n-butyraldehyde vapor in concentrations of 125, 500 and 2,000 ppm (0.34, 1.36, 5.44 mg/L). There was a full investigation with respect to body and organ weights, urinalysis, blood chemistry, pathology and hematological examinations. Rats of all concentrations had a significant incidence of squamous metaplasia of mucosal epithelium, rhinitis and initial globlet cell atrophy followed by globlet cell hyperplasia. These alterations were more severe in rats sacrificed after 6 weeks of exposure than in those sacrificed after 13 weeks of exposure. The changes are indicative of a response to repeated upper respiratory tract irritation. In none of the other parameters investigated or organs any significant differences were found between test and control groups which could be related to inhalation of n-butyraldehyde vapor concentrations, ie, no systemic toxicity was found. Thus, the NOAEL with respect to systemic toxicity is > 2,00 ppm, with respect to irritative effects < 125 ppm. A follow -up study with 51.3, 10.3 and 1.1 ppm (151, 30, 3.2 mg/cu m) in 15 male and female rats with a similar study design was performed in order to find also a NOAEL for effects on the upper respiratory tract. Histopathological findings indicated that no specific adverse effects could be attributed to n-butyraldehyde. A NOAEL of 51 ppm was therefore be derived from this study for irritation.[United Nations Environment Programme: Screening Information Data Sheets on 3-Methylbutanal (590-86-3) Available from, as of January 14, 2009: http://www.chem.unep.ch/irptc/sids/OECDSIDS/sidspub.html] **PEER REVIEWED**

[United Nations Environment Programme: Screening Information Data Sheets on 3-Methylbutanal (590-86-3) Available from, as of January 14, 2009: http://www.chem.unep.ch/irptc/sids/OECDSIDS/sidspub.html] **PEER REVIEWED**

/LABORATORY ANIMALS: Neurotoxicity/ Butyraldehyde is a vasodepressor in dogs.[Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V5:978] **PEER REVIEWED**

[Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V5:978] **PEER REVIEWED**

/LABORATORY ANIMALS: Neurotoxicity/...Decreases in nerve conduction velocity and amplitude have been reported in frogs.[Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V5:978] **PEER REVIEWED**

[Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V5:978] **PEER REVIEWED**

/GENOTOXICITY/ 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**

[Mortelmans K et al; Environ Mutagen 8: 1-119 (1986)] **PEER REVIEWED**

/GENOTOXICITY/ Five n-alkanals were examined ... for genotoxicity, as evaluated by the induction of unscheduled DNA synthesis (UDS), in primary cultures of rat and human hepatocytes. After 20 hr exposure, cytotoxicity was similar in cells of the two species, and increased with the length of the carbon chain. In rat hepatocytes, propanal (10-100 mM), butanal (10-100 mM), pentanal (3-30 mM) and hexanal (3-30 mM) induced a modest but significant and dose-dependent increase of net nuclear grain counts, while in human hepatocytes this effect was not detected. Nonanal (3-30 mM), which showed the highest cytotoxic effect, failed to induce UDS in both cell types...[Martelli A et al; Mutat

Res 323 (3): 121-6 (1994)] **PEER REVIEWED** PubMed Abstract

[Martelli A et al; Mutat Res 323 (3): 121-6 (1994)] **PEER REVIEWED** PubMed Abstract

/GENOTOXICITY/ Several aldehydes and peroxides were tested for mutagenicity using Salmonella typhimurium tester strains TA97a, TA100, TA102 and TA104, in the presence and absence of Aroclor-induced liver S9 mix from F344 rats and B6C3F1 mice, in either preincubation or vapor phase protocols. ... Butyraldehyde /was/ ... non-mutagenic. ...[Dillon D et al; Mutagenesis 13 (1): 19-26 (1998)] **PEER REVIEWED** PubMed Abstract

[Dillon D et al; Mutagenesis 13 (1): 19-26 (1998)] **PEER REVIEWED** PubMed Abstract

/GENOTOXICITY/ Intraperitoneal injection of butyraldehyde in mice produces chromosomal abnormalities during spermatogenesis.[Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V5:978] **PEER REVIEWED**

[Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V5:978] **PEER REVIEWED**

/GENOTOXICITY/ ...It produces DNA strand breaks in DNA PM2 in conjunction with copper chloride, but not alone, and cross-links with proteins, inducing unscheduled DNA synthesis in rat hepatocytes, but not human hepatocytes. Formation of DNA-protein cross-links is less efficient than for other low molecular weight aldehydes.[Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V5:978] **PEER REVIEWED**

[Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V5:978] **PEER REVIEWED**

/ALTERNATIVE and IN VITRO TESTS/ 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 C. 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** PubMed Abstract

[MARGINEANU DG ET AL; ARCH INT PHYSIOL BIOCHIM 89 (2): 159 (1981)] **PEER REVIEWED** PubMed Abstract

/ALTERNATIVE and IN VITRO TESTS/ Thirteen chemicals present in tobacco smoke were assessed for their effect on viability and proliferation of mouse lymphocytes in vitro. Acetaldehyde, benzene, butyraldehyde, isoprene, styrene, and toluene produced no effect on either viability or proliferation after 3 hr of exposure. Formaldehyde, catechol, acrylonitrile, propionaldehyde, and hydroquinone significantly inhibited T-lymphocyte and B-lymphocyte proliferation with IC50 values ranging from 1.19 x 10-5 M to 8.20 x 10-4 M after 3 hr of exposure. Acrolein and crotonaldehyde not only inhibited T-cell and B-cell proliferation, but also acted on viability with IC50 values ranging from 2.06 x 10-5 M to 4.26 x 10-5 M. Mixtures of acrolein, formaldehyde, and propionaldehyde or crotonaldehyde were tested and interactive effects at 0.5 and 1 x IC50 were observed. Two mixtures significantly inhibited T-cell proliferation when compared to the control at 0.1 x IC50 concentration.[Poirier M et al; J Toxicol Environ Health A 65 (19): 1437-51 (2002)] **PEER REVIEWED** PubMed Abstract

[Poirier M et al; J Toxicol Environ Health A 65 (19): 1437-51 (2002)] **PEER REVIEWED** PubMed Abstract

/ALTERNATIVE and IN VITRO TESTS/ The aliphatic n-butyr-and n-valeraldehyde as well as the aromatic benz- and anisaldehyde induced DNA strand breaks in PM2 DNA in the presence of CuCl2. Neither aldehydes nor CuCl2 alone showed DNA breakage properties...[Becker TW et al; Free Radic Res 24 (5): 325-32 (1996)] **PEER REVIEWED** PubMed Abstract

[Becker TW et al; Free Radic Res 24 (5): 325-32 (1996)] **PEER REVIEWED** PubMed Abstract

/OTHER TOXICITY INFORMATION/ ... 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**

[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**

/OTHER TOXICITY INFORMATION/... Male F-344 rats, weighing 190 to 210 g, were pretreated with 15 ppm formaldehyde (HCHO), 6 hr/day for 9 days, and challenged on the 10th day with a saturated (acetaldehyde, propionaldehyde, and butyraldehyde), unsaturated (acrolein and crotonaldehyde), or cyclic (cyclohexanecarboxaldehyde, 3-cyclohexene-1-carboxaldehyde, and benzaldehyde) ... In naive (nonpretreated) animals, the concentration eliciting a 50% decrease in respiratory rate (RD50) was 23 ppm or less for unsaturated aliphatic aldehydes. For cyclic and saturated aliphatic aldehydes, the RD50 ranged from 600 to 1000 ppm and 3000 to 6800 ppm, respectively. Formaldehyde pretreatment resulted in cross tolerance only with acetaldehyde (RD50 increased 3.5-fold) and acrolein (RD50 increased 5-fold). ...[Babiuk C et al; Toxicol Appl Pharmacol 79 (1): 143-9 (1985)] **PEER REVIEWED** PubMed Abstract

[Babiuk C et al; Toxicol Appl Pharmacol 79 (1): 143-9 (1985)] **PEER REVIEWED** PubMed Abstract

Non-Human Toxicity Values:

LD50 Rat oral 5.89 g/kg /5,890 mg/kg/[Budavari, S. (ed.). The Merck Index - Encyclopedia of Chemicals, Drugs and Biologicals. Rahway, NJ: Merck and Co., Inc., 1989., p. 242] **PEER REVIEWED**

[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**

[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[Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 649] **PEER REVIEWED**

[Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 649] **PEER REVIEWED**

LD50 Rat ip 800 mg/kg[Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 649] **PEER REVIEWED**

[Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 649] **PEER REVIEWED**

LC50 Mouse inhalation 44,610 mg/cu m/2 hr (15,400 ppm/2 hr)[Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 649] **PEER REVIEWED**

[Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 649] **PEER REVIEWED**

LD50 Mouse ip 1140 mg/kg[Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 649] **PEER REVIEWED**

[Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition.

Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 649] **PEER REVIEWED**

LD50 Mouse sc 2700 mg/kg[Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 649] **PEER REVIEWED**

[Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 649] **PEER REVIEWED**

LD50 Rabbit skin 3560 mg/kg[Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 649] **PEER REVIEWED**

[Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 649] **PEER REVIEWED**

Ecotoxicity Values:

EC50; Species: Pseudokirchneriella subcapitata (Green algae, exponential growth phase, 15000 cells/mL, UTEX 1648); Conditions: static, 24 deg C, dissolved oxygen 1-2 mg/L; Concentration: 23560 ug/L for 48 hr; Effect: decreased population growth rate[Chen CY et al; Environ Toxicol Chem 24 (5): 1067-73 (2005) Available from, as of December 22, 2008: http://cfpub.epa.gov/ecotox/quick_query.htm] **PEER REVIEWED**

[Chen CY et al; Environ Toxicol Chem 24 (5): 1067-73 (2005) Available from, as of December 22, 2008: http://cfpub.epa.gov/ecotox/quick_query.htm] **PEER REVIEWED**

EC50; Species: Pseudokirchneriella subcapitata (Green algae, exponential growth phase, 15000 cells/mL, UTEX 1648); Conditions: static, 24 deg C, dissolved oxygen 1-2 mg/L; Concentration: 1480 ug/L for 48 hr; Effect: decreased photosynthesis[Chen CY et al; Environ Toxicol Chem 24 (5): 1067-73 (2005) Available from, as of December 22, 2008: http://cfpub.epa.gov/ecotox/quick_query.htm] **PEER REVIEWED**

[Chen CY et al; Environ Toxicol Chem 24 (5): 1067-73 (2005) Available from, as of December 22, 2008: http://cfpub.epa.gov/ecotox/quick_query.htm] **PEER REVIEWED**

EC50; Species: Chlorococcales (Green algae order); Conditions: freshwater, static; Concentration: 380000 ug/L for 24 hr; Effect: physiology, assimilation efficiency[Krebs F; Deutsche Gewasserkundliche Mitteilungen 35 (5/6): 161-70 (1991) Available from, as of December 22, 2008: http://cfpub.epa.gov/ecotox/quick_query.htm] **PEER REVIEWED**

[Krebs F; Deutsche Gewasserkundliche Mitteilungen 35 (5/6): 161-70 (1991) Available from, as of December 22, 2008: http://cfpub.epa.gov/ecotox/quick_query.htm] **PEER REVIEWED**

LC50; Species: Daphnia magna (Water flea, age < or =24 hr); Conditions: freshwater, static, 20-22 deg C, pH 7.6-7.7; Concentration: 340000 ug/L for 24 hr; Effect: intoxication, immobilization [Bringmann G, Kuhn R; Z Wasser-Abwasser-Forsch 10 (5):161-6 (1977) Available from, as of December 22, 2008: http://cfpub.epa.gov/ecotox/quick_query.htm] **PEER REVIEWED**

[Bringmann G, Kuhn R; Z Wasser-Abwasser-Forsch 10 (5):161-6 (1977) Available from, as of December 22, 2008: http://cfpub.epa.gov/ecotox/quick_query.htm] **PEER REVIEWED**

LC50; Species: Pimephales promelas (Fathead minnow, age 29 days, length 17.2 mm, weight 0.073 g); Conditions: freshwater, flow through, 24.1 deg C, pH 7.7, hardness 41.2 mg/L CaCO3, alkalinity 32.0 mg/L CaCO3, dissolved oxgyen 6.8 mg/L; Concentration: 13400 ug/L for 96 hr (95% confidence limit: 13000-13800 ug/L) /99% purity/[Brooke L; Center for Lake Superior Environ Stud, Univ of Wisconsin-Superior: 414 (1984) Available from, as of December 22, 2008: http://cfpub.epa.gov/ecotox/quick_query.htm] **PEER REVIEWED**

[Brooke L; Center for Lake Superior Environ Stud, Univ of Wisconsin-Superior: 414 (1984) Available from, as of December 22, 2008: http://cfpub.epa.gov/ecotox/quick_query.htm] **PEER REVIEWED**

LC50; Species: Pimephales promelas (Fathead minnow, age 30 days, length 16.4 mm, weight 0.059

g); Conditions: freshwater, flow through, 25.1 deg C, pH 7.2, hardness 43.0 mg/L CaCO3, alkalinity 41.0 mg/L CaCO3, dissolved oxgyen 6.7 mg/L; Concentration: 16000 ug/L for 96 hr (95% confidence limit: 15400-16700 ug/L) /99% purity/[Brooke L; Center for Lake Superior Environ Stud, Univ of Wisconsin-Superior: 414 (1984) Available from, as of December 22, 2008: http://cfpub.epa.gov/ecotox/quick_query.htm] **PEER REVIEWED**

[Brooke L; Center for Lake Superior Environ Stud, Univ of Wisconsin-Superior: 414 (1984) Available from, as of December 22, 2008: http://cfpub.epa.gov/ecotox/quick_query.htm] **PEER REVIEWED**

Ongoing Test Status:

The following link will take the user to the National Toxicology Program (NTP) Test Agent Search Results page, which tabulates all of the "Standard Toxicology & Carcinogenesis Studies", "Developmental Studies", and "Genetic Toxicity Studies" performed with this chemical. Clicking on the "Testing Status" link will take the user to the status (i.e., in review, in progress, in preparation, on test, completed, etc.) and results of all the studies that the NTP has done on this chemical.[Available from: http://ntp-apps.niehs.nih.gov/ntp_tox/index.cfm?fuseaction=ntpsearch.searchresults&searchterm=123-72-8]

[Available from: http://ntp-apps.niehs.nih.gov/ntp_tox/index.cfm?fuseaction=ntpsearch.searchresults&searchterm=123-72-8]

Metabolism/ Pharmacokinetics:

Mechanism of Action:

Inhibition of intercellular communication is an important feature in the tumor promotion phase of a multistage carcinogenesis model. In atherosclerosis inhibition of cell-cell communication by atherogenic compounds, e.g., low density lipoproteins (LDL), also seems to be important. For testing atherogenic compounds we used an atherosclerosis relevant cell type, namely human smooth muscle cells. In order to investigate which part of the LDL particle would be involved in inhibition of metabolic co-operation between human smooth muscle cells in culture ... several fatty acids and their breakdown products /were tested/, namely aldehydes. Unsaturated C-18 fatty acids markedly influenced gap-junctional intercellular communication (GJIC), whereas saturated (C18:0, C16:0) and unsaturated fatty acids with > 20 carbon atoms did not inhibit GJIC. In the case of oleic and elaidic acid, orientation seemed important; however, after exposure to palmitoleic and palmitelaidic acid no differences were found. The most potent inhibitor of GJIC was linoleic acid, which inhibited GJIC by 75%. No correlation was found between degrees of unsaturation and ability to inhibit GJIC. Of the tested aldehydes, hexanal, propanal, butanal and 4-hydroxynonenal did significantly inhibit GJIC, while pentanal had no effect. Since modification of LDL was shown to be important in order for LDL to inhibit GJIC, these results show that fatty acids and their oxidative breakdown products may be of importance for the inhibition of GJIC by LDL.[de Haan LH et al; Carcinogenesis 15 (2): 253-6 (1994)] **PEER REVIEWED** PubMed Abstract

[de Haan LH et al; Carcinogenesis 15 (2): 253-6 (1994)] **PEER REVIEWED** PubMed Abstract

Pharmacology:

Therapeutic Uses:

Bovine soles and shavings from the heel were used in laboratory tests that examined the softening and swelling effects of rainwater, cow slurry (feces plus urine), urine, silage effluent, and washings from recently laid concrete. Formalin, glutaraldehyde and butyraldehyde were compared for their ability to prevent softening induced by water, urine or urea plus 2-mercaptoethanol. Exposure to rainwater, slurry or urine for 72 hr softened the soles on average by 16, 13 and 14 Shore Durometer Units. Silage effluent had less softening effect on soles (7 Shore Durometer Units), and pre-treating heel shavings with silage effluent reversed the swelling effect of water. Washings and scrapings taken from 3- and 7-d-old concrete surfaces prepared from Portland cement, caused swelling in heel shavings by a factor of 1.5 and 1.3. Formaldehyde, glutaraldehyde and butyraldehyde pre-treatment reduced the sole softening effect of urea plus 2-mercaptoethanol in cow soles. Formaldehyde and glutaraldehyde pre-treatment reduced the sole softening effect of urine, and formaldehyde was effective at reducing concrete washings-induced swelling. The findings are relevant to solar bruising and ulceration in cattle.[Gregory N et al; Food Chem Toxicol 44 (8): 1223-7 (2006)] **PEER REVIEWED** PubMed Abstract

`[Gregory N et al; Food Chem Toxicol 44 (8): 1223-7 (2006)] **PEER REVIEWED** PubMed Abstract`

Environmental Fate & Exposure:

Environmental Fate/Exposure Summary:

Butyraldehyde's production and use in the manufacture of plasticizers, rubber accelerators, solvents and high polymers may result in its release to the environment through various waste streams. It has been reported in the essential oils from flowers, fruits, leaves, and bark of various plants. Microbial degradation processes can also emit butyraldehyde to the atmosphere. 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 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 hrs. The half-life for the reaction of butyraldehyde with nitrate radicals has been calculated as 2.9 days. Butyraldehyde absorbs solar radiation (> 290 nm); direct photooxidation products include carbon monoxide, ethene, ethanal and carbon dioxide. 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 1.15X10-4 atm-cu m/mole. Butyraldehyde may volatilize from dry soil surfaces based upon its vapor pressure. Butyraldehyde is expected to biodegrade rapidly in soil and water, under both aerobic and anaerobic conditions. A theoretical BOD of 100% in 2 weeks using an activated sludge in the Japanese MITI test, suggests that biodegradation is an important environmental fate process. If released into water, butyraldehyde is not expected to adsorb to suspended solids and sediment based upon the estimated Koc. 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 9 hrs and 5 days, respectively. Butyraldehyde will react with photochemically produced hydroxyl radicals in water with a half-life of about 200 days. An estimated BCF of 3 suggests the potential for bioconcentration in aquatic organisms is low. Hydrolysis is not expected to be an important environmental fate process since this compound lacks functional groups that hydrolyze under environmental conditions. 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, ingestion of food and drinking water, and dermal contact with consumer products containing butyraldehyde. (SRC) **PEER REVIEWED**

PEER REVIEWED

Probable Routes of Human Exposure:

NIOSH (NOES Survey 1981-1983) has statistically estimated that 5,392 workers (950 of these were female) were 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. Monitoring data indicate that the general population may be exposed to butyraldehyde via inhalation of ambient air, ingestion of food and drinking water, and dermal contact with consumer products containing this compound(SRC).[(1) NIOSH; NOES. National Occupational Exposure Survey conducted from 1981-1983. Estimated numbers of employees potentially exposed to specific agents by 2-digit standard industrial classification (SIC). Available at http://www.cdc.gov/noes/ as of Feb 2009.] **PEER REVIEWED**

[(1) NIOSH; NOES. National Occupational Exposure Survey conducted from 1981-1983. Estimated numbers of employees potentially exposed to specific agents by 2-digit standard industrial classification (SIC). Available at http://www.cdc.gov/noes/ as of Feb 2009.] **PEER REVIEWED**

Butyraldehyde was found in 10 of 15 personal air samples at a mean concentration of 0.68 ppb from samples taken in Helsinki, tested May to Sep 1997(1).[(1) Jurvelin JA et al; J Air Waste Manage Assoc 53: 560-73 (2003)] **PEER REVIEWED**

[(1) Jurvelin JA et al; J Air Waste Manage Assoc 53: 560-73 (2003)] **PEER REVIEWED**

Body Burden:

Butyraldehyde was detected not quantified 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** PubMed Abstract

[(1) Pellizzari ED et al; Bull Environ Contam Toxicol 28: 322-8 (1982)] **PEER REVIEWED** PubMed Abstract

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**

[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**

Microbial degradation processes and plant volatiles can emit butyraldehyde to the atmosphere(1). Butyraldehyde can also occur in trace amounts in tea leaves, certain oils, and coffee aroma(2). Butyraldehyde is emitted from blooming rape(3).[(1) Graedel TE; Chemical Compounds in the

Atmosphere. NY, NY: Academic Press p. 164 (1976) (2) Billing E; Kirk-Othmer Encycl Chem Technol 4th ed. NY, NY: John Wiley & Sons 4: 736-47 (1992) (3) Muller K et al; Chemosphere 49: 1247-56 (2002)] **PEER REVIEWED**

[(1) Graedel TE; Chemical Compounds in the Atmosphere. NY, NY: Academic Press p. 164 (1976) (2) Billing E; Kirk-Othmer Encycl Chem Technol 4th ed. NY, NY: John Wiley & Sons 4: 736-47 (1992) (3) Muller K et al; Chemosphere 49: 1247-56 (2002)] **PEER REVIEWED**

Artificial Pollution Sources:

Butyraldehyde's production and use in the manufacture of plasticizers, rubber accelerators, solvents and high polymers(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).[(1) Lewis RJ Sr, ed; Hawley's Condensed Chem Dict. 15th ed. NY, NY: John Wiley and Sons Inc, p. 206 (2007) (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**

[(1) Lewis RJ Sr, ed; Hawley's Condensed Chem Dict. 15th ed. NY, NY: John Wiley and Sons Inc, p. 206 (2007) (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 1.15X10-4 atm-cu m/mole(4). Butyraldehyde is expected to volatilize from dry soil surfaces(SRC) based upon a vapor pressure of 111 mm Hg(5). A theoretical BOD of 100% in 2 weeks using an activated sludge in the Japanese MITI test(6), suggests that biodegradation is an important environmental fate process in soil(SRC). Under anaerobic conditions, butanal underwent 99% degradation (7 day lag period) using the Hungate serum bottle technique(7).[(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) NITE; Chemical Risk Information Platform (CHRIP). Biodegradation and Bioconcentration. Tokyo, Japan: Natl Inst Tech Eval. Available at http://www.safe.nite.go.jp/english/db.html as of Feb 2009. (7) Chou WL et al; Biotechnol Bioeng Symp 8: 391-414 (1979)] **PEER REVIEWED**

[(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) NITE; Chemical Risk Information Platform (CHRIP). Biodegradation and Bioconcentration. Tokyo, Japan: Natl Inst Tech Eval. Available at http://www.safe.nite.go.jp/english/db.html as of Feb 2009. (7) 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 1.15X10-4 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 9 hrs and 5 days, respectively(SRC). The rate constant for the reaction between photochemically produced hydroxyl radicals in water and butyraldehyde is 3.9X10+9 L/mole-sec(5); at an aquatic concentration of 1X10-17 mole/L of hydroxyl radicals(6), the half-life would be about 206 days(SRC). According to a classification scheme(7), an estimated BCF of 3 (SRC), from its log Kow(2) and a regression-derived equation(8), suggests the potential for bioconcentration in aquatic organisms is low(SRC). A theoretical BOD of 100% in 2 weeks using an activated sludge in the Japanese MITI test(9), suggests that biodegradation is an important environmental fate process in water(SRC).Under anaerobic conditions, butanal underwent 99% degradation (7 day lag period) using the Hungate serum bottle technique(10).[(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) Buxton GV et al; J Phys Chem Ref Data 17: 706 (1988) (6) Mill T et al; Science 207: 886 (1980) (7) Franke C et al; Chemosphere 29: 1501-14 (1994) (8) Meylan WM et al; Environ Toxicol Chem 18: 664-72 (1999) (9) NITE; Chemical Risk Information Platform (CHRIP). Biodegradation and Bioconcentration. Tokyo, Japan: Natl Inst Tech Eval. Available at http://www.safe.nite.go.jp/english/db.html as of Feb 2009. (10) Chou WL et al; Biotechnol Bioeng Symp 8: 391-414 (1979)] **PEER REVIEWED**

[(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) Buxton GV et al; J Phys Chem Ref Data 17: 706 (1988) (6) Mill T et al; Science 207: 886 (1980) (7) Franke C et al; Chemosphere 29: 1501-14 (1994) (8) Meylan WM et al; Environ Toxicol Chem 18: 664-72 (1999) (9) NITE; Chemical Risk Information Platform (CHRIP). Biodegradation and Bioconcentration. Tokyo, Japan: Natl Inst Tech Eval. Available at http://www.safe.nite.go.jp/english/db.html as of Feb 2009. (10) 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. 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 estimated to be 16 hrs(SRC), calculated from its rate constant of 2.35X10-11 cu cm/molecule-sec at 25 deg C(3). The rate constant for the vapor-phase reaction of butyraldehyde with nitrate radical has been experimentally determined to be 1.15X10-14 cu cm/sec (4), which corresponds to an atmospheric half-life of about 2.9 days(SRC). Butyraldehyde absorbs solar radiation (> 290 nm); direct photooxidation products include carbon monoxide, ethene, ethanal and carbon dioxide(5).[(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) Andresen O et al; in Proceedings From the EUROTRAC-2 Symposium 2000, Midgley PM et al, eds., Springer-Verlag: Berlin 5 pp (2001) (5) Tadic J et al; J Photochem Photobiol A:Chem 143:169-79 (2001)] **PEER REVIEWED**

[(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) Andresen O et al; in Proceedings From the EUROTRAC-2 Symposium 2000, Midgley PM et al, eds., Springer-Verlag: Berlin 5 pp (2001) (5) Tadic J et al; J Photochem Photobiol A:Chem 143:169-79 (2001)] **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).[(1) NITE; Chemical Risk Information Platform (CHRIP). Biodegradation and Bioconcentration. Tokyo, Japan: Natl Inst Tech Eval. Available at http://www.safe.nite.go.jp/english/db.html as of Feb 2009. (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**

[(1) NITE; Chemical Risk Information Platform (CHRIP). Biodegradation and Bioconcentration. Tokyo, Japan: Natl Inst Tech Eval. Available at http://www.safe.nite.go.jp/english/db.html as of Feb 2009. (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). Butyraldehyde degradation in an 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**

[(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 has been reported as 2.35X10-11 cu cm/molecule-sec(1). This corresponds to an atmospheric half-life of about 16 hrs at an atmospheric concentration of 5X10+5 hydroxyl radicals per cu cm(2). The rate constant for the vapor-phase reaction of butyraldehyde with nitrate radical has been experimentally determined to be 1.15X10-14 cu cm/sec(3). This corresponds to an atmospheric half-life of about 2.9 days at a concn of 2.4X10+8 nitrate radicals per cu cm(2). Butyraldehyde absorbs solar radiation (> 290 nm); direct photooxidation products include carbon monoxide, ethene, ethanal and carbon dioxide(4). The rate constant for the reaction between photochemically produced hydroxyl radicals in water and butyraldehyde is 3.9X10+9 L/mole-sec(5); at an aquatic concentration of 1X10-17 mole/L of hydroxyl radicals(6), the half-life would be about 206 days(SRC). Butyraldehyde is not expected to undergo hydrolysis in the environment due to the lack of functional groups that hydrolyze under environmental conditions(7).[(1) Atkinson R; Chem Rev 85: 69-201 (1985) (2) Atkinson R; Gas-Phase Tropospheric Chemistry of Organic Compounds, J Phys Chem Ref Data, Monograph 2, 216 pp (1994) (3) Andresen O et al; in Proceedings From the EUROTRAC-2 Symposium 2000, Midgley PM et al, eds., Springer-Verlag: Berlin 5 pp (2001) (4) Tadic J et al; J Photochem Photobiol A:Chem 143:169-79 (2001) (5) Buxton GV et al; J Phys Chem Ref Data 17: 706 (1988) (6) Mill T et al; Science 207: 886 (1980) (7) Lyman WJ et al; Handbook of Chemical Property Estimation Methods. Washington, DC: Amer Chem Soc pp. 7-4, 7-5, 8-12 (1990)] **PEER REVIEWED**

[(1) Atkinson R; Chem Rev 85: 69-201 (1985) (2) Atkinson R; Gas-Phase Tropospheric Chemistry of Organic Compounds, J Phys Chem Ref Data, Monograph 2, 216 pp (1994) (3) Andresen O et al; in Proceedings From the EUROTRAC-2 Symposium 2000, Midgley PM et al, eds., Springer-Verlag: Berlin 5 pp (2001) (4) Tadic J et al; J Photochem Photobiol A:Chem 143:169-79 (2001) (5) Buxton GV et al; J Phys Chem Ref Data 17: 706 (1988) (6) Mill T et al; Science 207: 886 (1980) (7) Lyman WJ et al; Handbook of Chemical Property Estimation Methods. Washington, DC: Amer Chem Soc pp. 7-4, 7-5, 8-12 (1990)] **PEER REVIEWED**

Environmental Bioconcentration:

An estimated BCF of 3 was calculated in fish 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**

[(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.[(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**

[(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 1.15X10-4 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 9 hrs(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 days(SRC). Butyraldehyde's Henry's Law constant indicates that volatilization from moist soil surfaces may occur (SRC). Butyraldehyde is expected to volatilize from dry soil surfaces(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**

[(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 (concentration 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**

[(1) Kopfler FC et al; Adv Environ Sci Technol 8(Fate Pollut Air Water Environ): 419-33 (1977)] **PEER REVIEWED**

SURFACE WATER: Butyraldehyde was detected not quantified in the Niagara River, which flows 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**

[(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**

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

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

Effluent Concentrations:

A butyraldehyde concentration 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 from particle board/carpet degassing is 0.047 mg/sq m-hr(4). Butyraldehyde was released as fireplace emissions at 80.22 and 22.48 mg/kg of fuel burnt for soft and hard wood, respectively(5). Butyraldehyde was found in emissions from a wood stove using hardwood at 36.49 mg/kg and using synthetic fuel at 9.06 mg/kg(5).[(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) Colombo A et al; Sci Tot Environ 91: 237-49 (1990) (5) McDonald JD et al; Environ Sci Technol 34: 2080-91 (2000)] **PEER REVIEWED**

[(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) Colombo A et al; Sci Tot Environ 91: 237-49 (1990) (5) McDonald JD et al; Environ Sci Technol 34: 2080-91 (2000)] **PEER REVIEWED**

Butyraldehyde was identified, not quantified, in rush hour traffic air samples taken at the Oakland-San Francisco Bay Bridge toll plaza 4/23/2001, 5-7 pm, 4/24/2001, 6-10 am, and 3-7 pm(1). The emission rate of butyraldehyde in the gas-phase from medium duty diesel trucks is 1300 ug/km driven(2). Butyraldehyde was found in highway tunnels in Tuscarora; light duty trucks emitted 0.062 mg/km traveled or 0.916 mg/L fuel used, heavy duty trucks emitted 0.220 mg/km traveled or 0.693 mg/L fuel used(3). Butyraldehyde concentrations from automobile exhaust were 2.2-49 ppbv in models from 1971, 1975 and 1977(4). Butyraldehyde emissions from a two stroke engine (chainsaw) using aliphatic gasoline, regular gasoline, and ethanol were 0.045-0.077, 0.038-0.052, and 0.016-0.038 g/kWh, respectively(5). Using the same two stroke engine, emissions of butyraldehyde from aliphatic gasoline mixed with ethanol at 15, 50, and 85% were 0.045-0.076, 0.036-0.066, and 0.025-0.052 g/kWh, respectively, and regular gasoline mixed with ethanol at 15, 50, and 85% were 0.041-0.058, 0.037-0.073, and 0.026-0.052 g/kWh, respectively(5). Butyraldehyde emissions from an automobile running on Swedish environmental classified diesel fuel were 2.9 mg/km and the same automobile running on European program emissions fuel were 3.4 mg/km(6).[(1) Destaillats H et al; Environ Sci Technol 36: 2227-35 (2002) (2) Schauer JJ et al; Environ Sci Technol 33: 1578-7 (1999) (3) Grosjean D et al; Environ Sci Technol 35: 45-53 (2001) (4) Kawamura K et al; Atmos Environ 34: 4175-91 (2000) (5) Magnusson R et al; Environ Sci Technol 36: 1656-64 (2002) (6) Westerholm R et al; Environ Sci Technol 35: 1748-54 (2001)] **PEER REVIEWED**

[(1) Destaillats H et al; Environ Sci Technol 36: 2227-35 (2002) (2) Schauer JJ et al; Environ Sci Technol 33: 1578-7 (1999) (3) Grosjean D et al; Environ Sci Technol 35: 45-53 (2001) (4) Kawamura K et al; Atmos Environ 34: 4175-91 (2000) (5) Magnusson R et al; Environ Sci Technol 36: 1656-64 (2002) (6) Westerholm R et al; Environ Sci Technol 35: 1748-54 (2001)] **PEER REVIEWED**

Butyraldehyde/isobutyraldehyde was measured in the emissions of gasoline powered motor vehicles at a rate of 370 ug/km and 31,000 ug/km for catalyst equipped engines and non-catalyst equipped engines(1). Butyraldehyde/isobutyraldehyde was given off six new vehicle interiors at an average of 19 ug/hr in new vehicles, 7.2 ug/hr in 20 day old vehicles and 7.2 ug/hr in 40 day old vehicles(2). Butyraldehyde/isobutyraldehyde was measured in the emissions of burnt wood at 96, 62, and 31 mg/kg of pine, oak, and eucalyptus, respectively(3).[(1) Schauer JJ et al; Environ Sci Technol 36: 1169-80 (2002) (2) Bauhof H, Wensing M; in Organic Indoor Air Pollutants. Occurrence, Measurement, Evaluation. Salthammer T, ed., Wiley-VCH: NY, NY pp 105-15 (1999) (3) Schauer JJ et al; Environ Sci Technol 35: 1716-28 (2001)] **PEER REVIEWED**

[(1) Schauer JJ et al; Environ Sci Technol 36: 1169-80 (2002) (2) Bauhof H, Wensing M; in Organic Indoor Air Pollutants. Occurrence, Measurement, Evaluation. Salthammer T, ed., Wiley-VCH: NY, NY pp 105-15 (1999) (3) Schauer JJ et al; Environ Sci Technol 35: 1716-28 (2001)] **PEER REVIEWED**

Atmospheric Concentrations:

URBAN/SUBURBAN: The gas-phase concentration 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 <1% total airborne concentration(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 concentration 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). Butyraldehyde was detected in 2471 of 2479 samples in urban/suburban and rural/remote locations throughout MN at concentrations of 0.011-3.41 ug/cu m(6).[(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) (6) Pratt GC et al; Environ Health Perspect 108: 815-25 (2000)] **PEER REVIEWED**

[(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) (6) Pratt GC et al; Environ Health Perspect 108: 815-25 (2000)] **PEER REVIEWED**

URBAN/SUBURBAN: Butyraldehyde, was detected at concentrations of 0.8-140 ug/cu m at Patission Street, Athens, Greece, sampled from June to December, 2000(1). Butyraldehyde was detected in the atmospheric samples taken half way between a petroleum chemical plant and the city of La Plata, Argentina at 19.80 ug/cu m and in the city at 16.99 ug/cu m, samples were taken Nov 1994(2). Butyraldehyde was detected at 0.16-0.39 ppbv in samples taken at the top of an 11 story building on the campus of Hong Kong University Science and Technology(3). Butyraldehyde was detected at 0.36 ppb in 4 of 13 Helsinki samples tested May to Sep 1997(4). Butyraldehyde was detected in Santiago, Chile atmospheric samples at 0.72-3.2 ppbv in Nov 2003(5). Butyraldehyde/isobutyraldehyde was detected at average concentrations of 0.190-1.062 ug/cu m in Rio de Janeiro, Brazil Oct 1999 to Nov 2000(6).[(1) Bakeas EB et al; Chemosphere 52: 805-13 (2003) (2) Herbarth O et al; Environ Toxicol Water Qual 12: 31-7 (1997) (3) Ho SSH, Yu JZ; Environ Sci Technol 38: 862-70 (2004) (4) Jurvelin JA et al; J Air Waste Manage Assoc 53: 560-73 (2003) (5) Rubio MA et al; Chemosphere 62: 1011-20 (2005) (6) Grosjean D et al; Environ Sci Technol 36: 1389-95 (2002)] **PEER REVIEWED**

[(1) Bakeas EB et al; Chemosphere 52: 805-13 (2003) (2) Herbarth O et al; Environ Toxicol Water Qual 12: 31-7 (1997) (3) Ho SSH, Yu JZ; Environ Sci Technol 38: 862-70 (2004) (4) Jurvelin JA et al; J Air Waste Manage Assoc 53: 560-73 (2003) (5) Rubio MA et al; Chemosphere 62: 1011-20 (2005) (6) Grosjean D et al; Environ Sci Technol 36: 1389-95 (2002)] **PEER REVIEWED**

RURAL/REMOTE: Butyraldehyde was detected at concentrations of 0.5-2.3 ug/cu m at Likovrisi, outside of Athens, Greece, during sampling from June to December, 2000(1).[(1) Bakeas EB et al; Chemosphere 52: 805-13 (2003)] **PEER REVIEWED** PubMed Abstract

[(1) Bakeas EB et al; Chemosphere 52: 805-13 (2003)] **PEER REVIEWED** PubMed Abstract

INDOOR: The concentration 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). Butyraldehyde was found in 12 of 15 indoor residences at avg concentration of 0.68 ppb and 4 of 9 work places at avg concentration of 0.35 ppb in Helsinki samples tested May to Sep 1997(2). Butyraldehyde was detected but concentrations were not reported in the vehicles of 50 late shift patrol cars Aug 13 to Oct 11, 2001(3). [(1) Reiss R et al; J Air Waste Manage Assoc 45: 811-22 (1995) (2) Jurvelin JA et al; J Air Waste Manage Assoc 53: 560-73 (2003) (3) Riediker M et al; Environ Sci Technol 37: 2084-93 (2003)] **PEER REVIEWED**

[(1) Reiss R et al; J Air Waste Manage Assoc 45: 811-22 (1995) (2) Jurvelin JA et al; J Air Waste Manage Assoc 53: 560-73 (2003) (3) Riediker M et al; Environ Sci Technol 37: 2084-93 (2003)] **PEER REVIEWED**

SOURCE DOMINATED: Butyraldehyde was detected in the atmospheric samples near a petroleum chemical and industrial plant at 42.68 ug/cu m inside and 102.26 ug/cu m outside, Nov 1994 in La Plata, Argentina(1). Butyraldehyde was detected in kitchen exhaust at concentrations of 2.38-9.81 ppbv(2).[(1) Herbarth O et al; Environ Toxicol Water Qual 12: 31-7 (1997) (2) Ho SSH, Yu JZ; Environ Sci Technol 38: 862-70 (2004)] **PEER REVIEWED**

[(1) Herbarth O et al; Environ Toxicol Water Qual 12: 31-7 (1997) (2) Ho SSH, Yu JZ; Environ Sci Technol 38: 862-70 (2004)] **PEER REVIEWED**

Food Survey Values:

Butyraldehyde has been detected not quantified 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**

[(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**

Plant Concentrations:

Butyraldehyde was emitted from rape during the blooming period at a rate of 0.042-2.87 and 0.030-3.41 ppbv during May 8 and 9, 1998(1).[(1) Muller K et al; Chemosphere 49:1247-56 (2002)] **PEER REVIEWED** PubMed Abstract

[(1) Muller K et al; Chemosphere 49:1247-56 (2002)] **PEER REVIEWED** PubMed Abstract

Milk Concentrations:

ENVIRONMENTAL: Butyraldehyde was detected not quantified 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** PubMed Abstract

[(1) Pellizzari ED et al; Bull Environ Contam Toxicol 28: 322-8 (1982)] **PEER REVIEWED** PubMed Abstract

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. ??Chemical?? is included on this list. Effective date 12/16/88; Sunset date: 12/19/95.[40 CFR 716.120 (USEPA); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of January 26, 2009: http://www.ecfr.gov] **PEER REVIEWED**

[40 CFR 716.120 (USEPA); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of January 26, 2009: http://www.ecfr.gov] **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. n-Butyraldehyde is produced, as an intermediate or a final product, by process units covered under this subpart.[40 CFR 60.489 (USEPA); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of January 26, 2009: http://www.ecfr.gov] **PEER REVIEWED**

[40 CFR 60.489 (USEPA); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of January 26, 2009: http://www.ecfr.gov] **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 (USFDA); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of January 26, 2009: http://www.ecfr.gov] **PEER REVIEWED**

[21 CFR 172.515 (USFDA); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of January 26, 2009: http://www.ecfr.gov] **PEER REVIEWED**

Butyraldehyde is an indirect food additive for use only as a component of adhesives.[21 CFR 175.105 (USFDA); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of January 26, 2009: http://www.ecfr.gov] **PEER REVIEWED**

[21 CFR 175.105 (USFDA); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of January 26, 2009: http://www.ecfr.gov] **PEER REVIEWED**

Chemical/Physical Properties:

Molecular Formula:

C4-H8-O **PEER REVIEWED**
PEER REVIEWED

Molecular Weight:

72.106[Lide, D.R. CRC Handbook of Chemistry and Physics 88TH Edition 2007-2008. CRC Press, Taylor & Francis, Boca Raton, FL 2007, p. 3-72] **PEER REVIEWED**
[Lide, D.R. CRC Handbook of Chemistry and Physics 88TH Edition 2007-2008. CRC Press, Taylor & Francis, Boca Raton, FL 2007, p. 3-72] **PEER REVIEWED**

Color/Form:

Liquid[Lide, D.R. CRC Handbook of Chemistry and Physics 88TH Edition 2007-2008. CRC Press, Taylor & Francis, Boca Raton, FL 2007, p. 3-72] **PEER REVIEWED**
[Lide, D.R. CRC Handbook of Chemistry and Physics 88TH Edition 2007-2008. CRC Press, Taylor & Francis, Boca Raton, FL 2007, p. 3-72] **PEER REVIEWED**
Water-white liquid[Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 15th Edition. John Wiley & Sons, Inc. New York, NY 2007., p. 206] **PEER REVIEWED**
[Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 15th Edition. John Wiley & Sons, Inc. New York, NY 2007., p. 206] **PEER REVIEWED**

Odor:

Characteristic, pungent, aldehyde odor[Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 15th Edition. John Wiley & Sons, Inc. New York, NY 2007., p. 206] **PEER REVIEWED**
[Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 15th Edition. John Wiley & Sons, Inc. New York, NY 2007., p. 206] **PEER REVIEWED**

Boiling Point:

74.8 deg C[Lide, D.R. CRC Handbook of Chemistry and Physics 88TH Edition 2007-2008. CRC Press, Taylor & Francis, Boca Raton, FL 2007, p. 3-72] **PEER REVIEWED**
[Lide, D.R. CRC Handbook of Chemistry and Physics 88TH Edition 2007-2008. CRC Press, Taylor & Francis, Boca Raton, FL 2007, p. 3-72] **PEER REVIEWED**

Melting Point:

-96.86 deg C[Lide, D.R. CRC Handbook of Chemistry and Physics 88TH Edition 2007-2008. CRC Press, Taylor & Francis, Boca Raton, FL 2007, p. 3-72] **PEER REVIEWED**
[Lide, D.R. CRC Handbook of Chemistry and Physics 88TH Edition 2007-2008. CRC Press, Taylor & Francis, Boca Raton, FL 2007, p. 3-72] **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: 740 (1992)] **PEER REVIEWED**

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

Density/Specific Gravity:

0.8016 g/cu cm 20 deg C[Lide, D.R. CRC Handbook of Chemistry and Physics 88TH Edition 2007-2008. CRC Press, Taylor & Francis, Boca Raton, FL 2007, p. 3-72] **PEER REVIEWED**

[Lide, D.R. CRC Handbook of Chemistry and Physics 88TH Edition 2007-2008. CRC Press, Taylor & Francis, Boca Raton, FL 2007, p. 3-72] **PEER REVIEWED**

Heat of Combustion:

2479.34 kJ/mol at 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**

[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 at 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. 330] **PEER REVIEWED**

[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**

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**

[Hansch, C., Leo, A., D. Hoekman. Exploring QSAR - Hydrophobic, Electronic, and Steric Constants. Washington, DC: American Chemical Society., 1995., p. 9] **PEER REVIEWED**

Solubilities:

Miscible with ethanol, ether, ethyl acetate, acetone, toluene, many other organic solvents andoils [O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals.

Whitehouse Station, NJ: Merck and Co., Inc., 2006., p. 259] **PEER REVIEWED**

[O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 2006., p. 259] **PEER REVIEWED**

Soluble in water; miscible with ethanol; very olubl ein acetone, benzene; slightly soluble in chloroform[Lide, D.R. CRC Handbook of Chemistry and Physics 88TH Edition 2007-2008. CRC Press, Taylor & Francis, Boca Raton, FL 2007, p. 3-72] **PEER REVIEWED**

[Lide, D.R. CRC Handbook of Chemistry and Physics 88TH Edition 2007-2008. CRC Press, Taylor & Francis, Boca Raton, FL 2007, p. 3-72] **PEER REVIEWED**

In water, 7.10X10+4 mg/L at 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**

[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: 1.3843 at 20 deg C[Lide, D.R. CRC Handbook of Chemistry and Physics 88TH Edition 2007-2008. CRC Press, Taylor & Francis, Boca Raton, FL 2007, p. 3-72] **PEER REVIEWED**

[Lide, D.R. CRC Handbook of Chemistry and Physics 88TH Edition 2007-2008. CRC Press, Taylor & Francis, Boca Raton, FL 2007, p. 3-72] **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**

[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**

[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**

[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**

[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: 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**

[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: 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**

[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 at 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**

[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**

[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 at 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.] **PEER REVIEWED**

[Daubert, T.E., R.P. Danner. Physical and Thermodynamic Properties of Pure Chemicals Data Compilation. Washington, D.C.: Taylor and Francis, 1989.] **PEER REVIEWED**

Viscosity:

0.45 cP at 20 deg C[Cornils B et al; Ullmann's Encyclopedia of Industrial Chemistry. 7th ed. (2008). NY, NY: John Wiley & Sons; Butanals. Online Posting Date: Sept 15, 2000.] **QC REVIEWED**

[Cornils B et al; Ullmann's Encyclopedia of Industrial Chemistry. 7th ed. (2008). NY, NY: John Wiley & Sons; Butanals. Online Posting Date: Sept 15, 2000.] **QC REVIEWED**

Other Chemical/Physical Properties:

Wt/gal: 6.7 lb at 20 deg C; Coefficient of expansion: 0.00114 at 20 deg C[Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 15th Edition. John Wiley & Sons, Inc. New York, NY 2007., p. 206] **PEER REVIEWED**

[Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 15th Edition. John Wiley & Sons, Inc. New York, NY 2007., p. 206] **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**

[The Chemical Society. Foreign Compound Metabolism in Mammals Volume 3. London: The Chemical Society, 1975., p. 516] **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**

[Buttery RG et al; J Agric Food Chem 17: 385-9 (1969)] **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**

[Atkinson R; Chem Rev 85: 69-201 (1985)] **PEER REVIEWED**

Chemical Safety & Handling:

DOT Emergency Guidelines:

/GUIDE 129: FLAMMABLE LIQUIDS (Polar/Water-Miscible/Noxious)/ 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 or confined areas (sewers, basements, tanks). Vapor explosion hazard indoors, outdoors or in sewers. Those substances designated with a (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. 2012 Emergency Response Guidebook. Washington, D.C. 2012] **PEER REVIEWED**

[U.S. Department of Transportation. 2012 Emergency Response Guidebook. Washington, D.C. 2012] **PEER REVIEWED**

/GUIDE 129: FLAMMABLE LIQUIDS (Polar/Water-Miscible/Noxious)/ 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. 2012 Emergency Response Guidebook. Washington, D.C. 2012] **PEER REVIEWED**

[U.S. Department of Transportation. 2012 Emergency Response Guidebook. Washington, D.C. 2012] **PEER REVIEWED**

/GUIDE 129: FLAMMABLE LIQUIDS (Polar/Water-Miscible/Noxious)/ Public Safety: CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed on the inside back cover. As an immediate precautionary measure, isolate spill or leak area for at least 50 meters (150 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. 2012 Emergency Response Guidebook. Washington, D.C. 2012] **PEER REVIEWED**

[U.S. Department of Transportation. 2012 Emergency Response Guidebook. Washington, D.C. 2012] **PEER REVIEWED**

/GUIDE 129: FLAMMABLE LIQUIDS (Polar/Water-Miscible/Noxious)/ Protective Clothing: Wear positive pressure self-contained breathing apparatus (SCBA). Structural firefighters' protective clothing will only provide limited protection.[U.S. Department of Transportation. 2012 Emergency Response Guidebook. Washington, D.C. 2012] **PEER REVIEWED**

[U.S. Department of Transportation. 2012 Emergency Response Guidebook. Washington, D.C. 2012] **PEER REVIEWED**

/GUIDE 129: FLAMMABLE LIQUIDS (Polar/Water-Miscible/Noxious)/ Evacuation: Large Spill: Consider initial downwind evacuation for at least 300 meters (1000 feet). 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. 2012 Emergency Response Guidebook. Washington, D.C. 2012] **PEER REVIEWED**

[U.S. Department of Transportation. 2012 Emergency Response Guidebook. Washington, D.C. 2012] **PEER REVIEWED**

/GUIDE 129: FLAMMABLE LIQUIDS (Polar/Water-Miscible/Noxious)/ Fire: CAUTION: All these products have a very low flash point: Use of water spray when fighting fire may be inefficient. Small Fire: Dry chemical, CO2, water spray or alcohol-resistant foam. Do not use dry chemical extinguishers to control fires involving nitromethane or nitroethane. Large Fire: 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. 2012 Emergency Response Guidebook. Washington, D.C. 2012] **PEER REVIEWED**

[U.S. Department of Transportation. 2012 Emergency Response Guidebook. Washington, D.C. 2012] **PEER REVIEWED**

/GUIDE 129: FLAMMABLE LIQUIDS (Polar/Water-Miscible/Noxious)/ 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 Spill: 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. 2012 Emergency Response Guidebook. Washington, D.C. 2012] **PEER REVIEWED**

[U.S. Department of Transportation. 2012 Emergency Response Guidebook. Washington, D.C. 2012] **PEER REVIEWED**

/GUIDE 129: FLAMMABLE LIQUIDS (Polar/Water-Miscible/Noxious)/ First Aid: Move victim to fresh air. Call 911 or emergency medical service. Give 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. In case of burns, immediately cool affected skin for as long as possible with cold water. Do not remove clothing if adhering to skin. 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. 2012 Emergency Response Guidebook. Washington, D.C. 2012] **PEER REVIEWED**

[U.S. Department of Transportation. 2012 Emergency Response Guidebook. Washington, D.C. 2012] **PEER REVIEWED**

Odor Threshold:

Odor threshold= 0.009 ppm[Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 2002. 4th ed.Vol 1 A-H Norwich, NY: Noyes Publications, 2002., p. 428] **PEER REVIEWED**

[Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 2002. 4th ed.Vol 1 A-H Norwich, NY: Noyes Publications, 2002., p. 428] **PEER REVIEWED**

Skin, Eye and Respiratory Irritations:

Irritating to skin, eyes and respiratory system.[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 49-35] **PEER REVIEWED**

[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 49-35] **PEER REVIEWED**

...Eye or skin contact may cause burns and possible permanent damage. High exposure can cause dizziness and lightheadedness. Higher exposures can cause pulmonary edema, a medical emergency that can be delayed for several hours. This can cause death... Prolonged or repeated skin exposure may cause skin disorders.[Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 2002. 4th ed.Vol 1 A-H Norwich, NY: Noyes Publications, 2002., p. 428] **PEER REVIEWED**

[Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 2002. 4th ed.Vol 1 A-H Norwich, NY: Noyes Publications, 2002., p. 428] **PEER REVIEWED**

Fire Potential:

Highly flammable liquid.[Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 649] **PEER REVIEWED**

[Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 649] **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. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 325-27] **PEER REVIEWED**

[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 325-27] **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. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 325-27] **PEER REVIEWED**

[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 325-27] **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. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 325-27] **PEER REVIEWED**

[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 325-27] **PEER REVIEWED**

Flammable Limits:

Lower: 1.9% by volume; Upper: 12.5% by volume.[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 325-27] **PEER REVIEWED**

[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 325-27] **PEER REVIEWED**

Flash Point:

-8 DEG F (-22 DEG C) (CLOSED CUP)[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 325-9] **PEER REVIEWED**

[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 325-9] **PEER REVIEWED**

Autoignition Temperature:

425 deg F 218 deg C[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 325-27] **PEER REVIEWED**

[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 325-27] **PEER REVIEWED**

Fire Fighting Procedures:

If material on fire or involved in fire: Do not extinguish fire unless flow can be stopped. Use water in flooding quantities as fog. Solid streams of water may spread fire. Cool all affected containers with flooding quantities of water. Apply water from as far a distance as possible. Use foam, dry chemical, or carbon dioxide.[Association of American Railroads; Bureau of Explosives. Emergency Handling of Hazardous Materials in Surface Transportation. Association of American Railroads, Pueblo, CO. 2005, p. 159] **PEER REVIEWED**

[Association of American Railroads; Bureau of Explosives. Emergency Handling of Hazardous Materials in Surface Transportation. Association of American Railroads, Pueblo, CO. 2005, p. 159] **PEER REVIEWED**

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**

[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. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 49-35] **PEER REVIEWED**

[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 49-35] **PEER REVIEWED**

Toxic Combustion Products:

Flammable liquid.[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 49-35] **PEER REVIEWED**

[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 49-35] **PEER REVIEWED**

...Poisonous gases, including carbon monoxide, are produced in fire...[Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 2002. 4th ed.Vol 1 A-H Norwich, NY: Noyes Publications, 2002., p. 429] **PEER REVIEWED**

[Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 2002. 4th ed.Vol 1 A-H Norwich, NY: Noyes Publications, 2002., p. 429] **PEER REVIEWED**

Firefighting Hazards:

May accumulate static electrical charges, and may cause ignition of its vapors.[Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 2002. 4th ed.Vol 1 A-H Norwich, NY: Noyes Publications, 2002., p. 428] **PEER REVIEWED**

[Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 2002. 4th ed.Vol 1 A-H Norwich, NY: Noyes Publications, 2002., p. 428] **PEER REVIEWED**

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**

[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**

[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. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 649] **PEER REVIEWED**

[Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 649] **PEER REVIEWED**

Reacts vigorously with chlorosulfonic acid, /nitric acid/, oleum, /sulfuric acid/.[Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 649] **PEER REVIEWED**

[Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 649] **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**

[Prager, J.C. Environmental Contaminant Reference Databook Volume 1. New York, NY: Van Nostrand Reinhold, 1995., p. 357] **PEER REVIEWED**

Mixing n-butyrlaldehyde and chlorosulfonic acid in a closed container caused the temperature and pressure to increase.[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 491-39] **PEER REVIEWED**

[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 491-39] **PEER REVIEWED**

Mixing n-butyrlaldehyde and 70% nitric acid in a closed container caused the temperature and pressure to increase.[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 491-39] **PEER REVIEWED**

[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 491-39] **PEER REVIEWED**

Mixing n-butyrlaldehyde and oleum in a closed container caused the temperature and pressure to increase.[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 491-39] **PEER REVIEWED**

[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 491-39] **PEER REVIEWED**

Mixing n-butyrlaldehyde and 96% sulfuric acid in a closed container caused the temperature and pressure to increase.[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 491-39] **PEER REVIEWED**

[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 491-39] **PEER REVIEWED**

Possible self-reaction in air; undergoes rapid oxidation to butyric acid in air. Incompatible with strong oxidizers (possible violent reaction), strong acids, caustics, ammonia, aliphatic amines, alkanolamines, aromatic amines. May corrode steel due to corrosive action of butyric acid.[Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 2002. 4th ed.Vol 1 A-H Norwich, NY: Noyes Publications, 2002., p. 428] **PEER REVIEWED**

[Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 2002. 4th ed.Vol 1 A-H Norwich, NY: Noyes Publications, 2002., p. 428] **PEER REVIEWED**

Hazardous Decomposition:

When heated to decomposition it emits acrid smoke and fumes.[Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 649] **PEER REVIEWED**

[Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 649] **PEER REVIEWED**

Hazardous Polymerization:

Hazardous polymerization may occur.[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 49-35] **PEER REVIEWED**

[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 49-35] **PEER REVIEWED**

...May polymerize due to heat or contact with acids or alkalis.[Sittig, M. Handbook of Toxic and

Hazardous Chemicals and Carcinogens, 2002. 4th ed.Vol 1 A-H Norwich, NY: Noyes Publications, 2002., p. 428] **PEER REVIEWED**
[Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 2002. 4th ed.Vol 1 A-H Norwich, NY: Noyes Publications, 2002., p. 428] **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**
[Prager, J.C. Environmental Contaminant Reference Databook Volume 1. New York, NY: Van Nostrand Reinhold, 1995., p. 357] **PEER REVIEWED**
Wear solvent-resistant gloves and clothing to prevent any reasonable probability of skin contact. ...All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full facepiece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Remove nonimpervious clothing immediately if wet or contaminated. Provide emergency showers and eyewash.[Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 2002. 4th ed.Vol 1 A-H Norwich, NY: Noyes Publications, 2002., p. 428] **PEER REVIEWED**
[Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 2002. 4th ed.Vol 1 A-H Norwich, NY: Noyes Publications, 2002., p. 428] **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**
[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**
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**
PEER REVIEWED
Personnel protection: Avoid breathing vapors. Keep upwind. Wear appropriate chemical protective gloves, boots and goggles. Do not handle broken packages unless wearing appropriate personal protective equipment. Wash away any material which may have contacted the body with copious amounts of water or soap and water.[Association of American Railroads; Bureau of Explosives. Emergency Handling of Hazardous Materials in Surface Transportation. Association of American

Railroads, Pueblo, CO. 2005, p. 159] **PEER REVIEWED**

[Association of American Railroads; Bureau of Explosives. Emergency Handling of Hazardous Materials in Surface Transportation. Association of American Railroads, Pueblo, CO. 2005, p. 159] **PEER REVIEWED**

Evacuation: If material leaking (not on fire) consider evacuation from downwind area based on amount of material spilled, location and weather conditions.[Association of American Railroads; Bureau of Explosives. Emergency Handling of Hazardous Materials in Surface Transportation. Association of American Railroads, Pueblo, CO. 2005, p. 159] **PEER REVIEWED**

[Association of American Railroads; Bureau of Explosives. Emergency Handling of Hazardous Materials in Surface Transportation. Association of American Railroads, Pueblo, CO. 2005, p. 159] **PEER REVIEWED**

If material not on fire and not involved in fire: Keep sparks, flames, and other sources of ignition away. Keep material out of water sources and sewers. Build dikes to contain flow as necessary. Attempt to stop leak if without undue personnel hazard. Use water spray to knock-down vapors. [Association of American Railroads; Bureau of Explosives. Emergency Handling of Hazardous Materials in Surface Transportation. Association of American Railroads, Pueblo, CO. 2005, p. 159] **PEER REVIEWED**

[Association of American Railroads; Bureau of Explosives. Emergency Handling of Hazardous Materials in Surface Transportation. Association of American Railroads, Pueblo, CO. 2005, p. 159] **PEER REVIEWED**

Low inhalation toxicity. Good warning property 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**

[National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978., p. 49-80] **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**

[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**

[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**

[IMDG; International Maritime Dangerous Goods Code; International Maritime Organization p.3196 (1998)] **PEER REVIEWED**

Storage Conditions:

On contact with air butyraldehyde is oxidized readily to the butyric acids. Therefore, storage under inert gas is mandatory.[Ullmann's Encyclopedia of Industrial Chemistry. 6th ed.Vol 1: Federal Republic of Germany: Wiley-VCH Verlag GmbH & Co. 2003 to Present, p. V5 697 (2003)] **PEER REVIEWED**

[Ullmann's Encyclopedia of Industrial Chemistry. 6th ed.Vol 1: Federal Republic of Germany: Wiley-VCH Verlag GmbH & Co. 2003 to Present, p. V5 697 (2003)] **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. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 49-35] **PEER REVIEWED**

[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 49-35] **PEER REVIEWED**

Outside or detached storage is preferred. ...Metal containers involving the transfer of this chemical should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of this chemical. Sources of ignition such as smoking and open flames, are prohibited where this chemical is used, handled, or stored ina manner that could create a potential fire or explosion hazard.[Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 2002. 4th ed.Vol 1 A-H Norwich, NY: Noyes Publications, 2002., p. 429] **PEER REVIEWED**

[Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 2002. 4th ed.Vol 1 A-H Norwich, NY: Noyes Publications, 2002., p. 429] **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**

[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. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 49-35] **PEER REVIEWED**

[Fire Protection Guide to Hazardous Materials. 13 ed. Quincy, MA: National Fire Protection Association, 2002., p. 49-35] **PEER REVIEWED**

Environmental considerations water spill: Use natural barriers or oil spill control booms to limit spill travel Remove trapped material with suction hoses.[Association of American Railroads; Bureau of Explosives. Emergency Handling of Hazardous Materials in Surface Transportation. Association of

American Railroads, Pueblo, CO. 2005, p. 159] **PEER REVIEWED**

[Association of American Railroads; Bureau of Explosives. Emergency Handling of Hazardous Materials in Surface Transportation. Association of American Railroads, Pueblo, CO. 2005, p. 159] **PEER REVIEWED**

Environmental considerations air spill: Apply water spray or mist to knock down vapors.[Association of American Railroads; Bureau of Explosives. Emergency Handling of Hazardous Materials in Surface Transportation. Association of American Railroads, Pueblo, CO. 2005, p. 159] **PEER REVIEWED**

[Association of American Railroads; Bureau of Explosives. Emergency Handling of Hazardous Materials in Surface Transportation. Association of American Railroads, Pueblo, CO. 2005, p. 159] **PEER REVIEWED**

Environmental considerations land spill: Dig a pit, pond, lagoon, holding area to contain liquid or solid material. Dike surface flow using soil, sand bags, foamed polyurethane, or foamed concrete. Absorb bulk liquid with fly ash, cement powder, or commercial sorbents.[Association of American Railroads; Bureau of Explosives. Emergency Handling of Hazardous Materials in Surface Transportation. Association of American Railroads, Pueblo, CO. 2005, p. 159] **PEER REVIEWED**

[Association of American Railroads; Bureau of Explosives. Emergency Handling of Hazardous Materials in Surface Transportation. Association of American Railroads, Pueblo, CO. 2005, p. 159] **PEER REVIEWED**

...Absorb liquid in vermiculite, dry sand, earth or similar noncombustible absorbent material and deposit in sealed container. Do not use sawdust or other combustible absorbent. Ventilate area of spill or leak after clean-up is complete...[Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 2002. 4th ed.Vol 1 A-H Norwich, NY: Noyes Publications, 2002., p. 429] **PEER REVIEWED**

[Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 2002. 4th ed.Vol 1 A-H Norwich, NY: Noyes Publications, 2002., p. 429] **PEER REVIEWED**

Disposal Methods:

SRP: The most favorable course of action is to use an alternative chemical product with less inherent propensity for occupational exposure or environmental contamination. Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations. **PEER REVIEWED**

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**

[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**

[USEPA; Engineering Handbook for Hazardous Waste Incineration p.2-4 (1981) EPA 68-03-3025] **PEER REVIEWED**

Occupational Exposure Standards:

NIOSH Recommendations:

Exposure to acetaldehyde has produced nasal tumors in rats and laryngeal tumors in hamsters, and exposure to malonaldehyde has produced thyroid gland and pancreatic islet cell tumors in rats. NIOSH therefore recommends that acetaldehyde and malonaldehyde be considered potential occupational carcinogens in conformance with the OSHA carcinogen policy. Testing has not been completed to determine the carcinogenicity of ... butyraldehyde, ... /a/ related low-molecular-weight-aldehyde. However, the limited studies to date indicate that ... /this substance has/ chemical reactivity and mutagenicity similar to acetaldehyde and malonaldehyde. Therefore, NIOSH recommends that careful consideration should be given to reducing ... /exposure to this related aldehyde/.[NIOSH. NIOSH Pocket Guide to Chemical Hazards & Other Databases CD-ROM. Department of Health & Human Services, Centers for Disease Prevention & Control. National Institute for Occupational Safety & Health. DHHS (NIOSH) Publication No. 2005-151 (2005)] **PEER REVIEWED**

[NIOSH. NIOSH Pocket Guide to Chemical Hazards & Other Databases CD-ROM. Department of Health & Human Services, Centers for Disease Prevention & Control. National Institute for Occupational Safety & Health. DHHS (NIOSH) Publication No. 2005-151 (2005)] **PEER REVIEWED**

Other Standards Regulations and Guidelines:

Workplace Environmental Exposure Level (WEEL): 8-hr Time-weighted Average (TWA) 25 ppm. [American Induustrial Hygiene Association. AIHA Emergency Response Planning Guidelines (ERPG) & Workplace Environmental Exposure Levels (WEEL). Fairfax, VA. 2008, p. 40] **PEER REVIEWED**

[American Induustrial Hygiene Association. AIHA Emergency Response Planning Guidelines (ERPG) & Workplace Environmental Exposure Levels (WEEL). Fairfax, VA. 2008, p. 40] **PEER REVIEWED**

Manufacturing/Use Information:

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, as of May 24, 2001: http://npirspublic.ceris.purdue.edu/ppis/] **PEER REVIEWED**

[U.S. Environmental Protection Agency/Office of Pesticide Program's Chemical Ingredients Database on Butyraldehyde (123-72-8). Available from, as of May 24, 2001: http://npirspublic.ceris.purdue.edu/ppis/] **PEER REVIEWED**

Chiefly in manufacturing of rubber accelerators, synthetic resins, solvents, plasticizers.[O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 2006., p. 259] **PEER REVIEWED**

[O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 2006., p. 259] **PEER REVIEWED**

Reported uses (ppm): (FEMA, 2005)

Reported uses (ppm): (FEMA, 2005)

Food Category	Usual	Max.
Alcoholic beverages	0.35	0.77
Baked goods	5.52	8.05
Frozen dairy	3.22	5.24
Gelatins, puddings	4.46	9.25
Gravies	1.16	2.41
Meat products	0.36	0.70
Nonalcoholic beverages	0.51	1.38
Soft candy	3.52	5.46

[Burdock, G.A. (ed.). Fenaroli's Handbook of Flavor Ingredients. 5th ed.Boca Raton, FL 2005, p. 221] **PEER REVIEWED**

[Burdock, G.A. (ed.). Fenaroli's Handbook of Flavor Ingredients. 5th ed.Boca Raton, FL 2005, p. 221] **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**

[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**

Plasticizers, rubber accelerators, solvents, high polymers[Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 15th Edition. John Wiley & Sons, Inc. New York, NY 2007., p. 206] **PEER REVIEWED**

[Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 15th Edition. John Wiley & Sons, Inc. New York, NY 2007., p. 206] **PEER REVIEWED**

Manufacturers:

BASF Corp., 100 Campus Dr., Florham Park, NJ 07932, (973) 426-6000; Chemicals Division, 3000 Continental Dr. - North, Mount Olive, NJ 07828-1234, (973) 426-2600; Chemical Intermediates; Production site: Freeport, TX 77541[SRI Consulting. 2008 Directory of Chemical Producers United States. Menlo Park, CA 2008, p. 469] **PEER REVIEWED**

[SRI Consulting. 2008 Directory of Chemical Producers United States. Menlo Park, CA 2008, p. 469] **PEER REVIEWED**

The Dow Chemical Co., 2030 Dow Center, Midland, MI 48642, (989) 636-1000; Production sites: Taft, LA 70057; Texas City, TX 77592[SRI Consulting. 2008 Directory of Chemical Producers United States. Menlo Park, CA 2008, p. 469] **PEER REVIEWED**

[SRI Consulting. 2008 Directory of Chemical Producers United States. Menlo Park, CA 2008, p. 469] **PEER REVIEWED**

Eastman Chemical Co., P.O. Box 511, Kingsport, TN 37662, (423) 229-2000; Chemical and Fibers Group; Production site: Longview, TX 75607[SRI Consulting. 2008 Directory of Chemical Producers United States. Menlo Park, CA 2008, p. 469] **PEER REVIEWED**

[SRI Consulting. 2008 Directory of Chemical Producers United States. Menlo Park, CA 2008, p. 469] **PEER REVIEWED**

OXEA Corp., 1505 West LBJ Freeway, Suite 400, P.O. Box 810349, Dallas, TX 75381 (972) 443-

8900; Production site: Bay City, TX 77404[SRI Consulting. 2008 Directory of Chemical Producers United States. Menlo Park, CA 2008, p. 469`] **PEER REVIEWED**
[SRI Consulting. 2008 Directory of Chemical Producers United States. Menlo Park, CA 2008, p. 469`] **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**
[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.[Burdock, G.A. (ed.). Fenaroli's Handbook of Flavor Ingredients. 5th ed.Boca Raton, FL 2005, p. 221] **PEER REVIEWED**
[Burdock, G.A. (ed.). Fenaroli's Handbook of Flavor Ingredients. 5th ed.Boca Raton, FL 2005, p. 221] **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**
[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**
[Ashford, R.D. Ashford's Dictionary of Industrial Chemicals. London, England: Wavelength Publications Ltd., 1994., p. 162] **PEER REVIEWED**

(1) Oxo process; (2) dehydrogenating butanol vapors over a catalyst, the butyraldehyde being separated by distillation; (3) partial reduction of crotonaldehyde.[Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 14th Edition. John Wiley & Sons, Inc. New York, NY 2001., p. 206] **PEER REVIEWED**
[Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 14th Edition. John Wiley & Sons, Inc. New York, NY 2001., p. 206] **PEER REVIEWED**

Usually manufactured by catalytic dehydrogenation of butanol, catalytic hydrogenation of crotonaldehyde, or by the oxo process from propene.[O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 2006., p. 259] **PEER REVIEWED**
[O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 2006., p. 259] **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**

[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:

Grades: Technical (93% minimum).[Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 15th Edition. John Wiley & Sons, Inc. New York, NY 2007., p. 206] **PEER REVIEWED**

[Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 15th Edition. John Wiley & Sons, Inc. New York, NY 2007., p. 206] **PEER REVIEWED**

98% Liquid grade ...[CHEMCYCLOPEDIA 1986 p.64] **PEER REVIEWED**

[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**

[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 polymerization 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**

[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**

[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**

[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**

[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**

[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**

[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**

Butanal is listed as a High Production Volume (HPV) chemical (65FR81686). Chemicals listed as HPV were produced in or imported into the U.S. in >1 million pounds in 1990 and/or 1994. The HPV list is based on the 1990 Inventory Update Rule. (IUR) (40 CFR part 710 subpart B; 51FR21438). [EPA/Office of Pollution Prevention and Toxics; High Production Volume (HPV) Challenge Program. Available from the Database Query page at: http://www.epa.gov/hpv/pubs/general/opptsrch.htm on Butanal (123-72-8) as of February 5, 2009] **PEER REVIEWED**

[EPA/Office of Pollution Prevention and Toxics; High Production Volume (HPV) Challenge Program. Available from the Database Query page at: http://www.epa.gov/hpv/pubs/general/opptsrch.htm on Butanal (123-72-8) as of February 5, 2009] **PEER REVIEWED**

Production volumes for non-confidential chemicals reported under the Inventory Update Rule.

Year	Production Range (pounds)
1986	>500 million - 1 billion
1990	> 1 billion
1994	> 1 billion
1998	> 1 billion
2002	> 1 billion

[US EPA; Non-confidential Production Volume Information Submitted by Companies for Chemicals Under the 1986-2002 Inventory Update Rule (IUR). Butanal (123-72-8). Available from, as of January 29, 2009: http://www.epa.gov/oppt/iur/tools/data/2002-vol.html] **PEER REVIEWED**

[US EPA; Non-confidential Production Volume Information Submitted by Companies for Chemicals Under the 1986-2002 Inventory Update Rule (IUR). Butanal (123-72-8). Available from, as of January 29, 2009: http://www.epa.gov/oppt/iur/tools/data/2002-vol.html] **PEER REVIEWED**

U. S. Exports:

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

[BUREAU OF THE CENSUS. U.S. EXPORTS, SCHEDULE E, 1984 p.277] **PEER REVIEWED**

Laboratory Methods:

Analytic Laboratory Methods:

Method: EPA-TSC/NERL 556; Procedure: gas chromatography with electron capture detector; Analyte: butyraldehyde; Matrix: finished drinking water and raw source water; Detection Limit: 0.35 ug/L.[National Environmental Methods Index; Analytical, Test and Sampling Methods. Available from http://www.nemi.gov on Butyraldehyde (123-72-8) as of February 10, 2009] **PEER REVIEWED**

[National Environmental Methods Index; Analytical, Test and Sampling Methods. Available from http://www.nemi.gov on Butyraldehyde (123-72-8) as of February 10, 2009] **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**

[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**

[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**

[USEPA; EMMI. EPA's Environmental Monitoring Methods Index. Version 1.1. PC# 4082. Rockville, MD: Government Institutes (1997)] **PEER REVIEWED**

Method: NIOSH 2539; Procedure: gas chromatography, flame ionization detector and gas chromatography/mass spectrometry; Analyte: butyraldehyde; Matrix: air; Detection Limit: 2 ug/sample.[CDC; NIOSH Manual of Analytical Methods, 4th ed. Butyraldehyde (123-72-8). Available from, as of February 11, 2009: http://www.cdc.gov/niosh/docs/2003-154/] **PEER REVIEWED**

[CDC; NIOSH Manual of Analytical Methods, 4th ed. Butyraldehyde (123-72-8). Available from, as of February 11, 2009: http://www.cdc.gov/niosh/docs/2003-154/] **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**

[USEPA; EMMI. EPA's Environmental Monitoring Methods Index. Version 1.1. PC# 4082. Rockville, MD: Government Institutes (1997)] **PEER REVIEWED**

Method: EPA-OGWDW/TSC 556.1; Procedure: fast gas chromatography system equipped with an electron capture detector; Analyte: butyraldehyde; Matrix: finished drinking water and raw source water; Detection Limit: 0.09 ug/L.[National Environmental Methods Index; Analytical, Test and

Sampling Methods. Available from http://www.nemi.gov on Butyraldehyde (123-72-8) as of February 10, 2009] **PEER REVIEWED**

[National Environmental Methods Index; Analytical, Test and Sampling Methods. Available from http://www.nemi.gov on Butyraldehyde (123-72-8) as of February 10, 2009] **PEER REVIEWED**

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** PubMed Abstract

[KUWATA K ET AL; J CHROMATOGR SCI 17 (5): 264 (1979)] **PEER REVIEWED** PubMed Abstract

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**

[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 AT 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**

[OHNO K ET AL; TAIKI OSEN GAKKAISHI 14 (9): 382 (1979)] **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**

[USEPA; EMMI. EPA's Environmental Monitoring Methods Index. Version 1.1. PC# 4082. Rockville, MD: Government Institutes (1997)] **PEER REVIEWED**

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**

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**

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**

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**

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**

PEER REVIEWED

BUTANAL[Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 649] **PEER REVIEWED**

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**

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**

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**

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**

PEER REVIEWED

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

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**

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**

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**
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**
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**
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**
PEER REVIEWED

BUTYRYLALDEHYDE **PEER REVIEWED**
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, as of May 24, 2001: http://npirspublic.ceris.purdue.edu/ppis/] **PEER REVIEWED**
PEER REVIEWED

FEMA NUMBER 2219[Burdock, G.A. (ed.). Fenaroli's Handbook of Flavor Ingredients. 5th ed.Boca Raton, FL 2005, p. 221] **PEER REVIEWED**
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**
PEER REVIEWED

Butirraldehido (Spanish)[Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 2002. 4th ed.Vol 1 A-H Norwich, NY: Noyes Publications, 2002., p. 428] **PEER REVIEWED**
PEER REVIEWED

Formulations/Preparations:

Grades: Technical (93% minimum).[Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 15th Edition. John Wiley & Sons, Inc. New York, NY 2007., p. 206] **PEER REVIEWED**
[Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 15th Edition. John Wiley & Sons, Inc. New York, NY 2007., p. 206] **PEER REVIEWED**

98% Liquid grade ...[CHEMCYCLOPEDIA 1986 p.64] **PEER REVIEWED**
[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**
[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:

20090817

Last Review Date:

Reviewed by SRP on 5/7/2009

Update History:

Field Update on 2014-12-05, 2 fields added/edited/deleted

Field Update on 2010-06-01, 1 fields added/edited/deleted

Complete Update on 2009-08-17, 76 fields added/edited/deleted

Field Update on 2008-08-23, 1 fields added/edited/deleted

Field Update on 2008-08-22, 1 fields added/edited/deleted

Field Update on 2008-08-21, 1 fields added/edited/deleted

Field Update on 2007-04-19, 1 fields added/edited/deleted

Field Update on 2007-04-19, 1 fields added/edited/deleted

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

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