

National Organic Standards Board,
c/o Robert Pooler, Agricultural Marketing Specialist,
USDA/AMS/TM/NOP, Room 2510-So., Ag Stop 0268,
P.O. Box 96456, Washington, D.C. 20090-6456.

Phone: 202/720-3252. Fax: 202/205-7808. e-mail: nlpetition@usda.gov.

National List Petition
Submitted: November 29, 2000

CYCLOHEXYLAMINE

This Petition is submitted by the following:

Joseph Hall
Co-chair, MPPL Subcommittee, OTA
California Natural Products, Inc.
1250 E. Lanthrop Road
Lanthrop, CA 95330
phone (209)858-2525
email joehall@californianatural.com

Jim Pierce
Organic Valley / CROPP Cooperative
507 Main St. La Farge WI 54639
phone (608)625-2602 fax (608)625-4177
email jim.pierce@organicvalley.com website www.organicvalley.com.

Greg Cunningham
General Mills
201 General Mills BLvd
Minneapolis Mn 55426-1350
phone number 763 764 3058
email - greg.cunningham@genmills.com

Kelly Shea; Farm Relations Manager
Horizon Organic Dairy
6311 Horizon Lane
Boulder, CO 80308-7577
phone (719) 372-9233
email kellys@horizonorganic.com

Kim Burton
Smucker Quality Beverages, Inc.
Speedway Avenue
Chico, CA 95926
phone (530) 899-5058
email- kim.burton@jmsmucker.com

Clifford L. Jacobson
Spray Chem Chemical Company, Inc.
705 Keenan Court
Durham, CA 95938
phone (530) 895-3658
email - cliff@spraychem.com

To: Robert Pooler
USDA/AMS/TM/NOP
email: Bob.Pooler@USDA.gov

From: Co-petitioners
Date: 12/5/00

re; additional information for petitions of Cyclohexylamine, Diethylaminoethanol, and Morpholine

➤ **Justification Statement;**

Boiler water additives are essential to prevent the corrosion of steam generating and distribution systems. These additives prevent corrosion by neutralizing carbonic acid as it forms from the carbon dioxide captured within the steam. Most manufactures have one boiler system serving their entire plant and therefore producing steam for all the operating needs. These steam generating and distribution systems represent significant capital investments for food manufacturers. As an example; a 500-hp boiler costs roughly \$200,000.00. Typically, a boiler this size will provide enough steam to operate a small processing facility with one or two production lines and fruit/vegetable processing area. The larger the operation the more boiler capacity is needed. Large operations will take multiple boiler systems, which will take on the average three boiler systems. This is an investment of approximately \$600,000.00 for the boilers alone. Additional capitol investment of the entire production area is at risk if the steam is not treated to neutralize the carbonic acid. Effective and safe boiler/steam additives are vital to protect these systems. A poorly maintained system will require replacement every 5 to 8 years as opposed to lasting between 50 to 100 years. Additionally, Most State's and private insurance companies require inspections to verify that a boiler is being properly maintained. This includes a proper chemical documentation program. Worker safety is also an issue as a poorly maintained boiler system can result in steam leaks and equipment failure under load.

The only effective steam and condensate line corrosion inhibitors available are amine based with the exception or ammonium hydroxide which is the only approved steam line treatment in dairy. The code of Federal Regulations lists only three approved volatile amines; **Cyclohexylamine, Diethylaminoethanol, and Morpholine.** For the most complete and economical protection of a steam system, it is advisable to design a blend of these amines which will accommodate to the specific yet changing conditions in a boiler system. Suppliers of these materials are familiar with the conditions needed for proper distribution ratio's and will create an optimum blend for their client.

➤ **Non-synthetic Substances**

There are no approved non-synthetic substances.

➤ **Alternative Control Methods**

1. Many operations **discontinue the use of boiler water additives** only during the production of organic products minimizing the corrosive impact of not using boiler water additives. Below are some of the reasons why this is not feasible for all operations:
 - This would only be possible for manufacturers of both organic and non-organic products whose organic production represented a relatively small portion of their running time.

- This would be impractical for producers targeting a national distribution. To achieve production volumes for national distribution organic production lines would have to run virtually continuously.
 - For perspective, a 500-hp system running without boiler water additives would increase fuel requirements by about \$100,000.00. This would result in 2 additional tons of nitrogen oxide and 1 additional ton of sulfur dioxide released into the atmosphere each year. As corrosion builds up the efficiency of heat transfer decreases requiring more energy to run the boiler.
2. **Culinary steam filters** (as suggested by prior NOSB addendum Number 7 – Orlando, 1995) do not remove the volatile amines and therefore are not an alternative.
 3. Placing a **steam to steam heat exchanger** between the existing boiler water system and the production line system .
 - Not a solution for all applications, the temperature differential has to be sufficient to maintain the required temperature and pressure to serve the production system
 - The cost of installation would present a significant expense. (Average cost for a line of national distribution is \$500,000.00. Life span of equipment is 5-8 years.)

Beneficial effects to the environment from the use of the synthetic substance.

The environment benefits from the proper maintenance and boiler water treatment program. A poorly maintained boiler will increase fuel requirements as corrosion builds up and the efficiency of heat transfer decreases requiring more energy to run the boiler. These results in additional nitrogen oxide and sulfur dioxide release into the atmosphere and promotes an unsafe work environment due to deterioration and possible catastrophic steam into the work places.

To: Robert Pooler
USDA/AMS/TM/NOP
email: Bob.Pooler@USDA.gov

From: Co-petitioners
Date: 12/5/00

re; additional information for petitions of Cyclohexylamine, Diethylaminoethanol, and Morpholine

➤ **Justification Statement;**

Boiler water additives are essential to prevent the corrosion of steam generating and distribution systems. These additives prevent corrosion by neutralizing carbonic acid as it forms from the carbon dioxide captured within the steam. Most manufactures have one boiler system serving their entire plant and therefore producing steam for all the operating needs. These steam generating and distribution systems represent significant capital investments for food manufacturers. As an example; a 500-hp boiler costs roughly \$200,000.00. Typically, a boiler this size will provide enough steam to operate a small processing facility with one or two production lines and fruit/vegetable processing area. The larger the operation the more boiler capacity is needed. Large operations will take multiple boiler systems, which will take on the average three boiler systems. This is an investment of approximately \$600,000.00 for the boilers alone. Additional capitol investment of the entire production area is at risk if the steam is not treated to neutralize the carbonic acid. Effective and safe boiler/steam additives are vital to protect these systems. A poorly maintained system will require replacement every 5 to 8 years as opposed to lasting between 50 to 100 years. Additionally, Most State's and private insurance companies require inspections to verify that a boiler is being properly maintained. This includes a proper chemical documentation program. Worker safety is also an issue as a poorly maintained boiler system can result in steam leaks and equipment failure under load.

The only effective steam and condensate line corrosion inhibitors available are amine based with the exception or ammonium hydroxide which is the only approved steam line treatment in dairy. The code of Federal Regulations lists only three approved volatile amines; **Cyclohexylamine, Diethylaminoethanol, and Morpholine.** For the most complete and economical protection of a steam system, it is advisable to design a blend of these amines which will accommodate to the specific yet changing conditions in a boiler system. Suppliers of these materials are familiar with the conditions needed for proper distribution ratio's and will create an optimum blend for their client.

➤ **Non-synthetic Substances**

There are no approved non-synthetic substances.

➤ **Alternative Control Methods**

1. Many operations **discontinue the use of boiler water additives** only during the production of organic products minimizing the corrosive impact of not using boiler water additives. Below are some of the reasons why this is not feasible for all operations:
 - This would only be possible for manufacturers of both organic and non-organic products whose organic production represented a relatively small portion of their running time.

- This would be impractical for producers targeting a national distribution. To achieve production volumes for national distribution organic production lines would have to run virtually continuously.
 - For perspective, a 500-hp system running without boiler water additives would increase fuel requirements by about \$100,000.00. This would result in 2 additional tons of nitrogen oxide and 1 additional ton of sulfur dioxide released into the atmosphere each year. As corrosion builds up the efficiency of heat transfer decreases requiring more energy to run the boiler.
2. **Culinary steam filters** (as suggested by prior NOSB addendum Number 7 – Orlando, 1995) do not remove the volatile amines and therefore are not an alternative.
 3. Placing a **steam to steam heat exchanger** between the existing boiler water system and the production line system .
 - Not a solution for all applications, the temperature differential has to be sufficient to maintain the required temperature and pressure to serve the production system
 - The cost of installation would present a significant expense. (Average cost for a line of national distribution is \$500,000.00. Life span of equipment is 5-8 years.)

Beneficial effects to the environment from the use of the synthetic substance.

The environment benefits from the proper maintenance and boiler water treatment program. A poorly maintained boiler will increase fuel requirements as corrosion builds up and the efficiency of heat transfer decreases requiring more energy to run the boiler. These results in additional nitrogen oxide and sulfur dioxide release into the atmosphere and promotes an unsafe work environment due to deterioration and possible catastrophic steam into the work places.

To: Robert Pooler
USDA/AMS/TM/NOP
email: Bob.Pooler@USDA.gov

From: Co-petitioners
Date: 12/5/00

re; additional information for petitions of Cyclohexylamine, Diethylaminoethanol, and Morpholine

➤ **Justification Statement:**

Boiler water additives are essential to prevent the corrosion of steam generating and distribution systems. These additives prevent corrosion by neutralizing carbonic acid as it forms from the carbon dioxide captured within the steam. Most manufactures have one boiler system serving their entire plant and therefore producing steam for all the operating needs. These steam generating and distribution systems represent significant capital investments for food manufacturers. As an example; a 500-hp boiler costs roughly \$200,000.00. Typically, a boiler this size will provide enough steam to operate a small processing facility with one or two production lines and fruit/vegetable processing area. The larger the operation the more boiler capacity is needed. Large operations will take multiple boiler systems, which will take on the average three boiler systems. This is an investment of approximately \$600,000.00 for the boilers alone. Additional capitol investment of the entire production area is at risk if the steam is not treated to neutralize the carbonic acid. Effective and safe boiler/steam additives are vital to protect these systems. A poorly maintained system will require replacement every 5 to 8 years as opposed to lasting between 50 to 100 years. Additionally, Most State's and private insurance companies require inspections to verify that a boiler is being properly maintained. This includes a proper chemical documentation program. Worker safety is also an issue as a poorly maintained boiler system can result in steam leaks and equipment failure under load.

The only effective steam and condensate line corrosion inhibitors available are amine based with the exception or ammonium hydroxide which is the only approved steam line treatment in dairy. The code of Federal Regulations lists only three approved volatile amines; **Cyclohexylamine, Diethylaminoethanol, and Morpholine.** For the most complete and economical protection of a steam system, it is advisable to design a blend of these amines which will accommodate to the specific yet changing conditions in a boiler system. Suppliers of these materials are familiar with the conditions needed for proper distribution ratio's and will create an optimum blend for their client.

➤ **Non-synthetic Substances**

There are no approved non-synthetic substances.

➤ **Alternative Control Methods**

1. Many operations **discontinue the use of boiler water additives** only during the production of organic products minimizing the corrosive impact of not using boiler water additives. Below are some of the reasons why this is not feasible for all operations:
 - This would only be possible for manufacturers of both organic and non-organic products whose organic production represented a relatively small portion of their running time.

- This would be impractical for producers targeting a national distribution. To achieve production volumes for national distribution organic production lines would have to run virtually continuously.
 - For perspective, a 500-hp system running without boiler water additives would increase fuel requirements by about \$100,000.00. This would result in 2 additional tons of nitrogen oxide and 1 additional ton of sulfur dioxide released into the atmosphere each year. As corrosion builds up the efficiency of heat transfer decreases requiring more energy to run the boiler.
2. **Culinary steam filters** (as suggested by prior NOSB addendum Number 7 – Orlando, 1995) do not remove the volatile amines and therefore are not an alternative.
 3. Placing a **steam to steam heat exchanger** between the existing boiler water system and the production line system .
 - Not a solution for all applications, the temperature differential has to be sufficient to maintain the required temperature and pressure to serve the production system
 - The cost of installation would present a significant expense. (Average cost for a line of national distribution is \$500,000.00. Life span of equipment is 5-8 years.)

Beneficial effects to the environment from the use of the synthetic substance.

The environment benefits from the proper maintenance and boiler water treatment program. A poorly maintained boiler will increase fuel requirements as corrosion builds up and the efficiency of heat transfer decreases requiring more energy to run the boiler. These results in additional nitrogen oxide and sulfur dioxide release into the atmosphere and promotes an unsafe work environment due to deterioration and possible catastrophic steam into the work places.

CYCLOHEXYLAMINE

Processing

Category: Synthetic

Common Name: Cyclohexylamine

Synonyms: Cyclohexanamine; Aminocyclohexane; Hexahydroaniline; CHA; Hexahydrobenzenamine; amino-hexahydrobenzene; Cyclohexylamine; C₆H₁₃N (Attachment C-9)

Manufacturers:

BASF
3000 Continental Drive – North
Mt. Olive, NJ 07828
Corp. Phone 973-426-2600

Elf Atochem/ Atofina
2000 Market Street
Philadelphia, PA 1903-3222
215-419-7000

List of uses, rates: Cyclohexylamine is used in boiler systems to prevent carbonic acid corrosion in return lines. Typically, cyclohexylamine is used in conjunction with morpholine and diethylaminoethanol the amount will be dictated by the levels of carbonate and bicarbonate in the steam and condensate. FDA-Boiler Water Additives, Title 21, Part 173 (21 CFR 173.310) (4-1-89 Edition) directs that usage cannot exceed 10 ppm in steam, and excluding us of such steam in contact with milk and milk products. Usage cannot exceed the amount required to protect the system.

Other uses: In organic synthesis, manufacture of insecticides, plasticizers, corrosion inhibitors, rubber chemicals, dyestuffs, emulsifying agent, dry cleaning soaps, acid gas absorbents. Paint, pigment, surfactant, insecticide, oxygen absorber. Boiler water treatment, rubber accelerator (Attachment C-1).

Sources, mfg. Descript: Prepared by catalytic hydrogenation of aniline at elevated temperatures and pressures. Fractionation of crude reaction product yields **cyclohexylamine**, unchanged aniline, & high-boiling residue containing N-phenylcyclohexylamine (cyclohexylaniline) & dicyclohexylamine. (attachment C-8)

Summary of previous reviews by state or private certification agencies: Unknown if states have done previous reviews. Historically, certification agencies have ignored the issue of boiler chemical amines coming in contact with organic products.

Regulatory status: Approved by FDA not to exceed 10 ppm in steam, and not approved for contact with milk and milk products. See 21CFR173.310 (Attachment C-2).

CAS Number & Label: CAS No. 108-91-8 (Attachment C-3).
Requires Flammable markings. (Labels in Attachment C-4).

Physical properties, chemical mode of action, environmental impact, interaction with other materials, toxicity and persistence, effects on human health, effects on soil organisms, crops or livestock:

Physical properties: Flammable and corrosive colorless to yellow liquid with a strong fishy odor. Melting point – 17.7°C, boiling point 134.5°C. Density 3.42. (Attachment C-1)

Chemical mode of action:

Neutralizes carbonic acid in steam and steam condensates.

Environmental impact:

NIOSH does not indicate any negative environmental impacts.(Attachment C-5)

See TOXNET research document (Attachment C-8)

Interaction with other materials:

Is not compatible with strong oxidizers (such as chlorine, bromine and fluorine), strong acids (such as Hydrochloric, sulfuric, and nitric), acid chlorides and acidanhydrides.

Toxicity and persistence:

See TOXNET search results. (Attachment C-8)

Effects on human health:

See TOXNET search results. (Attachments C-6 & C-8)

Effects on soil organisms:

NIOSH does not indicate any environmental hazards.

See TOXNET search results. (Attachment C-8)

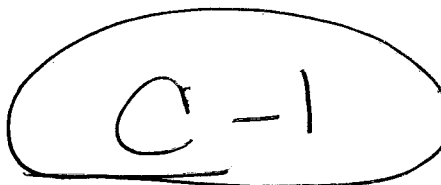
Safety, MSDS, NIEHS reports:

Flammable, corrosive. When inhaled causes burning sensation, coughing labored breathing.

When in contact with skin and eyes causes redness and blisters. When ingested causes abdominal cramps, burning sensation, vomiting. (see attachment C-5)

Research information, reviews, bibliographies:

RESULTS OF DIALOG AND TOXLINE COMPUTER SEARCHES : Copies of the computer search printouts are included in Attachment C-7

NTP CHEMICAL REPOSITORY
CYCLOHEXYLAMINE-IDENTIFIERS
=====

*CATALOG ID NUMBER: 000851
*CAS NUMBER: 108-91-8
*BASE CHEMICAL NAME: CYCLOHEXYLAMINE
*PRIMARY NAME: CYCLOHEXYLAMINE
*CHEMICAL FORMULA: C6H13N
*STRUCTURAL FORMULA:
*WLN: L6TJ AZ

*SYNONYMS:
AMINOCYCLOHEXANE
AMINOHEXAHYDROBENZENE
HEXAHYDROANILINE
CHA
CYCLOHEXANAMINE
HEXAHYDROBENZENAMINE

-PHYSICAL CHEMICAL DATA
=====

*PHYSICAL DESCRIPTIONS: CLEAR COLORLESS LIQUID
*MOLECULAR WEIGHT: 99.17
*SPECIFIC GRAVITY: 0.8467 @ 25/25 DENSTIY: 0.85 g/mL @25
*DENSITY: 3.42 ELL: 1.5% ELU
*MP (DEG C): -17.7
*BP (DEG C): 134.5
*SOLUBILITIES:
 WATER : VERY SOLUBLE
 DMSO : VERY SOLUBLE
 95% ETHANOL : VERY SOLUBLE
 METHANOL : Not available
 ACETONE : VERY SOLUBLE
 TOLUENE : Not available
OTHER SOLVENTS: Not available
 ETHER : VERY SOLUBLE
 BENZENE: VERY SOLUBLE
*VOLATILITY : MODERATE.
 Vapor density : 3.42
*FLAMMABILITY (FLASH POINT): HIGH. ?FLASH POINT: 110 DEGREES F. NO DANGEROUS R

The autoignition temperature is 293 C (559 F).

*UEL: 9.4%

LEL: Not available

*REACTIVITY: MAY REACT VIOLENTLY WITH OXIDIZING MATERIALS.

*STABILITY: Sensitive to air and light

*OTHER PHYSICAL DATA: Strong, fishy amine odor.

-TOXICITY

=====

*NIOSH REGISTRY NUMBER: GX0700000

*TOXICITY: (abbreviations)

typ.	dose	mode	specie	amount	unit	other
	LD50	ORL	RAT	710	MG/KG	
	LD50	IPR	RAT	200	MG/KG	
	LD50	IPR	MUS	300	MG/KG	
	LD50	SCU	MUS	1150	MG/KG	
	LD50	SKN	RBT	320	MG/KG	
	LDLO	PAR	RBT	500	MG/KG	

*AQTX/TLM96: 1000-100 PPM

*SAX TOXICITY EVALUATION: THR=MODERATE VIA ORAL AND INHALATION ROUTES; HIGH VIA

*CARCINOGENICITY: Not available

*MUTAGENICITY:

CYT-HMN:LEU 10 UMOL/L/5H
 CYT-RAT-UNK 50 MG/KG
 SPM-RAT-IPR 5 MG/KG/5D
 DLT-MUS-IPR 500 MG/KG/5D-I
 CYT-HAM:FBR 10 MG/L
 CYT-DOM-UNK 50 MG/KG

*TERATOGENICITY: Not available

*STANDARDS, REGULATIONS & RECOMMENDATIONS:

OSHA: Federal Register (1/19/89)

Final Limit: PEL-TWA 10 ppm [610]

ACGIH: TLV-TWA 10 ppm [610]

NIOSH Criteria Document: None

NFPA Hazard Rating: Health (H): 2

Flammability (F): 3

Reactivity (R): 0

H2: Materials hazardous to health, but areas may be entered freely with full-faced mask self-contained breathing apparatus which provides eye protection (see NFPA for details).

F3: Materials which can be ignited under almost all normal temperature conditions (see NFPA for details).

R0: Materials which are normally stable even under fire exposure conditions and which are not reactive with water (see NFPA for details).

*OTHER TOXICITY DATA:

Skin and Eye Irritation Data:

skn-hmn 125 mg/48H SEV

Review: Toxicology Review-2

-OTHER DATA (Regulatory)

=====

*PROPER SHIPPING NAME (IATA): Cyclohexylamine

C-1

*UN/ID NUMBER: UN2357

*HAZARD CLASS: 8

SUBSIDIARY RISK: 3

PACKING GROUP: II

*LABELS REQUIRED: Corrosive and Flammable liquid

*PACKAGING: PASSENGER: PKG. INSTR.: 808, Y808
CARGO : PKG. INSTR.: 812MAXIMUM QUANTITY: 1 L, 0.5 L
MAXIMUM QUANTITY: 30 L

*SPECIAL PROVISIONS: None

*USES:

IN ORGANIC SYNTHESIS, MANUFACTURE OF INSECTICIDES, PLASTICIZERS, CORROSION INHIBITORS, RUBBER CHEMICALS, DYESTUFFS, EMULSIFYING AGENT, DRY CLEANING SOAPS, ACID GAS ABSORBENTS. PAINT, PIGMENT, SURFACTANT, INSECTICIDE, OXYGEN ABSORBER. BOILER WATER TREATMENT, RUBBER ACCELERATOR.

uses

*COMMENTS: Not available

-HANDLING PROCEDURES

=====

*ACUTE/CHRONIC HAZARDS:

TOXIC. CAUSES IRRITATION ON CONTACT. HIGHLY TOXIC DECOMPOSITION PRODUCTS. ?MUTAGEN.

*MINIMUM PROTECTIVE CLOTHING:

If Tyvek-type disposable protective clothing is not worn during handling of this chemical, wear disposable Tyvek-type sleeves taped to your gloves.

*RECOMMENDED GLOVE MATERIALS: P

The following gloves show the best resistance based on permeation testing. It is recommended that two different glove types be used for best protection. However, if this chemical makes direct contact with your glove, or if a tear, puncture or hole develops, remove them at once.

SUGGESTED GLOVES: Butyl rubber (to 160 min.)

*RECOMMENDED RESPIRATOR:

Where the neat test chemical is weighed and diluted, wear a NIOSH-approved half face respirator equipped with a combination filter cartridge, i.e. organic vapor/acid gas/HEPA (specific for organic vapors, HCl, acid gas, SO₂ and a high efficiency particulate filter).

*OTHER: Not available

*STORAGE PRECAUTIONS:

You should store this chemical in a freezer and away from all mineral acids and bases.

*SPILLS AND LEAKAGE:

If you should spill this chemical, use absorbent paper to pick up all liquid spill material. Seal the absorbent paper, as well as any of your clothing which may be contaminated, in a vapor-tight plastic bag for eventual disposal. Wash any surfaces you may have contaminated with a strong soap and water solution. Do not reenter the contaminated area until the Safety Officer (or other responsible person) has verified that the area has been properly cleaned.

*DISPOSAL AND WASTE TREATMENT:

You should dispose of all waste and contaminated materials associated with this chemical as specified by existing local, state and federal regulations concerning hazardous waste disposal. It is suggested that your contaminated materials should be destroyed by incineration in a special, high temperature (>2000 degrees F),

chemical incinerator facility.

-EMERGENCY PROCEDURES

=====

*SKIN CONTACT:

IMMEDIATELY flood affected skin with water while removing and isolating all contaminated clothing. Gently wash all affected skin areas thoroughly with soap and water.

IMMEDIATELY call a hospital or poison control center even if no symptoms (such as redness or irritation) develop.

IMMEDIATELY transport the victim to a hospital for treatment after washing the affected areas.

*INHALATION:

IMMEDIATELY leave the contaminated area; take deep breaths of fresh air. IMMEDIATELY call a physician and be prepared to transport the victim to a hospital even if no symptoms (such as wheezing, coughing, shortness of breath, or burning in the mouth, throat, or chest) develop.

Provide proper respiratory protection to rescuers entering an unknown atmosphere. Whenever possible, Self-Contained Breathing Apparatus (SCBA) should be used; if not available, use a level of protection greater than or equal to that advised under Respirator Recommendation.

*EYE CONTACT:

First check the victim for contact lenses and remove if present. Flush victim's eyes with water or normal saline solution for 20 to 30 minutes while simultaneously calling a hospital or poison control center.

Do not put any ointments, oils, or medication in the victim's eyes without specific instructions from a physician.

IMMEDIATELY transport the victim after flushing eyes to a hospital even if no symptoms (such as redness or irritation) develop.

*INGESTION:

If the victim is conscious and not convulsing, give 1 or 2 glasses of water to dilute the chemical and IMMEDIATELY call a hospital or poison control center.

Generally, the induction of vomiting is NOT recommended outside of a physician's care due to the risk of aspirating the chemical into the victim's lungs. However, if the victim is conscious and not convulsing and if medical help is not readily available, consider the risk of inducing vomiting because of the high toxicity of the chemical ingested. Ipecac syrup or salt water may be used in such an emergency. IMMEDIATELY transport the victim to a hospital.

If the victim is convulsing or unconscious, do not give anything by mouth, ensure that the victim's airway is open and lay the victim on his/her side with the head lower than the body. DO NOT INDUCE VOMITING. IMMEDIATELY transport the victim to a hospital.

*SYMPTOMS: MAY CAUSE IRRITATION ON CONTACT. CAUSES NAUSEA AND NARCOTIC EFFECTS

*FIREFIGHTING:

This compound is not very flammable but any fire involving this compound may produce dangerous vapors. You should evacuate the area. All firefighters should wear full-body protective clothing and use self-contained breathing apparatuses.

You should extinguish any fires involving this chemical with a dry chemical, carbon dioxide, foam, or halon extinguisher.

-SOURCES

=====

*SOURCES:

Lewis, R.J., Sr. and R.L. Tatken, Eds. Registry of Toxic Effects of Chemical Substances. DHEW (NIOSH) Publication

- No. 79-100. National Institute for Occupational Safety and Health. Cincinnati, OH. 1979. GX0700000.
- Oak Ridge National Laboratory. Environmental Mutagen Information Center (EMIC), Bibliographic Data Base. Oak Ridge National Laboratory. Oak Ridge, TN. LISTED.
- Windholz, M., Ed. The Merck Index. 9th Ed. Merck and Co. Rahway, NJ. 1976. PP.357, NO.2734.
- International Technical Information Institute. Toxic and Hazardous Industrial Chemicals Safety Manual for Handling and Disposal with Toxicity and Hazard Data. International Technical Information Institute. 1978. PP.145-146, NO.183.
- Weast, R.C. and M.A. Astle, Eds. CRC Handbook of Chemistry and Physics. 60th Ed. CRC Press, Inc. Boca Raton, FL. 1982. PP.C-260, NO.C640.
- Proctor, N.H. and J.P. Hughes. Chemical Hazards of the Workplace. J.B. Lippincott. Philadelphia. 1978. NOT LISTED.
- Hawley, G.G., Ed. The Condensed Chemical Dictionary. 10th Ed. Van Nostrand Reinhold. New York. 1981. PP.298.
- Sax, N.I. Dangerous Properties of Industrial Materials. 4th Ed. Van Nostrand Reinhold. New York. 1975. PP.530.
- U.S. Environmental Protection Agency, Office of Toxic Substances. Toxic Substances Control Act Chemical Substances Inventory, Initial Inventory. 6 Vols. U.S. Environmental Protection Agency. Washington, D.C. 1979. LISTED.
- Steere, N.V., Ed. Handbook of Laboratory Safety. 2nd Ed. CRC Press, Inc. Cleveland, OH. 1971. PP.750-751, NO.308.
- Oak Ridge National Laboratory. Environmental Teratogen Information Center (ETIC), Bibliographic Data Base. Oak Ridge National Laboratory. Oak Ridge, TN. LISTED.
- Aldrich Chemical Company. Aldrich Catalog/Handbook of Fine Chemicals. Aldrich Chemical Co., Inc. Milwaukee, WI. 1980. PP.271, NO.C10,465-5.
- Occupational Safety and Health Administration. Tentative OSHA Listing of Confirmed and Suspected Carcinogens by Category. Occupational Safety and Health Administration. Washington, DC. 1979. NOT LISTED.
- [610] Clansky, Kenneth B., Ed. Suspect Chemicals Sourcebook: A Guide to Industrial Chemicals Covered Under Major Federal Regulatory and Advisory Programs. Roytech Publications, Inc. Burlingame, CA. 1990. Update, p. xxviii.
- [620] United States National Toxicology Program. Chemical Status Report. NTP Chemtrack System. Research Triangle Park, NC. November 6, 1990. Not listed.
-

Sodium metasilicate.....
 Sodium nitrate.....
 Sodium phosphate (mono-, di-, tri-)
 Sodium polyacrylate.....
 Sodium polymethacrylate.....
 Sodium silicate.....
 Sodium sulfate.....
 Sodium sulfite (neutral or
 alkaline).

[[Page 130]]

Sodium tripolyphosphate.....
 Sorbitol anhydride esters: a
 mixture consisting of sorbitan
 monostearate as defined in Sec.
 172.842 of this chapter;
 polysorbate 60 ((polyoxyethylene
 (20) sorbitan monostearate)) as
 defined in Sec. 172.836 of this
 chapter; and polysorbate 20
 ((polyoxyethylene (20) sorbitan
 monolaurate)), meeting the
 specifications of the Food
 Chemicals Codex, 4th ed. (1996),
 pp. 306-307, which is incorporated
 by reference in accordance with 5
 U.S.C. 552(a) and 1 CFR part 51.
 Copies are available from the
 National Academy Press, 2101
 Constitution Ave. NW., Box 285,
 Washington, DC 20055 (Internet
<http://www.nap.edu>), or may be
 examined at the Center for Food
 Safety and Applied Nutrition's
 Library, Food and Drug
 Administration, 200 C St. SW., rm.
 3321, Washington, DC, or at the
 Office of the Federal Register,
 800 North Capitol St. NW., suite
 700, Washington, DC.
 Tannin (including quebracho
 extract).
 Tetrasodium EDTA.....
 Tetrasodium pyrophosphate.....

The mixture is used as an
 anticorrosive agent in steam
 boiler distribution systems, with
 each component not to exceed 15
 parts per million in the steam.

Substances	Limitations
Cyclohexylamine.....	Not to exceed 10 parts per million in steam, and excluding use of such steam in contact with milk and milk products.
Diethylaminoethanol.....	Not to exceed 15 parts per million in steam, and excluding use of such steam in contact with milk and milk products.
Hydrazine.....	Zero in steam.
Morpholine.....	Not to exceed 10 parts per

	million in steam, and excluding use of such steam in contact with milk and milk products.
Octadecylamine.....	Not to exceed 3 parts per million in steam, and excluding use of such steam in contact with milk and milk products.
Trisodium nitrilotriacetate.....	Not to exceed 5 parts per million in boiler feedwater; not to be used where steam will be in contact with milk and milk products.

(e) To assure safe use of the additive, in addition to the other information required by the Act, the label or labeling shall bear:

(1) The common or chemical name or names of the additive or additives.

(2) Adequate directions for use to assure compliance with all the provisions of this section.

[42 FR 14526, Mar. 15, 1977, as amended at 45 FR 73922, Nov. 7, 1980; 45 FR 85726, Dec. 30, 1980; 48 FR 7439, Feb. 22, 1983; 49 FR 5748, Feb. 15, 1984; 49 FR 10106, Mar. 19, 1984; 50 FR 49536, Dec. 3, 1985; 53 FR 15199, Apr. 28, 1988; 54 FR 31012, July 26, 1989; 55 FR 12172, Apr. 2, 1990; 61 FR 14245, Apr. 1, 1996; 64 FR 1759, Jan. 12, 1999; 64 FR 29227, June 1, 1999]

C-3

CYCLOHEXYLAMINE

TYPE OF PRODUCT: Volatile Amine, Alkyl Amine

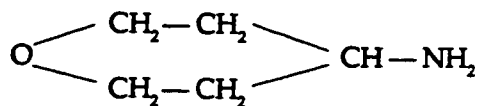
FUNCTION: Prevent Carbonic Acid Corrosion in Return Lines

COMMON NAME AND ABBREV.: Cyclohexylamine (CYCLO or CHA)

OTHER NAMES: Hexahydrobenzene
Aminocyclohexane
Hexahydroaniline

FORMULA: $C_6H_{13}N$ or $(CH_2)_5CH.NH_2$

STRUCTURE: Primary Amine



C.A.S. NAME AND NUMBER: Cyclohexanamine - 108-91-8

SPECIFIC GRAVITY: 0.865 MOLECULAR WEIGHT: 99

FLASH POINT: 83° F. FREEZING POINT: 0° F.

OTHER SPECIFICATIONS ARE SHOWN ON THE SUMMARY SHEET

SUPPLIERS: Air Prod., Atochem, BASF, Hoechst Celanese, Mobay.

CONCERNS: Low Flash Point, Freezing in Shipping or Unheated Storage. Cyclohexanol should not exceed 0.1% and water should not exceed 0.5%. Listed as an extremely hazardous substance by EPA. May require additional regulatory labeling and reporting. Amines bicarbonates vary in their formation, and cyclohexylamine is among the most insoluble.

AQUA TECH

PROFESSIONAL
— WATER TREATMENT
— PRODUCTS

Steam Tec 5000

PRODUCT DESCRIPTION

Steam Tec 5000 is an aqueous blend of neutralizing amines. It is designed to volatilize and travel with the steam. When the steam condenses Steam Tec 5000 will neutralize any carbonic acid formed when carbon dioxide in the steam dissolves into the condensate water. Because it contains multiple neutralizing amines, it is suitable for a wide range of system sizes and designs.

DIRECTIONS

Since the quantity of CO₂ carried in the steam is directly related to the amount of bicarbonate alkalinity in the feed water, the specific dosage of Steam Tec 5000 will be based primarily on the alkalinity of the boiler feed water.

Plant configuration, boiler pressure, condensate contamination, and other factors will determine the demand for Steam Tec 5000.

**CONSULT YOUR AQUA TEC REPRESENTATIVE FOR
DETAILED USAGE INSTRUCTIONS**

CAUTIONS

AVOID CONTACT WITH SKIN OR EYES, DO NOT TAKE INTERNALLY. SEE MSDS FOR DETAILED HEALTH AND SAFETY DATA

CORROSIVE LIQUID, BASIC, ORGANIC, N.O.S.,
(MORPHOLINE, AQUEOUS MIXTURE, CYCLOHEXYLAMINE),
8, UN 3267, PGII, ERG # 153

This product is acceptable for use in FDA/USDA regulated plants where steam contacts edible food product. This product is not approved for use where steam contacts milk or milk products.

C-4

NFPA Hazard Rating	HEALTH 3	REACTIVITY 0	FLAMMABILITY 0	SPECIAL -
--------------------------	-------------	-----------------	-------------------	--------------

CONTAINER SIZE	GROSS WEIGHT
55 Gal.	478 lb.

705 KEENAN COURT DURHAM, CA 95938 530-895-3658

Material Safety Data Sheet CONTINUED Page 2 of 3

Product Name **STEAM TEC 5000**

IV HEALTH HAZARD DATA

Threshold Limit Value	NOT ESTABLISHED ON THIS PRODUCT
Route of Exposure	<input checked="" type="checkbox"/> Inhalation <input checked="" type="checkbox"/> Ingestion <input checked="" type="checkbox"/> Skin <input checked="" type="checkbox"/> Eye <input type="checkbox"/> Not Hazardous
Eye Contact Hazard	Highly irritating, may result in tissue damage and/or destruction
Ingestion Hazard	Harmful if swallowed
Inhalation Hazard	Highly irritating, to respiratory tract and mucous membranes. Prolonged contact may result in tissue damage and/or destruction
Skin Contact Hazard	Dermal irritant. Mild to severe skin irritation depending on length of exposure, solution concentration, and first aid measures
Skin Absorption Hazard	Frequent or widespread contact may absorb harmful amounts. The signs and symptoms of toxicity are similar to those of swallowing and inhalation
Effects of Acute Exposure	Exposure of the skin to concentrated product should be avoided to prevent severe irritation. Inhalation at high levels of mist can cause irritation to lung tissue due to corrosive characteristics.
Effects of Chronic Exposure	causes severe eye and skin irritation or burns. Harmful if swallowed, inhaled, or absorbed through skin.

V EMERGENCY AND FIRST AID PROCEDURES

Eye Contact	FLUSH IMMEDIATELY WITH COPIOUS AMOUNTS OF TAP WATER OR NORMAL SALINE FOR A MINIMUM OF 15 MINUTES. TAKE EXPOSED INDIVIDUAL TO A HEALTH CARE PROFESSIONAL, PREFERABLY AN OPHTHALMOLOGIST, FOR FURTHER EVALUATION
Skin Contact	WASH EXPOSED AREA WITH PLENTY OF SOAP AND WATER. REPEAT WASHING. REMOVE CONTAMINATED CLOTHING AND WASH THOROUGHLY BEFORE REUSE. IF IRRITATION PERSISTS CONSULT A HEALTH CARE PROFESSIONAL
Inhalation	IF SYMPTOMS DEVELOP, MOVE INDIVIDUAL AWAY FROM EXPOSURE AND INTO FRESH AIR. IF SYMPTOMS PERSIST, SEEK MEDICAL ATTENTION. IF BREATHING IS DIFFICULT, ADMINISTER OXYGEN. KEEP PERSON WARM AND QUIET; SEEK IMMEDIATE MEDICAL ATTENTION.
Ingestion	DO NOT INDUCE VOMITING. Rinse with copious amounts of water or milk, first. Irrigate the esophagus and dilute stomach contents by slowly giving one or two glasses of water or milk. Avoid giving alcohol or alcohol related products. In cases where individual is semi-comatose, comatose, or convulsing, DO NOT GIVE FLUIDS BY MOUTH. In case of intentional ingestion of the product seek medical assistance immediately.

VI REACTIVITY DATA

Incompatibility (Materials to Avoid)	ACIDS AND OXIDIZERS
Conditions to Avoid	NONE
Hazardous Decomposition	When heated to decomposition this product emits toxic oxides of carbon and nitrogen
Stability	<input checked="" type="checkbox"/> STABLE <input type="checkbox"/> UNSTABLE <input type="checkbox"/> Hazardous Polymerization <input type="checkbox"/> MAY OCCUR <input checked="" type="checkbox"/> WILL NOT OCCUR

Material Safety Data Sheet CONTINUED Page 3 of 3

Product Name **STEAM TEC 5000**

VII SPILL OR LEAK PROCEDURES

Steps To Be Taken If Material Is Released Or Spilled
 Wear recommended protective clothing.
 Small spills can be flushed with water to the sewer.
 Large spills should be absorbed and put in waste containers for disposal.

Waste Disposal Method
 Dispose of in accordance with Federal, State, And local Regulations.
 Rinse empty container and return to manufacturer or other industrial use.

VIII SPECIAL PROTECTIVE INFORMATION

Respiratory Protection (Specify Type)
 IF OSHA PEL EXCEEDED USE NIOSH APPROVED RESPIRATOR WITH ORGANIC VAPOR CARTRIDGE, OR SUPPLIED AIR.

Ventilation	Local Exhaust	PREFERABLE	Special	NONE
	Mechanical (general)	OK	Other	N/A

Protective Gloves RUBBER

Eye Protection CHEMICAL GOGGLES

Other Protective Equipment RUBBER APREN AND RUBBER BOOTS

IX SPECIAL PRECAUTIONS

Precautionary Labeling
 For industrial use only.
 Do not get product in eyes, on skin, or on clothing.
 Keep container tightly closed when not in use.
 Wash thoroughly after exposure to product.
 This product is not formulated to contain a known carcinogen or reproductive toxin.

Precautions To Be Taken In Handling
 Keep out of the reach of children.
 Read and follow label directions.
 Store in cool, dry, well ventilated area, away from heat, sparks, and open flame. Unrinsed empty container is hazardous. Could contain combustibile residues. Do not cut, weld, or puncture on or near this container.

Prepared By **CLIFFORD L. JACOBSON** Date **11/6/98**

This material safety data sheet is provided as an information resource only. It should not be taken as a warrenty or representation for which the preparer assumes legal responsibility. While we believe the information contained herein is accurate and compiled from sources believed to be reliable, it is the responsibility of the user to investigate and verify its validity. The buyer assumes all responsibility of using and handling the product in accordance with applicable federal, state, and local regulations.

C-5

International Chemical Safety Cards

CYCLOHEXYLAMINE

ICSC: 0245

<p>CYCLOHEXYLAMINE Cyclohexanamine Aminocyclohexane Aminohexahydrobenzene $C_6H_{11}NH_2$ Molecular mass: 99.2</p>	<p>HAZARD SYMBOLS <i>Consult National Legislation</i></p>
<p>CAS # 108-91-8 RTECS # GX0700000 ICSC # 0245 UN # 2357 EC # 612-050-00-8</p>	

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Flammable.	NO open flames, NO sparks, and NO smoking. NO contact with oxidants.	Powder, alcohol-resistant foam, water in large amounts, carbon dioxide.
EXPLOSION	Above 26°C explosive vapour/air mixtures may be formed.	Above 26°C closed system, ventilation, and explosion-proof electrical equipment.	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		AVOID ALL CONTACT!	IN ALL CASES CONSULT A DOCTOR!
• INHALATION	Corrosive. Burning sensation. Cough. Laboured breathing.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Half-upright position. Refer for medical attention.
• SKIN	Corrosive. Redness. Pain. Blisters.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse skin with plenty of water or shower. Refer for medical attention.
• EYES	Corrosive. Redness. Pain. Severe deep burns.	Face shield.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• INGESTION	Corrosive. Abdominal cramps. Burning sensation. Vomiting. Collapse.	Do not eat, drink, or smoke during work.	Rinse mouth. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Collect leaking liquid in sealable containers. Absorb remaining liquid in sand or inert absorbent and remove to safe place (extra personal protection: self-contained breathing apparatus).	Fireproof. Separated from strong oxidants, acids, food and feedstuffs.	Do not transport with food and feedstuffs. C symbol R: 10-21/22-34 S: 36/37/39 UN Haz Class: 8 UN Subsidiary Risks: 3 UN Pack Group: II

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0245

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities © IPCS CEC 1993

International Chemical Safety Cards

CYCLOHEXYLAMINE

ICSC: 0245

I M P O R T A N T D A T A	PHYSICAL STATE; APPEARANCE: COLOURLESS LIQUID , WITH PUNGENT ODOUR.	ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation and by ingestion.
	PHYSICAL DANGERS: The vapour is heavier than air.	INHALATION RISK: A harmful contamination of the air can be reached rather quickly on evaporation of this substance at 20°C.
	CHEMICAL DANGERS: The substance decomposes on heating producing toxic gases (nitrogen oxides). The substance is a strong base, it reacts violently with acid and is corrosive. Reacts violently with strong oxidants causing fire hazard.	EFFECTS OF SHORT-TERM EXPOSURE: Corrosive. The substance is corrosive to the eyes, the skin and the respiratory tract. Inhalation of the vapour may cause lung oedema (see Notes). The effects may be delayed.
	OCCUPATIONAL EXPOSURE LIMITS: TLV: 10 ppm; 41 mg/m ³ (as TWA) (ACGIH 1992-1993). PDK: 1 mg/m ³ (USSR 1993).	EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: Repeated or prolonged contact may cause skin sensitization.
PHYSICAL PROPERTIES	Boiling point: 134°C Melting point: -18°C Relative density (water = 1): 0.9 Solubility in water: good Vapour pressure, kPa at 20°C: 1.2	Relative vapour density (air = 1): 3.4 Relative density of the vapour/air-mixture at 20°C (air = 1): 1.03 Flash point: (c.c.) 26°C Auto-ignition temperature: 293°C Explosive limits, vol% in air: 1.5%-9.4%
ENVIRONMENTAL DATA		
NOTES		
The symptoms of lung oedema often do not become manifest until a few hours have passed and they are aggravated by physical effort. Rest and medical observation are therefore essential. Immediate administration of an appropriate spray, by a doctor or a person authorized by him/her, should be considered.		
Transport Emergency Card: TEC (R)-71 NFPA Code: H 2; F 3; R 0		
ADDITIONAL INFORMATION		
ICSC: 0245		CYCLOHEXYLAMINE
© IPCS, CEC, 1993		
IMPORTANT LEGAL NOTICE:	Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use.	

**CYCLAMATES
(Group 3)**

C-6

For definition of Groups, see Preamble Evaluation.

Supplement 7: (1987) (p. 178)

Calcium cyclamate

CAS No.: 139-06-0

Chem. Abstr. Name: Cyclohexylsulfamic acid, calcium salt

Cyclamic acid

CAS No.: 100-88-9

Chem. Abstr. Name: Cyclohexylsulfamic acid

Cyclohexylamine

CAS No.: 108-91-8

Chem. Abstr. Name: Cyclohexanamine

Sodium cyclamate

CAS No.: 139-05-9

Chem. Abstr. Name: Cyclohexylsulfamic acid, monosodium

A. Evidence for carcinogenicity to humans (*inadequate*)

The evidence that the risk of cancer is increased among users of artificial sweeteners is inconsistent [ref: 1]. Since the positive report of Howe *et al.* [ref: 2], reports have become available on six case-control studies and on one population study of bladder cancer.

The largest was a population-based study in ten areas of the USA, with 3010 bladder cases and 5783 controls. The relative risk for bladder cancer associated with use of artificial sweeteners was 1.0 (95% confidence interval, 0.9-1.1) among men and 1.1 (0.9-1.3) among women. Significant trends of increasing risk with increasing average daily consumption were found in certain subgroups examined *a priori* on the basis of the results of animal experiments; these subgroups were female nonsmokers and male heavy smokers [ref: 3]. Subsequent, independent re-analysis of the same data by a different statistical technique (multiple logistic regression) confirmed the original findings overall but cast doubt on the significance of the findings in the two subgroups because of inconsistent dose-response trends, especially among the male heavy smokers [ref: 4]. In response, the original investigators noted that the inconsistency derived from the development of risk scores which, in their opinion, were not correctly derived, as two relevant variables had been omitted [ref: 5]. In a subsequent report on data from one of the areas participating in this study, the use of hospital and population controls was compared. A higher proportion of hospital controls was found to have used artificial sweeteners than population controls [ref: 6]. This had been postulated earlier [ref: 2] as a possible reason for the negative findings of a hospital-based case-control study [ref: 7]. Bias resulting from use of prevalent rather than incident cases [ref: 8] has been suggested as a possible reason for the negative findings of another hospital based case-control study [ref: 9].

Two other case-control studies have also shown increased risks among subgroups. In one, conducted simultaneously in Japan, the UK and the USA, the relative risks among women in the US component of the study associated with 'any' use of diet drinks and of sugar substitutes were 1.6 and 1.5, respectively, and 2.6 and 2.1, respectively, for nonsmokers [ref: 10]. In the other two areas, however, a history of use of sugar substitutes, primarily saccharin, was not associated with an elevated bladder cancer risk [ref: 11]. In the other study, conducted in West Yorkshire, UK, although elevated risks

were found for saccharin takers who were nonsmokers, the risks associated with cyclamate use were not examined [ref: 12].

Two studies in Denmark [ref: 13,14], one in the USA [ref: 15] and a further case-control study in Canada [ref: 16], however, gave negative results. In one of the Danish studies, incidence of bladder cancer at ages 20-34 among people born 1941-1945 (when use of saccharin was high in Denmark) was compared with that among those born 1931-1940. The risk for men was 1.0 (0.7-1.6) and that for women, 0.3 (0.1-1.0) [ref: 13]. The other two studies were population-based case-control studies of bladder cancer. In Denmark, the relative risk for people of the two sexes combined was 0.78 (0.58-1.05) [ref: 14]. In a study in the USA of bladder cancer in women aged 20-49, the odds ratio for regular use of artificially sweetened beverages, table-top sweetener or both was 1.1 (0.7-1.7) [ref: 15]. In Canada, the odds ratio for use of cyclamate was 1.09 (0.60-1.97) in males and 0.92 (0.63-1.36) in females. In neither study were the increased risks seen in subgroups in other studies replicated.

In the USA, in a study of 1862 patients hospitalized for cancer and of 10 874 control patients, a greater proportion of artificial sweetener users was among women found only with cancer of the stomach. Little information was available on urinary-tract cancer. No overall association was found between artificial sweetener use and cancer [ref: 17].

B. Evidence for carcinogenicity to animals (*limited*)

Sodium cyclamate was tested for carcinogenicity both alone and in combination with other chemicals in different animal species and by several routes of administration. Following its oral administration to two strains of mice, an increased incidence of lymphosarcomas was observed in female mice of one strain; a few bladder tumours were seen in rats exposed orally. Several other experiments in mice, rats, hamsters and monkeys were inadequate for evaluation. A 10:1 mixture of sodium cyclamate:sodium saccharin was given to mice in one multigeneration experiment and to rats in two single-generation experiments: transitional-cell carcinomas were induced in the bladders of male rats of one strain given the highest dose [ref: 1]. In a similar two-generation experiment in rats, no treatment-related tumour was observed [ref: 18]. Instillation of low doses of *N*-methyl-*N*-nitrosourea into the bladder of rats fed sodium cyclamate for long periods resulted in a dose-related induction of transitional-cell neoplasms of the bladder. After subcutaneous injection of rats with sodium cyclamate, no tumour was observed at the site of injection, the only site for which tumour incidence was reported. A significant increase in the incidence of bladder carcinomas was observed in mice given bladder implants of pellets containing sodium cyclamate [ref: 1]. Transplacental application of cyclamate to rats did not produce an increase in tumour incidence at any site [ref: 19].

Calcium cyclamate did not alter tumour incidence when tested by oral administration in a two-generation experiment in rats but produced local tumours in another experiment following its subcutaneous injection [ref: 1].

Cyclohexylamine was tested by oral administration at several dose levels in different strains of mice and rats, and in one multigeneration study in mice. No tumour related to treatment was observed [ref: 1].

C. Other relevant data

No data were available on the genetic and related effects of calcium cyclamate, dicyclohexylamine or cyclohexylamine in humans. In a single study, eight persons ingesting sodium cyclamate (70 mg/kg per day) did not exhibit chromosomal aberrations in their lymphocytes [ref: 20].

Calcium cyclamate induced chromosomal aberrations in bone-marrow cells of gerbils, but not in bone-marrow cells or spermatogonia of rats treated *in vivo*. It did not induce dominant lethal mutations in rats or mice or micronuclei or sperm abnormalities in mice treated *in vivo*. It induced chromosomal aberrations in human lymphocytes but not in rat kangaroo cells in culture. It did not

induce aneuploidy in *Drosophila* , but contradictory results were reported in assays for sex-linked recessive lethal mutations and heritable translocations. Calcium cyclamate was not mutagenic to bacteria [ref: 20].

Sodium cyclamate did not induce dominant lethal mutations or chromosomal aberrations in spermatogonia or spermatocytes of mice treated *in vivo* . It induced sister chromatid exchanges and chromosomal aberrations in cultured human lymphocytes and chromosomal aberrations in cultured Chinese hamster cells. It did not induce aneuploidy or sex-linked recessive lethal mutations in *Drosophila* or chromosomal aberrations in plants [ref: 20].

Cyclohexylamine did not induce dominant lethal mutations in one study in rats, but contradictory results were obtained in mice. It gave weakly positive results in the mouse spot test. Cyclohexylamine induced chromosomal aberrations in lymphocytes but not in bone-marrow cells of hamsters and lambs or in spermatogonia of hamsters and mice treated *in vivo* . In treated rats, chromosomal aberrations were induced in spermatogonia but not in leucocytes, and contradictory results were obtained for bone-marrow cells. Cyclohexylamine induced sister chromatid exchanges in cultured human lymphocytes, but, again, conflicting results were obtained concerning the induction of chromosomal aberrations. Cyclohexylamine enhanced virus-induced transformation of Syrian hamster embryo cells and induced chromosomal aberrations in cultured rat kangaroo cells. It did not induce somatic or sex-linked recessive lethal mutations, aneuploidy or heritable translocations in *Drosophila* and was not mutagenic and did not induce prophage in bacteria. In host-mediated assays, it did not induce mutation in bacteria or chromosomal aberrations in human leucocytes [ref: 20].

Dicyclohexylamine induced chromosomal aberrations in cultured human lymphocytes. It was not mutagenic to bacteria [ref: 20].

Overall evaluation

Cyclamates are *not classifiable as to their carcinogenicity to humans (Group 3)* .

For definition of the italicized terms, see Preamble Evaluation.

Subsequent evaluation: Vol. 73 (1999)

Also see previous evaluation: Vol. 22 (1980)

References

1. IARC Monographs, 22, 55-109, 171-185, 1980
2. Howe, G.R., Burch, J.D., Miller, A.B., Cook, G.M., Estève, J., Morrison, B., Gordon, P., Chambers, L.W., Fodor, G. & Winsor, G.M. (1980) Tobacco use, occupation, coffee, various nutrients and bladder cancer. J. natl Cancer Inst., 64, 701-713
3. Hoover, R.M. & Strasser, P.H. (1980) Artificial sweeteners and human bladder cancer. Preliminary results. Lancet, i, 837-840
4. Walker, A.M., Dreyer, N.A., Friedlander, E., Loughlin, J., Rothman, K.J. & Kohn, H.I. (1982) An independent analysis of the National Cancer Institute study on non-nutritive sweeteners and bladder cancer. Am. J. publ. Health, 72, 376-381
5. Hoover, R. & Hartge, P. (1982) Non-nutritive sweeteners and bladder cancer. Am. J. publ. Health, 72, 382-383

6. Silverman, D.T., Hoover, R.N. & Swanson, G.M. (1983) Artificial sweeteners and lower urinary tract cancer: hospital vs. population controls. *Am. J. Epidemiol.*, 117, 326-334
7. Wynder, E.L. & Stellman, S.D. (1980) Artificial sweetener use and bladder cancer: a case-control study. *Science*, 207, 1214-1216
8. Goldsmith, D.F. (1982) Calculation of potential bias in the odds ratio illustrated by a study of saccharin use and bladder cancer. *Environ. Res.*, 27, 298-306
9. Kessler I.I. & Clark, J.P. (1978) Saccharin, cyclamate, and human bladder cancer. No evidence of an association. *J. Am. med. Assoc.*, 240, 349-355
10. Morrison, A.S. & Buring, J.E. (1980) Artificial sweeteners and cancer of the lower urinary tract. *New Engl. J. Med.*, 302, 537-541
11. Morrison, A.S., Verhoek, W.G., Leck, I., Aoki, K., Ohno, Y. & Obata, K. (1982) Artificial sweeteners and bladder cancer in Manchester, UK, and Nagoya, Japan. *Br. J. Cancer*, 45, 332-336
12. Cartwright, R.A., Adib, R., Glashan, R. & Gray, B.K. (1981) The epidemiology of bladder cancer in West Yorkshire. A preliminary report on non-occupational aetiologies. *Carcinogenesis*, 2, 343-347
13. Jensen, O.M. & Kamby, C. (1982) Intra-uterine exposure to saccharine and risk of bladder cancer in man. *Int. J. Cancer*, 29, 507-509
14. Møller-Jensen, O., Knudsen, J.B., Sørensen, B.L. & Clemmesen, J. (1983) Artificial sweeteners and absence of bladder cancer risk in Copenhagen. *Int. J. Cancer*, 32, 577-582
15. Piper, J.M., Matanoski, G.M. & Tonascia, J. (1986) Bladder cancer in young women. *Am. J. Epidemiol.*, 123, 1033-1042
16. Risch, H.A., Burch, J.D., Miller, A.B., Hill, G.B., Steele, R. & Howe, G.R. (1987) Dietary factors and the incidence of cancer of the urinary bladder. *Am. J. Epidemiol.* (in press)
17. Morrison, A.S. (1979) Use of artificial sweeteners by cancer patients. *J. natl Cancer Inst.*, 62, 1397-1399
18. Schmähl, D. & Habs, M. (1984) Investigations on the carcinogenicity of the artificial sweeteners sodium cyclamate and sodium saccharin in rats in a two-generation experiment. *Arzneimittel.-Forsch.*, 34, 604-606
19. Schmähl, D. & Habs, M. (1980) Absence of carcinogenic response to cyclamate and saccharin in Sprague-Dawley rats after transplacental application. *Arzneimittel.-Forsch.*, 30, 1905-1906
20. IARC Monographs, Suppl. 6, 188-195, 240-241, 1987

Synonyms for Calcium cyclamate

- Calcium cyclohexane sulphamate
- Calcium cyclohexylsulphamate
- Cyclamate calcium
- Cyclohexanesulphamic acid, calcium salt
- Cyclohexylsulphamic acid, calcium salt

- Cyclan
- Cylan
- Dietil
- Sucaryl calcium

Synonyms for Cyclamic acid

- Cyclamate
- Cyclohexanesulphamic acid
- Cyclohexylamid sulphuric acid
- Cyclohexylaminesulphonic acid
- Cyclohexylsulphamic acid
- *N*-Cyclohexylsulphamic acid
- Hexamic acid
- Sucaryl
- Sucaryl acid

Synonyms for Cyclohexylamine

- Aminocyclohexane
- Aminohexahydrobenzene
- CHA
- Hexahydroaniline
- Hexahydrobenzenamine

Synonyms for Sodium cyclamate salt

- Assugrin feinsuss
- Assugrin vollsuss [also contains saccharin]
- Asugryn
- Cyclamate sodium
- Cyclohexanesulphamic acid, monosodium salt
- Cyclohexylsulphamate sodium
- Cyclohexylsulphamic acid, monosodium salt
- Dulzor-etas
- Hachi-sugar
- Izbiosuc
- Natreen [also contains saccharin]
- Sodium cyclohexanesulphamate
- Sodium cyclohexyl amidosulfate
- Sodium cyclohexylsulphamate
- Sodium cyclohexylsulphamidate
- Sodium *N*-cyclohexylsulphamate
- Sodium sucaryl
- Sucaryl sodium
- Succaril [also contains saccharin]
- Sucrosa
- Sucrun 7
- Suessette
- Suestamin
- Sugarin
- Sugaron

Last updated: 30 September 1999



TOXLINE Search Results

C - 7

Items 1 through 20 of 753

Page 1 of 38. to page

References are sorted in **Year of Publication** order.
Click on **Sort** to change the order of the retrieved References.

- | Select Record | Reference |
|----------------------------|---|
| 1 <input type="checkbox"/> | <u>Efficient nucleotide excision repair of cisplatin, oxaliplatin, and Bis-aceto-ammine-dichloro-cyclohexylamine-platinum(IV) (JM216) platinum intrastrand DNA diadducts.</u>
Reardon JT; Vaisman A; Chaney SG; Sancar A
Cancer Res 1999 Aug 15;59(16):3968-71 [EMIC] |
| 2 <input type="checkbox"/> | <u>The results of assays in Drosophila as indicators of exposure to carcinogens.</u>
Vogel EW; Graf U; Frei HJ; Nivard MM
IARC Sci Publ 1999(146):427-70 [EMIC] |
| 3 <input type="checkbox"/> | <u>Biodegradation of cyclohexylamine by Brevibacterium oxydans IH-35A.</u>
Iwaki H ; Shimizu M ; Tokuyama T ; Hasegawa Y
Appl Environ Microbiol; VOL 65, ISS 5, 1999, P2232-4 [TOXBIB] |
| 4 <input type="checkbox"/> | <u>Flow-injection and stopped-flow completely continuous flow spectrophotometric determinations of aniline and cyclohexylamine.</u>
SAURINA J ; HERNANDEZ-CASSOU S
ANALYTICA CHIMICA ACTA; 396 (2-3). 1999. 151-159. [BIOSIS] |
| 5 <input type="checkbox"/> | <u>[The anti-arrhythmia activity of new dicyclohexylamide derivatives of N-substituted alpha-aminocarboxylic acids]</u>
Berdiaev SU ; Paliani-Katsitadze NSh ; Turilova AI ; Kaverina NV ; Likhosherstov AM ; Lebedeva AS ; Ogurtsov VA
Eksp Klin Farmakol; VOL 62, ISS 4, 1999, P26-9 [Russian] [TOXBIB] |
| 6 <input type="checkbox"/> | <u>Effect of coadministration of caffeine and either adenosine agonists or cyclic nucleotides on ketorolac analgesia.</u>
Aguirre-Bañuelos P ; Castañeda-Hernández G ; Lâopez-Muñoz FJ ; Granados-Soto V
Eur J Pharmacol; VOL 377, ISS 2-3, 1999, P175-82 [TOXBIB] |
| 7 <input type="checkbox"/> | <u>Cyclamates</u>
Anonymous
TA:IARC Monographs on the evaluation of the carcinogenic risk of chemicals to humans
PG:195-222 YR:1999 IP: VI:73 [RISKLINE] |
| 8 <input type="checkbox"/> | <u>Biodegradation of cyclohexylamine by Brevibacterium oxydans IH-35A.</u>
IWAKI H ; SHIMIZU M ; TOKUYAMA T ; HASEGAWA Y
APPLIED AND ENVIRONMENTAL MICROBIOLOGY; 65 (5). 1999. 2232-2234. [BIOSIS] |
| 9 <input type="checkbox"/> | <u>A phase I study of oral uracil/ftorafur (UFT) plus leucovorin and bis-acetato-ammine-dichloro-cyclohexylamine-platinum IV (JM-216) each given over 14 days every 28 days.</u>
DeMario MD ; Ratain MJ ; Vogelzang NJ ; Mani S ; Vokes EE ; Fleming GF ; Melton K ; Johnson S ; Benner S ; Lebwohl D
Cancer Chemother Pharmacol; VOL 43, ISS 5, 1999, P385-8 [TOXBIB] |

- 10 **[Limits of exposure in the prevention of damage of reproduction: an operational proposal]**
Fig`a-Talamanca I
G Ital Med Lav Ergon 1998 Jan-Mar;20(1):5-9 [Italian] [DART]
- 11 **DNA sequence selectivity of cisplatin analogues in intact human cells.**
Murray V; Whittaker J; McFadyen WD
Chem Biol Interact 1998 Mar 12;110(1-2):27-37 [EMIC]
- 12 **Sensitivity to cisplatin and platinum-containing compounds of Schizosaccharomyces pombe rad mutants.**
Perego P; Zunino F; Carenini N; Giuliani F; Spinelli S; Howell SB
Mol Pharmacol 1998 Jul;54(1):213-9 [EMIC]
- 13 **Reaction of cyclohexylamine with hypochlorite and enhancement of oxidation of plasma sulfhydryl groups by hypochlorite in vitro.**
Hu ML ; Tsai HH
Food Chem Toxicol; VOL 36, ISS 9-10, 1998, P755-9 [TOXBIB]
- 14 **[A new class-III antiarrhythmic preparation among the dicyclohexylamides of aminocarboxylic acids]**
Kaverina NV ; Lyskovtsev VV ; Sokolov SF ; Poppe H ; Marx D ; Kishchuk EP ; Turilova AI ; Likhosherstov AM ; Tsorin IB ; Chichkanov GG
Vestn Ross Akad Med Nauk, ISS 11, 1998, P42-6 [Russian] [TOXBIB]
- 15 **Tumor cell cytotoxicity of a novel metal chelator.**
Torti SV ; Torti FM ; Whitman SP ; Brechbiel MW ; Park G ; Planalp RP
Blood; VOL 92, ISS 4, 1998, P1384-9 [TOXBIB]
- 16 **Evaluation of renal function in low-dose cyclosporine-treated patients using technetium-99m diaminocyclohexane: a cationic tubular excretion agent.**
Sonmezoglu K ; Erdil TY ; Demir M ; Sayman HB ; Kabasakal L ; Yardi OF ; Ozkara H ; Cem Mat M ; Solanki K ; Britton KE
Eur J Nucl Med; VOL 25, ISS 12, 1998, P1630-6 [TOXBIB]
- 17 **Contact Sensitivity to Ancamine 2280 (p-Aminocyclohexylamine) Following a Change in Work Practice**
Gordon PM ; McLelland J
Contact Dermatitis, Vol. 38, No. 1, page 54, 3 references, 1998 [NIOSH]
- 18 **Reaction of cyclohexylamine with hypochlorite and enhancement of oxidation of plasma sulfhydryl groups by hypochlorite in vitro.**
HU M-L ; TSAI H-H
FOOD AND CHEMICAL TOXICOLOGY; 36 (9-10). 1998. 755-759. [BIOSIS]
- 19 **Effects of cyclohexylamine and norspermidine on powdery mildew infection of spring barley.**
MACKINTOSH CA ; WALTERS DR
INTERNATIONAL JOURNAL OF PEST MANAGEMENT; 44 (3). 1998. 181-184. [BIOSIS]
- 20 **Pharmacodynamics of a monoclonal antiphencyclidine Fab with broad selectivity for phencyclidine-like drugs.**
Hardin JS ; Wessinger WD ; Proksch JW ; Owens SM
J Pharmacol Exp Ther; VOL 285, ISS 3, 1998, P1113-22 [TOXBIB]

Items 1 through 20 of 753

Page 1 of 38. to page

CYCLOHEXYLAMINE

CASRN: 108-91-8

For other data, click on the Table of Contents

C-8

Human Health Effects:**Human Toxicity Excerpts:****CYCLOHEXYLAMINE IS WEAK METHEMOGLOBIN-FORMING SUBSTANCE.**

[American Conference of Governmental Industrial Hygienists, Inc. Documentation of the Threshold Limit Values, 4th ed., 1980. Cincinnati, Ohio: American Conference of Governmental Industrial Hygienists, Inc., 1980. 114]**QC REVIEWED**

SEVERE EYE AND RESPIRATORY IRRITANT. ... BURNS SKIN ON CONTACT.

[National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978., p. 49-109]**QC REVIEWED**

IN HUMAN PATCH TESTS 25% SOLN PRODUCED SEVERE SKIN IRRITATION & POSSIBLE SKIN SENSITIZATION.

[Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 3159]**QC REVIEWED**

...REPORTED THREE CASES OF TRANSITORY SYSTEMIC TOXIC EFFECTS FROM ACUTE ACCIDENTAL INDUSTRIAL EXPOSURES. THE SYMPTOMS WERE LIGHT-HEADEDNESS, DROWSINESS, ANXIETY AND APPREHENSION, AND NAUSEA. SLURRED SPEECH, VOMITING, AND PUPILLARY DILATATION OCCURRED IN ONE CASE. OPERATORS EXPOSED TO 4 TO 10 PPM HAD NO SYMPTOMS.

[Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 3159]**QC REVIEWED**

MODERN COMPENDIUMS RATE CYCLOHEXYLAMINE AS MODERATELY TOXIC OR VERY TOXIC, & NOTE THAT AMINE IS INTENSELY IRRITATING TO SKIN & IS REGARDED AS MODERATE SENSITIZING POTENTIAL.

[American Conference of Governmental Industrial Hygienists, Inc. Documentation of the Threshold Limit Values, 4th ed., 1980. Cincinnati, Ohio: American Conference of Governmental Industrial Hygienists, Inc., 1980. 114]**QC REVIEWED**

PRESUMABLY SPLASH IN EYE WOULD...BE SEVERELY INJURIOUS.

[Grant, W. M. Toxicology of the Eye. 2nd ed. Springfield, Illinois: Charles C. Thomas, 1974. 343]**QC REVIEWED**

THE TERATOGENIC, MUTAGENIC, AND CARCINOGENIC POTENTIALS OF CYCLOHEXYLAMINE LACK UNIFORM, EXPERIMENTAL AGREEMENT.

QC REVIEWED

CYCLOHEXYLAMINE & DICYCLOHEXYLAMINE ARE...NERVE POISONS.

[Lefaux, R. Practical Toxicology of Plastics. Cleveland: CRC Press Inc., 1968. 148]**QC REVIEWED**

POISONING CAN FOLLOW ABSORPTION OF LIQUID THROUGH SKIN.

[Lefaux, R. Practical Toxicology of Plastics. Cleveland: CRC Press Inc., 1968. 148]**QC REVIEWED**

Skin, Eye and Respiratory Irritations:

SEVERE EYE AND RESPIRATORY IRRITANT. ... BURNS SKIN ON CONTACT.

[National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978.,p. 49-109]**QC REVIEWED**

Probable Routes of Human Exposure:

A National Occupational Hazard Survey (1973-74) estimates that 9532 people are exposed to **cyclohexylamine**(1). An NOES survey estimates that 3,002 total workers are exposed to **cyclohexylamine**(2).

[(1) RTEC; Current Awareness File (1984) (2) NIOSH; National Occupational Exposure Survey (NOES) Sept 20 (1985)]**QC REVIEWED**

Minimum Fatal Dose Level:

4. 4= VERY TOXIC: PROBABLE ORAL LETHAL DOSE (HUMAN) 50-500 MG/KG; BETWEEN 1 TEASPOON & 1 OZ FOR 70 KG PERSON (150 LB).

[Gosselin, R.E., H.C. Hodge, R.P. Smith, and M.N. Gleason. Clinical Toxicology of Commercial Products. 4th ed. Baltimore: Williams and Wilkins, 1976.,p. II-139]
PEER REVIEWED

Emergency Medical Treatment:**Emergency Medical Treatment:****EMT Copyright Disclaimer:**

Portions of the POISINDEX(R) database are provided here for general reference. THE COMPLETE POISINDEX(R) DATABASE, AVAILABLE FROM MICROMEDEX, SHOULD BE CONSULTED FOR ASSISTANCE IN THE DIAGNOSIS OR TREATMENT OF SPECIFIC CASES. Copyright 1974-1998 Micromedex, Inc. Denver, Colorado. All Rights Reserved. Any duplication, replication or redistribution of all or part of the POISINDEX(R) database is a violation of Micromedex' copyrights and is strictly prohibited.

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

Life Support:

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

Clinical Effects:

SUMMARY OF EXPOSURE

0.2.1.1 ACUTE EXPOSURE

- o In cases of reported human vapor exposure, workers developed nausea, lightheadedness, apprehension and anxiety, drowsiness, slurred speech, vomiting, and dilated pupils. Dermal irritation or moderately severe caustic burns may be seen. Skin sensitization may occur. **Cyclohexylamine** is a severe eye irritant.
- o Ingestions have not been reported, but potentially serious injury to the esophagus and gastrointestinal tract might be predicted to occur based on the other irritative effects of **cyclohexylamine**.
- o Additional effects in exposed EXPERIMENTAL ANIMALS have been methemoglobinemia, seizures with fatal exposure, degenerative changes in the brain, liver, and kidney following fatal doses and premortem shock, hyperactivity, anemia, and elevated metabolic rates and

temperature. Teratogenic, mutagenic, and carcinogenic properties have been inconclusively demonstrated.

HEENT

0.2.4.1 ACUTE EXPOSURE

- o Eye, nose, and throat irritation may occur. Mydriasis was observed in one worker with acute vapor exposure. Complete eye destruction occurred in a rabbit using the Standard Draize Test.

RESPIRATORY

0.2.6.1 ACUTE EXPOSURE

- o Irritation of the respiratory tract may occur.

NEUROLOGIC

0.2.7.1 ACUTE EXPOSURE

- o Drowsiness, dizziness, and lightheadedness have been reported. Exposed humans have developed anxiety and apprehension. In experimental animals, CNS stimulation, seizures and brain degenerative changes were observed.

GASTROINTESTINAL

0.2.8.1 ACUTE EXPOSURE

- o Nausea and vomiting have been reported in exposed workers. Potentially severe esophageal and gastrointestinal tract irritation may occur after ingestion due to this agent's severe irritant properties.

HEPATIC

0.2.9.1 ACUTE EXPOSURE

- o In animals, degenerative changes in the liver were observed. This effect has not been reported in exposed humans.

GENITOURINARY

0.2.10.1 ACUTE EXPOSURE

- o Renal degenerative changes were observed in fatally poisoned experimental animals.
- o Testicular toxicity was observed in animal studies.

HEMATOLOGIC

0.2.13.1 ACUTE EXPOSURE

- o **Cyclohexylamine** is a weak methemoglobin forming agent. No human cases of methemoglobinemia from exposure to this agent have been reported.

0.2.13.2 CHRONIC EXPOSURE

- o A mild anemia was observed in experimental animals chronically administered **cyclohexylamine**. This effect has not been reported in exposed humans.

DERMATOLOGIC

0.2.14.1 ACUTE EXPOSURE

- o In humans, severe irritation and possible sensitization was reported.

METABOLISM

0.2.17.1 ACUTE EXPOSURE

- o Elevated metabolic rates were reported in experimental animals administered **cyclohexylamine**. This effect has not been seen in exposed humans.

REPRODUCTIVE HAZARDS

- o The potential teratogenic effects of **cyclohexylamine** have been assessed as probably without significance in the setting of industrial exposure.
- o Testicular atrophy was seen in some rats with chronic exposure. Based on a no-effect dose for the testes of rats, it was concluded that the acceptable daily intake in humans is 0 to 11 mg/kg/day.

CARCINOGENICITY

0.2.21.1 IARC CATEGORY

- o The IARC group 3: limited animal evidence and inadequate human evidence of carcinogenicity.
- o IARC (**Cyclohexylamine**) (RTECS, 1999)
 1. Animal: Limited evidence (1987)
 2. Human: Inadequate evidence (1980)

3. Group 3 (1987)
- 0.2.21.2 HUMAN OVERVIEW
- o The potential mutagenic and carcinogenic effects of **cyclohexylamine** have been assessed as probably without significance in the setting of industrial exposure.

GENOTOXICITY

- o Mutations and chromosome aberrations induced by **cyclohexylamine** were detected in human cells and in the cells of some experimental animals.
- o Humans exposed to **cyclohexylamine** have not had chromosome aberrations (Clayton & Clayton, 1982).

Laboratory:

- o Monitor complete blood count and liver and renal function tests after significant exposure. Monitor chest x-ray and arterial blood gases in patients with respiratory tract irritation. Obtain methemoglobin levels in cyanotic patients.

Treatment Overview:

SUMMARY EXPOSURE

- o Only a few cases of inhalation exposure have been reported, with transient symptoms which improved spontaneously. Move victims of inhalation exposure to fresh air and administer 100% humidified supplemental oxygen with assisted ventilation as required. Copiously flush exposed skin and eyes. Obtain ophthalmic consultation early, as severe eye damage can occur.
- o ORAL - Ingestions have not been reported, but potentially serious injury to the esophagus and gastrointestinal tract might be predicted to occur based on the other irritative effects of **cyclohexylamine**. Immediate dilution with milk or water might be beneficial. Induced emesis should be avoided and gastric lavage done only with caution. Observe patients carefully for signs of esophageal or gastrointestinal tract irritation.
- o COMBUSTION - If exposure to burning **cyclohexylamine** has occurred, there could be potential exposure to released oxides of nitrogen. Such patients should be monitored for the possible development of severe respiratory tract irritation with bronchospasm or pulmonary edema. Refer to "NITROGEN OXIDES" management for further information.

ORAL EXPOSURE

- o EMESIS: Induction of emesis is not recommended because of the potential for CNS depression and seizures.
 - o DILUTION: Following ingestion and/or prior to gastric evacuation, immediately dilute with 4 to 8 ounces (120 to 240 mL) of milk or water (not to exceed 15 mL/kg in a child).
 - o Consider aspiration of gastric contents using a small, flexible nasogastric tube if it can be performed within one hour in patients with large ingestions. The potential benefits of early gastric aspiration must be weighed against potential complications such as perforation or bleeding.
 - o Observe patients carefully for signs of esophageal or gastrointestinal tract irritation. Consider endoscopy within 24 hours in patients with evidence of significant GI irritation or burns after ingestion.
 - o Activated charcoal may obscure endoscopy results but may be useful in patients with large ingestions.
1. ACTIVATED CHARCOAL: Administer charcoal as 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.
- o If central nervous system depression occurs, airway patency and oxygenation must be assured.
- o SEIZURES: Administer a benzodiazepine IV; DIAZEPAM (ADULT: 5 to 10 mg, repeat every 10 to 15 minutes as needed. CHILD: 0.2 to 0.5 mg/kg, repeat every 5 minutes as needed) or LORAZEPAM (ADULT: 4 to 8 mg; CHILD: 0.05 to 0.1 mg/kg).
- 1. Consider phenobarbital and/or phenytoin or fosphenytoin if seizures are uncontrollable or recur after diazepam 30 mg (adults) or 10 mg (children > 5 years).
- 2. Monitor for hypotension, dysrhythmias, respiratory depression and the need for endotracheal intubation.
- 3. Evaluate for hypoglycemia, electrolyte disturbances, and hypoxia.
- o METHEMOGLOBINEMIA: Administer 1 to 2 mg/kg of 1% methylene blue slowly IV if the patient is symptomatic. Additional doses may be required.

INHALATION EXPOSURE

- o DECONTAMINATION: Move patient to fresh air. Monitor for respiratory distress. If cough or difficulty in breathing develops, evaluate for respiratory tract irritation, bronchitis, or pneumonitis. Administer 100 percent humidified supplemental oxygen with assisted ventilation as required.
- o Treatment should include recommendations listed in the ORAL/PARENTERAL EXPOSURE section when appropriate.

EYE EXPOSURE

- o DECONTAMINATION: Exposed eyes should be irrigated with copious amounts of tepid water for at least 15 minutes. If irritation, pain, swelling, lacrimation, or photophobia persist, the patient should be seen in a health care facility.

DERMAL EXPOSURE

- o DECONTAMINATION: Wash exposed area extremely thoroughly with soap and water. A physician may need to examine the area if irritation or pain persists.
- o Treatment should include recommendations listed in the ORAL/PARENTERAL EXPOSURE section when appropriate.

Range of Toxicity:

- o Workers exposed to 4 to 10 parts per million exhibited no symptoms.
- o Experimental animals exposed by inhalation to 1,200 to 12,000 parts per million for 6 to 7 hours died.

[Rumack BH: POISINDEX(R) Information System. Micromedex, Inc., Englewood, CO, 2001; CCIS Volume 107, edition exp February, 2001. Hall AH & Rumack BH (Eds):TOMES(R) Information System. Micromedex, Inc., Englewood, CO, 2001; CCIS Volume 107, edition exp February, 2001.] **PEER REVIEWED**

Antidote and Emergency Treatment:

Methylene blue, alone or in combination with oxygen, is indicated as treatment in nitrite-induced methemoglobinemia.

[Sheehy MH et al; Nitrite Intoxication: Protection With Methylene Blue And Oxygen; Toxicol Appl Pharmacol 30 (2): 221-6 (1974)]**QC REVIEWED**

Animal Toxicity Studies:**Non-Human Toxicity Excerpts:**

CNS DEPRESSION. /FROM TABLE/

[Dreisbach, R. H. Handbook of Poisoning. 9th ed. Los Altos, California: Lange Medical Publications, 1977. 134]**QC REVIEWED**

IN CONTRAST WITH MARGINAL EFFECTS NOTED...IN WHICH FAIRLY LARGE DOSES OF CYCLOHEXYLAMINE WERE ADMINISTERED /INVESTIGATORS/ FOUND NO EFFECTS IN RATS OR RABBITS ON FERTILITY, REPRODUCTION, EMBRYOGENESIS & PERI- AND POST-NATAL DEVELOPMENT.

[American Conference of Governmental Industrial Hygienists, Inc. Documentation of the Threshold Limit Values, 4th ed., 1980. Cincinnati, Ohio: American Conference of Governmental Industrial Hygienists, Inc., 1980. 114]**QC REVIEWED**

/INVESTIGATORS/ STUDIED THE INDUCTION OF CHROMOSOME DAMAGE IN RATS AFTER INTRAPERITONEAL INJECTION OF THE AMINE AND FOUND A DOSE-DEPENDENT INCREASE IN CHROMOSOMAL BREAKS. THE AUTHORS CONSIDERED THIS INDICATIVE OF POTENTIAL CARCINOGENIC, MUTAGENIC OR TERATOGENIC ACTIVITY OF CYCLOHEXYLAMINE.

[American Conference of Governmental Industrial Hygienists, Inc. Documentation of the Threshold Limit Values, 4th ed., 1980. Cincinnati, Ohio: American Conference of Governmental Industrial Hygienists, Inc., 1980. 114]**QC REVIEWED**

INHALATION EXPOSURE OF RATS TO 12000 PPM OF VAPOR FOR 6 HR CAUSED 2 DEATHS IN 3 ANIMALS BY END OF 48 HR. HOWEVER, RATS WITHSTOOD 6-HR EXPOSURE TO 1000 PPM WITHOUT DEVELOPMENT OF SIGNS OF TOXICITY OR DEATHS.

[American Conference of Governmental Industrial Hygienists, Inc. Documentation of the Threshold Limit Values, 4th ed., 1980. Cincinnati, Ohio: American Conference of Governmental Industrial Hygienists, Inc., 1980. 114]**QC REVIEWED**

ONE DROP OF 50% AQ SOLN, APPLIED TO CONJUNCTIVAL SAC OF RABBIT EYE, CAUSED COMPLETE DESTRUCTION OF EYE.

[American Conference of Governmental Industrial Hygienists, Inc. Documentation of the Threshold Limit Values, 4th ed., 1980. Cincinnati, Ohio: American Conference of Governmental Industrial Hygienists, Inc., 1980. 113]**QC REVIEWED**

WHEN THE UNDILUTED MATERIAL WAS APPLIED TO GUINEA PIGS & HELD IN CONTACT WITH SKIN UNDER AN IMPERVIOUS CUFF FOR 24 HR, LD50 WAS BETWEEN 1 & 5 ML/KG; EDEMA, NECROSIS AND PERSISTENT ESCHARS ATTESTED TO STRONG IRRITATING ACTION OF COMPD.

[American Conference of Governmental Industrial Hygienists, Inc. Documentation of the Threshold Limit Values, 4th ed., 1980. Cincinnati, Ohio: American Conference of Governmental Industrial Hygienists, Inc., 1980. 113]**QC REVIEWED**

...RABBITS, GUINEA PIGS, AND RATS /EXPOSED/ TO...VAPORS, 7 HR/DAY, 5 DAYS/WK, AT AVERAGE CONCENTRATIONS OF 1200, 800 AND 150 PPM. AT 1200 PPM, ALL ANIMALS EXCEPT ONE RAT SHOWED EXTREME IRRITATION AND DIED AFTER A SINGLE EXPOSURE. FRACTIONAL MORTALITY OCCURRED AFTER REPEATED EXPOSURE AT 800 PPM. AT 150 PPM, FOUR OF FIVE RATS & TWO GUINEA PIGS SURVIVED 70 HR OF EXPOSURE, BUT ONE RABBIT DIED AFTER 7 HR. THE CHIEF EFFECTS WERE IRRITATION OF THE RESPIRATORY TRACT AND EYE IRRITATION WITH THE DEVELOPMENT OF CORNEAL OPACITIES. NO CONVULSIONS WERE OBSERVED.

[Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 3159]**QC REVIEWED**

/IT/...PRODUCED CONVULSANT DEATHS IN RABBITS WHEN INJECTED IN OLIVE OIL @

DOSES OF 0.5 G/KG. IT WAS GIVEN DAILY FOR 82 DAYS IN DRINKING WATER @ 100 MG/KG, PATHOLOGICAL FINDINGS OR WEIGHT LOSS APPEARED IN RABBITS, GUINEA PIGS, & RATS.

[Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 3158]**QC REVIEWED**

IN MICE.../IT/ HAS TYPICAL SYMPATHOMIMETIC EFFECTS LIKE AMPHETAMINE WITH HYPERPYREXIA, HYPERTHERMIA, INCR METABOLIC RATE & DEGREE OF LETHALITY THAT IS DEPENDENT ON AMBIENT TEMP & CROWDING.

[Gosselin, R.E., H.C. Hodge, R.P. Smith, and M.N. Gleason. Clinical Toxicology of Commercial Products. 4th ed. Baltimore: Williams and Wilkins, 1976.,p. II-139]**QC REVIEWED**

CYCLOHEXYLAMINE INDUCED CHROMOSOME ABERRATIONS IN LYMPHOCYTES OF CHINESE HAMSTERS. 200 MG/KG ORALLY WAS GIVEN ON 3 SUCCESSIVE DAYS, CONSIDERED EQUIV TO 1.43 G FOR 60 KG MAN.

[VAN WENT-DE VRIES GF ET AL; IN VIVO CHROMOSOME-DAMAGING EFFECT OF CYCLOHEXYLAMINE IN THE CHINESE HAMSTER; FOOD COSMET TOXICOL 13(4) 415 (1975)]**QC REVIEWED**

MULTIGENERATION EXPERIMENTS, INCL STUDIES ON REPRODUCTIVE CAPACITY AND PERINATAL DEVELOPMENT, AND TERATOLOGICAL STUDIES, PERFORMED WITH SWISS MICE RECEIVING 0.5% **CYCLOHEXYLAMINE** SULFATE IN THE DIET, SHOWED A SIGNIFICANT DECR IN THE NUMBER OF IMPLANTATION SITES AND IN THE NUMBER OF LIVEBORN FETUSES AS WELL AS AN INCREASED PERINATAL MORTALITY & A SIGNIFICANT REDUCTION IN WEIGHT GAIN. ... NO SIGNIFICANT TERATOGENIC OR EMBRYOTOXIC EFFECTS WERE FOUND IN RHESUS MONKEYS TREATED WITH 25, 50 OR 75 MG/KG BODY WEIGHT **CYCLOHEXYLAMINE** FOR DIFFERENT 4-DAY PERIODS DURING THE PHASE OF ORGANOGENESIS (20-45 DAYS OF PREGNANCY). /**CYCLOHEXYLAMINE** SULFATE/

[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work).,p. V22 87]**QC REVIEWED**

NO SUBSTANCE-RELATED TERATOGENIC EFFECTS WERE OBSERVED IN ICR MICE TREATED ORALLY WITH 20, 50, OR 100 MG/KG BODY WEIGHT **CYCLOHEXYLAMINE** EITHER FROM DAY 0 TO DAY 5 OR FROM DAY 6 TO DAY 11 OF PREGNANCY. THERE WAS PRONOUNCED FETAL GROWTH RETARDATION WITH THE HIGHEST DOSE WHICH WAS LETHAL TO SOME MOTHERS AND A SLIGHT, BUT STATISTICALLY SIGNIFICANT GROWTH RETARDATION IN OTHER TREATED GROUPS. THE NUMBER OF RESORPTIONS WAS INCREASED IN SOME TREATED GROUPS, BUT WAS STATISTICALLY SIGNIFICANT ONLY WITH THE HIGHEST DOSE.

[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work).,p. V22 87]**QC REVIEWED**

...INJECTED 50 TO 250 MG/KG OF **CYCLOHEXYLAMINE** /VIA CATHETER IN THE FETAL JUGULAR VEIN/...OF UNBORN SHEEP FOR PERIODS OF 5 OR 18 HR, AND EXAMINED CULTURES OF FETAL LYMPHOCYTES HARVESTED AFTER 48 HR AND AFTER 68 HR. THE PERCENTAGE OF FETAL LYMPHOCYTE ABERRATIONS WAS INCREASED BY **CYCLOHEXYLAMINE** TREATMENT, AND A RELATIVELY HIGH FREQUENCY OF CHROMOSOMAL ABNORMALITIES WAS OBSERVED.

[Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 3161]**QC REVIEWED**

CYCLOHEXYLAMINE GIVEN BY ORAL GAVAGE TO MALE BEAGLE DOGS (250

MG/KG/DAY) & MALE RATS (200 MG/KG/DAY) ADVERSELY AFFECTED BODY WT GAIN & FOOD CONSUMPTION IN BOTH SPECIES. ALTHOUGH A DEGREE OF TOLERANCE DEVELOPED, VOMITING TENDED TO OCCUR AFTER **CYCLOHEXYLAMINE** ADMIN TO DOGS. THE ONLY LESION DETECTABLE BY CONVENTIONAL HISTOLOGICAL EXAM WAS FOCAL ATROPHY OF SEMINIFEROUS TUBULES IN 1 RAT EXAMINED 13 WK AFTER CESSATION OF **CYCLOHEXYLAMINE** TREATMENT. QUANTITATIVE ASSESSMENT OF TESTICULAR SPERMATOGENESIS SHOWED THAT **CYCLOHEXYLAMINE** ADMIN REDUCED THE COUNTS OF PACHYTENE SPERMATOCYTES, & OF EARLY & LATE SPERMATIDS, IN BOTH SPECIES. THESE EFFECTS WERE APPARENTLY REVERSIBLE IN DOGS BUT NOT IN RATS.
 [JAMES RW ET AL; TESTICULAR RESPONSES OF RATS AND DOGS TO **CYCLOHEXYLAMINE** OVERDOSAGE; FOOD COSMET TOXICOL 19 (3): 291-6 (1981)]**QC REVIEWED**

Cyclohexylamine was tested for mutagenicity in the Salmonella/microsome preincubation assay using the standard protocol approved by the National Toxicology Program. **Cyclohexylamine** was tested at doses of 0.033, 0.10, 0.33, 1.0, 3.3, and 10 mg/plate in as many as 5 Salmonella typhimurium strains (TA1535, TA1537, TA97, TA98, and TA100) in the presence and absence of rat or hamster liver S-9. **Cyclohexylamine** was negative in these tests and the highest ineffective dose tested in any S. typhimurium strain was 10 mg/plate.
 [Mortelmans K et al; Environ Mutagen 8:1-119 (1986)]**QC REVIEWED**

Mice were fed **cyclohexylamine** (as the hydrochloride) at a constant intake of 400 mg/kg/day for 13 weeks. Food intake and body weight gain were not affected. The metabolism of (14)C labeled **cyclohexylamine** administered as a single oral dose (2 uCi per mouse) was not significantly different among animals chronically fed **cyclohexylamine** for 0, 3, 7, or 13 weeks. The major metabolite produced was 3-aminocyclohexanol; total metabolism was less than 2%. No treatment related testicular changes were observed in mice. Concentrations of **cyclohexylamine** in plasma (ug/ml) after 3 weeks feeding were 0.20; after 7 weeks 0.18; and after 13 weeks, 4.51 + or - 2.94. Concentrations of the chemical in testes (ug/g wet weight) varied from 6.81 + or - 5.21 at 3 weeks to 4.51 + or - 2.94 at 13 weeks.
 [Roberts A et al; Toxicol Appl Pharmacol 98 (2): 216-29 (1989)]**QC REVIEWED**

Wistar and DA rats were fed **cyclohexylamine** (as the hydrochloride) at constant intake of 400 mg/kg/day for 13 weeks. Significant decreases in food intake and body weight gain were observed in both strains of rats. The metabolism of (14)C-labeled **cyclohexylamine** administered as a single oral dose (8 uCi per rat) was similar for both strains of rat, with no consistent effect due to age or prolonged feeding with **cyclohexylamine**. However, there was reduced elimination of carbon 14 in the treated Wistar and DA rats compared to that in the controls during the first 6 hr after dosing; the difference was statistically significant at 3 weeks in both strains and at 13 weeks in the DA strain. The major metabolites produced were 3- and 4-aminocyclohexanols; at 13 weeks the total metabolism was 17% to 18% for the Wistar rats, 4% to 6% in the DA rats. After 13 weeks, testicular atrophy was demonstrated in both strains of rat fed **cyclohexylamine**; DA rats appeared more sensitive to testicular toxicity than the Wistar rats. Concentrations of **cyclohexylamine** and its metabolites in plasma and in testicular tissue were higher in Wistar rats than in DA rats.
 [Roberts A et al; Toxicol Appl Pharmacol 98 (2): 216-29 (1989)]**QC REVIEWED**

Metabolism/Pharmacokinetics:

Metabolism/Metabolites:

ALLEGED CARCINOGENICITY OF.../SODIUM CYCLAMATE/ WHEN CHRONICALLY FED (IN ADMIXTURE WITH SACCHARIN) AT HIGH DOSE LEVELS TO RATS COULD BE CAUSED BY N-HYDROXYCYCLOHEXYLAMINE THAT HAS BEEN REPORTED TO BE PRODUCED IN SMALL QUANTITIES IN RABBITS DOSED WITH **CYCLOHEXYLAMINE**, WHICH IS METABOLITE FORMED FROM.../SODIUM CYCLAMATE/.
 [The Chemical Society. Foreign Compound Metabolism in Mammals. Volume 1: A Review

of the Literature Published Between 1960 and 1969. London: The Chemical Society, 1970. 87]**QC REVIEWED**

FEEDING 0.2 G/KG TO RABBITS GAVE UNCHANGED **CYCLOHEXYLAMINE** AND N-HYDROXYCYCLOHEXYLAMINE IN URINE. ISOTOPE DILUTION ASSAYS AFTER (14)C-LABELED COMPD GAVE 45% UNCONJUGATED **CYCLOHEXYLAMINE**, 0.2% UNCONJUGATED N-HYDROXYCYCLOHEXYLAMINE, 2.5% CYCLOHEXANONE OXIME. [ELLIOTT TH ET AL; THE METABOLISM OF CYCLOHEXYLAMINE IN RABBITS; BIOCHEM J 109(2) 11 (1968)]**QC REVIEWED**

...AN 8-YEAR FEEDING STUDY WITH CYCLAMATE (200 MG/KG, 6 DAYS/WEEK) IN RHESUS MONKEYS PRODUCED NO ABNORMAL MORPHOLOGY OF THE LIVER, KIDNEYS, BLADDER, AND TESTES. MOST OF THE CYCLAMATE WAS EXCRETED UNCHANGED IN THE URINE, BUT **CYCLOHEXYLAMINE** WAS TRANSFORMED IN TURN INTO CYCLOHEXANONE AND CYCLOHEXANOL TO THE EXTENT OF 1-2% OF THE DOSE. /CYCLAMATE/
[The Chemical Society. Foreign Compound Metabolism in Mammals. Volume 5: A Review of the Literature Published during 1976 and 1977. London: The Chemical Society, 1979. 420]**QC REVIEWED**

CYCLOHEXYLAMINE WAS DEAMINATED TO CYCLOHEXANONE BY RABBIT LIVER MICROSOMES IN THE PRESENCE OF NADPH & MOLECULAR OXYGEN. CYCLOHEXANONE OXIME WAS ALSO IDENTIFIED FROM THE INCUBATION MIXTURE. [KUREBAYASHI H ET AL; OXIDATIVE DEAMINATION OF CYCLOHEXYLAMINE AND ITS HOMOLOGS BY RABBIT LIVER MICROSOMES; BIOCHEM PHARMACOL 28 (11): 1719-26 (1979)]**QC REVIEWED**

WASHED WHOLE-CELL SUSPENSION OF BACTERIA PREPD FROM FECES OF RATS FED ORAL CYCLAMATE: SUGGEST BACTERIAL CONVERSION OF CYCLAMATE TO SUSPECTED BLADDER CARCINOGEN **CYCLOHEXYLAMINE** IS CONTROLLED BY PREVAILING SULFUR METABOLISM OF INTESTINAL BACTERIA. [TESORIERO AA, ROXON JJ; CYCLAMATE METABOLISM: INCORPORATION OF 35S INTO PROTEINS OF INTESTINAL BACTERIA IN VITRO AND PRODUCTION OF VOLATILE 35S-CONTAINING COMPOUNDS; XENOBIOTICA 5(1) 25 (1975)]**QC REVIEWED**

FOLLOWING CYCLAMATE INTAKE, **CYCLOHEXYLAMINE** WAS EXCRETED IN URINE LATER THAN CYCLAMATE, PEAK IN 2ND DAY OR LATER. THE CONVERSION IN THE BODY PROBABLY NOT SIMULTANEOUS WITH CYCLAMATE ADSORPTION. DEGRADING SYSTEM MAY BE GRADUALLY OR ADAPTIVELY FORMED TO ATTACK CYCLAMATE. [ASAHINA M; EXCRETION OF CYCLOHEXYLAMINE, A METABOLITE OF CYCLAMATE, IN HUMAN URINE; CHEM PHARM BULL (TOKYO) 19(3) 628 (1971)]**QC REVIEWED**

Absorption, Distribution & Excretion:

IV INFUSION OF (14)C-SODIUM CYCLAMATE & (14)C-**CYCLOHEXYLAMINE** INTO PREGNANT RHESUS MONKEYS SHOWED THAT WHILE TRANSPLACENTAL TRANSFER OF (14)C-SODIUM CYCLAMATE WAS LIMITED, THE AMINE READILY CROSSED THE PLACENTA SINCE FETAL & MATERNAL BLOOD LEVELS OF (14)C WERE SIMILAR. [The Chemical Society. Foreign Compound Metabolism in Mammals. Volume 1: A Review of the Literature Published Between 1960 and 1969. London: The Chemical Society, 1970. 87]**QC REVIEWED**

WHEN RABBITS FED (14)C-LABELED COMPOUND, 68% OF RADIOACTIVITY WAS RECOVERED FROM URINE IN 60 HR, ONLY 0.5% ELIMINATED IN BREATH. [ELLIOTT TH ET AL; THE METABOLISM OF CYCLOHEXYLAMINE IN RABBITS; BIOCHEM J 109(2) 11 (1968)]**QC REVIEWED**

Cyclohexylamine showed dose dependent kinetics after administration of single oral doses of 35, 200, or 500 mg/kg in rats, with a reduction in plasma clearance from 37 to 24 ml/min/kg, an increase in apparent half-life from 11.8 to 12 hr, and an increased area under the testicular concentration vs time curve. Saturation of **cyclohexylamine** uptake by rat renal cortical slices in vitro and of renal tubular secretion in vivo occurred at concentrations and doses comparable to the oral dose studies. **Cyclohexylamine** clearance from a 10 mg/kg infusion was 2.58 + or - 1.13 ml/min and from a 200 mg/kg infusion, 2.49 + or - 1.65 ml/min. The **cyclohexylamine** to inulin clearance ratios were 2 at a dose of 10 mg/kg and 1.23 at a dose of 200 mg/kg. During chronic dietary administration the concentrations of **cyclohexylamine** in the plasma and testes showed a pronounced diurnal variation in rats, reaching a peak concentration at the end of the dark cycle at 6 AM (6.3 + or - 1.5 ug/ml in plasma and 45.7 + or - 3.4 ug/g in testes). The lowest concentrations of **cyclohexylamine** were at 9 PM (1.5 + or - 0.5 ug/ml in plasma and 10.9 + or - 3.6 ug/g in testes). The steady state plasma clearance was 33 ml/min/kg. The concentrations of **cyclohexylamine** in the plasma and testes of rats showed a nonlinear relationship to dietary intake. Elevated concentrations were found at intake greater than 200 mg/kg/day.

[Roberts A, Renwick AG; Toxicol Appl Pharmacol 98 (2): 230-42 (1989)]**QC
REVIEWED**

Biological Half-Life:

Cyclohexylamine showed dose dependent kinetics after administration of single oral doses of 35, 200 or 500 mg/kg in mice, with a reduction in plasma clearance from 61 to 53 ml/min/kg, an increase in apparent half-life from 1.4 to 3.5 hr, and an increased area under the testicular concentration vs time curve. During chronic dietary administration the concentrations of **cyclohexylamine** in the plasma and testes showed little diurnal variation. The steady state plasma clearance was 65 ml/min/kg. The concentrations of **cyclohexylamine** in the plasma and testes of the mice showed a linear relationship to dietary intake, even at the highest intake, about 900 mg/kg/day.

[Roberts A, Renwick AG; Toxicol Appl Pharmacol 98 (2): 230-42 (1989)]**QC
REVIEWED**

Interactions:

CHLORPROMAZINE, RESERPINE & PHENOXYBENZAMINE PROTECT MICE AGAINST DEATH.

[Gosselin, R.E., H.C. Hodge, R.P. Smith, and M.N. Gleason. Clinical Toxicology of Commercial Products. 4th ed. Baltimore: Williams and Wilkins, 1976.,p. II-139]
QC REVIEWED

Pharmacology:

Interactions:

CHLORPROMAZINE, RESERPINE & PHENOXYBENZAMINE PROTECT MICE AGAINST DEATH.

[Gosselin, R.E., H.C. Hodge, R.P. Smith, and M.N. Gleason. Clinical Toxicology of Commercial Products. 4th ed. Baltimore: Williams and Wilkins, 1976.,p. II-139]
QC REVIEWED

Minimum Fatal Dose Level:

4. 4= VERY TOXIC: PROBABLE ORAL LETHAL DOSE (HUMAN) 50-500 MG/KG; BETWEEN 1 TEASPOON & 1 OZ FOR 70 KG PERSON (150 LB).

[Gosselin, R.E., H.C. Hodge, R.P. Smith, and M.N. Gleason. Clinical Toxicology of Commercial Products. 4th ed. Baltimore: Williams and Wilkins, 1976.,p. II-139]
PEER REVIEWED

Environmental Fate & Exposure:

Environmental Fate/Exposure Summary:

Cyclohexylamine (CHA) will enter the environment as emissions or in wastewater during its manufacture and use in boiler water treatment, production of rubber chemicals, and as a chemical intermediate. Estimated CHA demand was 8.2 million lbs. in 1983 and 8.5 million lbs. in 1984(1). If released to the atmosphere, CHA would be expected to photooxidize by reaction with hydroxyl radicals (calculated half-life of 1.82 days). If released on land, it would be subject to evaporation and leaching to groundwater where its fate is unknown. It should not adsorb to soil but may be subject to biodegradation. If released to water, it may be subject to evaporation and hydrolysis but will not adsorb to sediments or bioconcentrate in aquatic organisms. It is biodegraded in river mud sand sewage inocula and therefore may be susceptible to biodegradation in water. Human exposure is difficult to estimate in the absence of monitoring data, but may be primarily occupational(SRC). [(1) Chemical Marketing Reporter Chem Profiles Jan 30 (1984)]**QC REVIEWED**

Probable Routes of Human Exposure:

A National Occupational Hazard Survey (1973-74) estimates that 9532 people are exposed to **cyclohexylamine**(1). An NOES survey estimates that 3,002 total workers are exposed to **cyclohexylamine**(2).

[(1) RTEC; Current Awareness File (1984) (2) NIOSH; National Occupational Exposure Survey (NOES) Sept 20 (1985)]**QC REVIEWED**

Natural Pollution Sources:

Cyclohexylamine is not known to occur as a natural product(1).

[(1) IARC; Some Non-nutritive Sweetening Agents 22: 55-109 (1980)]**QC REVIEWED**

Artificial Pollution Sources:

Cyclohexylamine (CHA) is a metabolite of the artificial sweetener cyclamate(1). It may also be released as a result of its major use in boiler water treatment, as well as use in rubber chemicals and as a chemical intermediate in the production of dyes, insecticides and pharmaceuticals(2).

[(1) IARC; Some Non-nutritive Sweetening Agents 22: 55-109 (1980) (2) Syracuse Research Corporation; Information Profiles on Potential Occupational Hazards. Vol. 1 Single Chemicals TR79-607 (1979)]**QC REVIEWED**

Environmental Fate:

TERRESTRIAL FATE: No information concerning the fate and transport of **cyclohexylamine** (CHA) in soil were found. If released to soils, CHA will probably be subject to evaporation as well as leaching to groundwater, with little adsorption to soils expected. Since CHA is biodegraded in river muds and sewage inocula (see also BIOD), biodegradation in soils may be significant. (SRC)

QC REVIEWED

AQUATIC FATE: Very little information concerning the fate and transport of **cyclohexylamine** (CHA) in water were found. If released to water, CHA will not be expected to adsorb appreciably to sediments or bioconcentrate in aquatic organisms. Since CHA is biodegraded in river muds and sewage inocula, it may be biodegraded in water, but is not likely to directly photolyze. Due to the miscibility of CHA and water, evaporation of CHA from aqueous solution is difficult to predict. (SRC)

QC REVIEWED

ATMOSPHERIC FATE: No information concerning the atmospheric fate and transport of **cyclohexylamine** (CHA) was found. If released to the atmosphere, CHA is not likely to directly photolyze but should react with photochemically produced hydroxyl ions with an estimated half-life of 1.82 days(1). Due to its high water solubility, CHA may undergo significant washout from the atmosphere(SRC).

[(1) GEMS; Graphical Exposure Modeling System. Fate of Atmospheric Pollutants (FAP) Data Base. Office of Toxic Substances USEPA (1985)]**QC REVIEWED**

Environmental Biodegradation:

Biodegradation of **cyclohexylamine** (CHA) in 3 inocula over 14 days: acclimated sewage sludge, 100 mg/l CHA - 100% degradation, 79.1% theoretical BOD (theo BOD); sewage sludge, 50 mg/l CHA - 100% degradation, 67.8% theo BOD; sewage sludge, 100 mg/l CHA - 0% degradation; river mud, 50 mg/l - 0% degradation; river mud, 10 mg/l, 100% degradation, 82.1% theo BOD(1).

[(1) Calamari D et al; Chemosphere 9: 753-62 (1980)]**QC REVIEWED**

Environmental Abiotic Degradation:

Aliphatic amines do not absorb radiation above 250 nm(1) so **cyclohexylamine** (CHA) would not be expected to directly photolyze. The principal loss mechanism for amines in the atmosphere is by reaction with photochemically produced hydroxyl radicals(2) which results in a calculated half-life of 1.82 days(3).

[(1) Calvert JG, Pitts JN Jr; Photochemistry. John Wiley & Sons New York pp.899 (1966) (2) Graedel TE; p.283-92 in Chemical Compounds in the Atmosphere. Academic Press New York (1978) (3) GEMS; Graphical Exposure Modeling System. Fate of Atmospheric Pollutants (FAP) Data Base. Office of Toxic Substances USEPA (1985)]**QC REVIEWED**

Environmental Bioconcentration:

Using a recommended value for the log octanol-water partition coefficient of 1.49(1), a BCF of 7.99 was estimated(2,SRC). Based on this estimated BCF value, **cyclohexylamine** is not expected to bioconcentrate significantly in aquatic organisms(SRC).

[(1) Hansch C, Leo AJ; Medchem Project Issue No. 26, Pomona College, Claremont CA (1985) (2) Lyman WJ et al; Handbook of Chemical Property Estimation Methods. McGraw-Hill New York Ch 5 (1982)]**QC REVIEWED**

Soil Adsorption/Mobility:

Using a recommended value for the log octanol-water partition coefficient of 1.49(1), a Koc value of 154 was estimated(2,SRC). Based on this Koc value and the high water solubility of **cyclohexylamine**, extensive leaching and very little adsorption to soil or sediments is expected (SRC).

[(1) Hansch C, Leo AJ; Medchem Project Issue No.26 Pomona College, Claremont CA (1985) (2) Lyman WJ et al; Handbook of Chemical Property Estimation Methods. McGraw-Hill New York Ch 5 (1982)]**QC REVIEWED**

Volatilization from Water/Soil:

Based on a vapor pressure (VP) of 9 mm Hg at 25 degC(1), **cyclohexylamine** (CHA) will readily evaporate from surfaces. Based on the above VP and the estimated lack of adsorption to soils, CHA should readily evaporate from dry soils. Since CHA is miscible with water, the rate of evaporation from water is difficult to predict(SRC).

[(1) Parrish CF; Encyclopedia of Chemical Technol 3rd ed. John Wiley & Sons New York 21: 380-1 (1983) (2) Windhoz M et al; The Merck Index 9th ed. p.357 (1978)]**QC REVIEWED**

Effluent Concentrations:

Effluent from a tire manufacturing plant contained **cyclohexylamine** at approximately 0.01 ppm (+/- 30%)(1).

[(1) Jungclauss GA et al; Anal Chem 48: 1894-96 (1976)]**QC REVIEWED**

Environmental Standards & Regulations:**State Drinking Water Guidelines:**

(FL) FLORIDA 5,000 ug/l

[USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee (FSTRAC). Summary of State and Federal Drinking Water Standards and Guidelines (11/93)] **QC REVIEWED**

Chemical/Physical Properties:**Molecular Formula:**

C6-H13-N

QC REVIEWED

Molecular Weight:

99.17

[The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 392]**QC REVIEWED**

Color/Form:

COLORLESS TO YELLOW LIQUID

[National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978.,p. 49-108]**QC REVIEWED**

Colorless or yellow liquid.

[NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No. 94-116. Washington, D.C.: U.S. Government Printing Office, June 1994. 84]**QC REVIEWED**

Odor:

STRONG, FISHY, AMINE ODOR

[The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 392]**QC REVIEWED**

Strong, fishy, amine-like odor.

[NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No. 94-116. Washington, D.C.: U.S. Government Printing Office, June 1994. 84]**QC REVIEWED**

Boiling Point:

134.5 DEG C @ 760 MM HG

[The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 392]**QC

REVIEWED**

Melting Point:

-17.7 DEG C

[The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 392]**QC
REVIEWED**

Density/Specific Gravity:

0.8647 @ 25 DEG C/25 DEG C

[The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 392]**QC
REVIEWED**

Dissociation Constants:

PKA 10.7

[Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and
Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons,
1981-1982. 3137]**QC REVIEWED**

pH:

STRONG BASE

[The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 392]**QC
REVIEWED**

Solubilities:

SOL IN ALL PROPORTIONS IN ACETONE, BENZENE

[Weast, R.C. (ed.). Handbook of Chemistry and Physics. 60th ed. Boca Raton,
Florida: CRC Press Inc., 1979.,p. C-260]**QC REVIEWED**

MISCIBLE WITH WATER AND WITH COMMON ORGANIC SOLVENTS: ALCOHOL,
ETHERS, KETONES, ESTERS, ALIPHATIC HYDROCARBONS; COMPLETELY MISCIBLE
WITH AROMATIC HYDROCARBONS

[The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 392]**QC
REVIEWED**

SOL IN CHLORINATED HYDROCARBONS, MINERAL OIL, PEANUT OIL AND SOYA BEAN
OIL

[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man.
Geneva: World Health Organization, International Agency for Research on
Cancer,1972-PRESENT. (Multivolume work).,p. V22 60]**QC REVIEWED**

Spectral Properties:

INDEX OF REFRACTION: 1.4565 @ 25 DEG C/D

[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man.
Geneva: World Health Organization, International Agency for Research on
Cancer,1972-PRESENT. (Multivolume work).,p. V22 60]**QC REVIEWED**

IR: 845 (Sadler Research Laboratories Prism Collection)

[Weast, R.C. and M.J. Astle. CRC Handbook of Data on Organic Compounds. Volumes I
and II. Boca Raton, FL: CRC Press Inc. 1985.,p. V1 507]**QC REVIEWED**

NMR: 6937 (Sadler Research Laboratories Spectral Collection)

[Weast, R.C. and M.J. Astle. CRC Handbook of Data on Organic Compounds. Volumes I and II. Boca Raton, FL: CRC Press Inc. 1985.,p. V1 507]**QC REVIEWED**

MASS: 241 (Atlas of Mass Spectral Data, John Wiley & Sons, New York)

[Weast, R.C. and M.J. Astle. CRC Handbook of Data on Organic Compounds. Volumes I and II. Boca Raton, FL: CRC Press Inc. 1985.,p. V1 507]**QC REVIEWED**

Vapor Density:

3.42 (AIR= 1)

[Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 3137]**QC REVIEWED**

Other Chemical/Physical Properties:

ON DISTILLATION WITH WATER, **CYCLOHEXYLAMINE** FORMS AZEOTROPIC MIXT, BOILING @ 96.4 DEG C @ 760 MM HG; REACTS WITH EXCESS AMMONIA & ZINC CHLORIDE @ 350 DEG C TO PRODUCE ALPHA-PICOLINE

[The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 392]**QC REVIEWED**

REACTS WITH ORGANIC COMPOUNDS CONTAINING AN ACTIVE HALOGEN ATOM, ACID ANHYDRIDES & ALKYLENE OXIDES, TO REPLACE ONE OR BOTH HYDROGEN ATOMS ON THE NITROGEN ATOM; REACTS WITH NITROUS ACID TO FORM CYCLOHEXANOL

[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work).,p. V22 60]**QC REVIEWED**

Chemical Safety & Handling:

DOT Emergency Guidelines:

Fire or explosion: Flammable/combustible materials. May be 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. Some may polymerize (P) 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. 1996 North American Emergency Response Guidebook. A Guidebook for First Responders During the Initial Phase of aHazardous Materials/Dangerous Goods Incident. U.S. Department of Transportation (U.S. DOT) Research and Special Programs Administration, Office of HazardousMaterials Initiatives and Training (DHM-50), Washington, D.C. (1996).,p. G-132]**QC REVIEWED**

Health: May cause toxic effects if inhaled or ingested/swallowed. Contact with substance may cause severe burns to 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. 1996 North American Emergency Response Guidebook. A Guidebook for First Responders During the Initial Phase of aHazardous Materials/Dangerous Goods Incident. U.S. Department of Transportation (U.S. DOT) Research and Special Programs Administration, Office of HazardousMaterials Initiatives and Training (DHM-50), Washington, D.C. (1996).,p. G-132]**QC REVIEWED**

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. Isolate spill or leak area immediately for at least 50 to 100 meters (160 to 330 feet) in all directions. Keep unauthorized personnel away. Stay upwind. Keep out of low areas. Ventilate closed spaces before entering.

[U.S. Department of Transportation. 1996 North American Emergency Response Guidebook. A Guidebook for First Responders During the Initial Phase of aHazardous Materials/Dangerous Goods Incident. U.S. Department of Transportation (U.S. DOT) Research and Special Programs Administration, Office of HazardousMaterials Initiatives and Training (DHM-50), Washington, D.C. (1996)..p. G-132]**QC REVIEWED**

Protective clothing: Wear positive pressure self-contained breathing apparatus (SCBA). Wear chemical protective clothing which is specifically recommended by the manufacturer. It may provide little or no thermal protection. Structural firefighters' protective clothing is recommended for fire situations only; it is not effective in spill situations.

[U.S. Department of Transportation. 1996 North American Emergency Response Guidebook. A Guidebook for First Responders During the Initial Phase of aHazardous Materials/Dangerous Goods Incident. U.S. Department of Transportation (U.S. DOT) Research and Special Programs Administration, Office of HazardousMaterials Initiatives and Training (DHM-50), Washington, D.C. (1996)..p. G-132]**QC REVIEWED**

Evacuation: Large spill: See the Table of Initial Isolation and Protective Action Distances for highlighted substances. For non-highlighted substances, increase, in the downwind direction, as necessary, the isolation distance shown under "PUBLIC SAFETY". 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. 1996 North American Emergency Response Guidebook. A Guidebook for First Responders During the Initial Phase of aHazardous Materials/Dangerous Goods Incident. U.S. Department of Transportation (U.S. DOT) Research and Special Programs Administration, Office of HazardousMaterials Initiatives and Training (DHM-50), Washington, D.C. (1996)..p. G-132]**QC REVIEWED**

Fire: Some of these materials may react violently with water. Small fires: Dry chemical, CO₂, water spray or alcohol-resistant foam. Large fires: Water spray, fog or alcohol-resistant foam. Move containers from fire area if you can do it without risk. Dike fire control water for later disposal; do not scatter the material. Do not get water inside containers. 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 the ends of tanks. 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. 1996 North American Emergency Response Guidebook. A Guidebook for First Responders During the Initial Phase of aHazardous Materials/Dangerous Goods Incident. U.S. Department of Transportation (U.S. DOT) Research and Special Programs Administration, Office of HazardousMaterials Initiatives and Training (DHM-50), Washington, D.C. (1996)..p. G-132]**QC REVIEWED**

Spill or Leak: Fully encapsulating, vapor protective clothing should be worn for spills and leaks with no fire. 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 with earth, sand or other non-combustible material and transfer to containers (except for Hydrazine). Use clean non-sparking tools to collect absorbed material. Large spills: Dike far ahead of liquid spill for later disposal. Water spray may reduce vapor; but may not prevent ignition in closed spaces.

[U.S. Department of Transportation. 1996 North American Emergency Response Guidebook. A Guidebook for First Responders During the Initial Phase of

aHazardous Materials/Dangerous Goods Incident. U.S. Department of Transportation (U.S. DOT) Research and Special Programs Administration, Office of Hazardous Materials Initiatives and Training (DHM-50), Washington, D.C. (1996), p. G-132] **QC REVIEWED**

First aid: Move victim to fresh air. Call emergency medical care. Apply artificial respiration if victim is not breathing. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. 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. 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. 1996 North American Emergency Response Guidebook. A Guidebook for First Responders During the Initial Phase of aHazardous Materials/Dangerous Goods Incident. U.S. Department of Transportation (U.S. DOT) Research and Special Programs Administration, Office of Hazardous Materials Initiatives and Training (DHM-50), Washington, D.C. (1996), p. G-132] **QC REVIEWED**

Skin, Eye and Respiratory Irritations:

SEVERE EYE AND RESPIRATORY IRRITANT. ... BURNS SKIN ON CONTACT.

[National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978., p. 49-109] **QC REVIEWED**

Fire Potential:

FLAMMABLE LIQUID...

[International Labour Office. Encyclopedia of Occupational Health and Safety. Volumes I and II. New York: McGraw-Hill Book Co., 1971. 92] **QC REVIEWED**

NFPA Hazard Classification:

FLAMMABILITY 3. 3= MATERIALS WHICH CAN BE IGNITED UNDER ALMOST ALL NORMAL TEMP CONDITIONS. WATER MAY BE INEFFECTIVE BECAUSE OF LOW FLASH POINT.

[National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978., p. 325M-59] **QC REVIEWED**

HEALTH 2. 2= MATERIALS HAZARDOUS TO HEALTH, BUT AREAS MAY BE ENTERED FREELY WITH FULL-FACED MASK SELF-CONTAINED BREATHING APPARATUS WHICH PROVIDES EYE PROTECTION.

[National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978., p. 325M-59] **QC REVIEWED**

REACTIVITY 0. 0= MATERIALS WHICH [IN THEMSELVES] ARE NORMALLY STABLE EVEN UNDER FIRE EXPOSURE CONDITIONS AND WHICH ARE NOT REACTIVE WITH WATER. NORMAL FIRE FIGHTING PROCEDURES MAY BE USED.

[National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978., p. 325M-59] **QC REVIEWED**

Flash Point:

88 DEG F, 31 DEG C CC

[National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978.,p. 325M-59]**QC REVIEWED**

Autoignition Temperature:

560 DEG F (293 DEG C).

[National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978.,p. 325M-59]**QC REVIEWED**

Fire Fighting Procedures:

IF LEAK OR SPILL HAS NOT IGNITED, USE WATER SPRAY TO DISPERSE VAPORS & TO PROTECT MEN ATTEMPTING TO STOP LEAK. WATER SPRAY MAY BE USED TO FLUSH SPILLS AWAY FROM EXPOSURES & TO DILUTE SPILLS TO NON-FLAMMABLE MIXTURE. USE DRY CHEMICAL, ALCOHOL FOAM OR CARBON DIOXIDE; WATER MAY BE INEFFECTIVE, BUT WATER SHOULD BE USED TO KEEP FIRE-EXPLOSIVE CONTAINERS COOL.

[National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978.,p. 49-109]**QC REVIEWED**

Firefighting Hazards:

VAPOR...MAY TRAVEL CONSIDERABLE DISTANCE TO SOURCE OF IGNITION & FLASH BACK.

[National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978.,p. 49-108]**QC REVIEWED**

Hazardous Reactivities & Incompatibilities:

Oxidizers, organic compounds, acid anhydrides, acid chlorides, acids, lead [Note: Corrosive to copper, aluminum, zinc & galvanized steel].

[NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No. 94-116. Washington, D.C.: U.S. Government Printing Office, June 1994. 84]**QC REVIEWED**

Hazardous Decomposition:

DANGEROUS WHEN HEATED TO DECOMP, IT EMITS HIGHLY TOXIC FUMES...

[Sax, N.I. Dangerous Properties of Industrial Materials. 6th ed. New York, NY: Van Nostrand Reinhold, 1984. 834]**QC REVIEWED**

Protective Equipment & Clothing:

USUAL PROTECTIVE MEASURES (GOGGLES & APRON) MUST BE EMPLOYED WHEN HANDLING THESE SUBSTANCES. ...WORK MUST BE DONE IN WELL-VENTILATED PLACES.

[Lefaux, R. Practical Toxicology of Plastics. Cleveland: CRC Press Inc., 1968. 148]**QC REVIEWED**

WEAR SELF-CONTAINED BREATHING APPARATUS; WEAR GOGGLES IF EYE PROTECTION NOT PROVIDED.

[National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978.,p. 49-109]**QC REVIEWED**

Wear appropriate personal protective clothing to prevent skin contact.

[NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No. 94-116. Washington, D.C.: U.S. Government Printing Office, June 1994. 84]**QC REVIEWED**

Wear appropriate eye protection to prevent eye contact.

[NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No. 94-116. Washington, D.C.: U.S. Government Printing Office, June 1994. 84]**QC REVIEWED**

Eyewash fountains should be provided in areas where there is any possibility that workers could be exposed to the substance; this is irrespective of the recommendation involving the wearing of eye protection.

[NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No. 94-116. Washington, D.C.: U.S. Government Printing Office, June 1994. 84]**QC REVIEWED**

Facilities for quickly drenching the body should be provided within the immediate work area for emergency use where there is a possibility of exposure. [Note: It is intended that these facilities should provide a sufficient quantity or flow of water to quickly remove the substance from any body areas likely to be exposed. The actual determination of what constitutes an adequate quick drench facility depends on the specific circumstances. In certain instances, a deluge shower should be readily available, whereas in others, the availability of water from a sink or hose could be considered adequate.]

[NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No. 94-116. Washington, D.C.: U.S. Government Printing Office, June 1994. 84]**QC REVIEWED**

Preventive Measures:

The worker should immediately wash the skin when it becomes contaminated.

[NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No. 94-116. Washington, D.C.: U.S. Government Printing Office, June 1994. 84]**QC REVIEWED**

Work clothing that becomes wet should be immediately removed due to its flammability hazard.

[NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No. 94-116. Washington, D.C.: U.S. Government Printing Office, June 1994. 84]**QC 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 (7/1/96)]**QC 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.3067-3, 3126-1 (1988)]**QC REVIEWED**

Storage Conditions:

PROTECT AGAINST PHYSICAL DAMAGE. OUTSIDE OR DETACHED STORAGE IS PREFERABLE. INSIDE STORAGE SHOULD BE IN STD FLAMMABLE LIQ STORAGE ROOM. SEPARATE FROM OXIDIZING MATERIALS.

[National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978.,p. 49-109]**QC REVIEWED**

Occupational Exposure Standards:

Threshold Limit Values:

8 hr Time Weighted Avg (TWA) 10 ppm

[American Conference of Governmental Industrial Hygienists. Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents Biological Exposure Indices for 1998. Cincinnati, OH: ACGIH, 1998. 28]**QC REVIEWED**

Excursion Limit Recommendation: Excursions in worker exposure levels may exceed three times the TLV-TWA for no more than a total of 30 min during a work day, and under no circumstances should they exceed five times the TLV-TWA, provided that the TLV-TWA is not exceeded.

[American Conference of Governmental Industrial Hygienists. Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents Biological Exposure Indices for 1998. Cincinnati, OH: ACGIH, 1998. 6]**QC REVIEWED**

A4. A4= Not classifiable as a human carcinogen.

[American Conference of Governmental Industrial Hygienists. Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents Biological Exposure Indices for 1998. Cincinnati, OH: ACGIH, 1998. 28]**QC REVIEWED**

NIOSH Recommendations:

10 hr Time-Weighted avg: 10 ppm (40 mg/cu m).

[NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No. 94-116. Washington, D.C.: U.S. Government Printing Office, June 1994. 84]**QC REVIEWED**

Manufacturing/Use Information:

Major Uses:

IN ORG SYNTHESIS; MFR INSECTICIDES, PLASTICIZERS, EMULSIFYING AGENTS, DRY-CLEANING SOAPS, ACID GAS ABSORBENTS

[The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 392]**QC REVIEWED**

CORROSION INHIBITOR IN BOILER WATER & OIL FIELDS; CHEM INT FOR RUBBER-PROCESSING CHEMS, DYES-EG, ACID BLUE 62 (FORMER USE), CYCLAMATE ARTIFICIAL SWEETENERS (NON-US USE) & FOR HERBICIDE-EG, LENACIL (NON-US USE); PROCESSING AGENT FOR NYLON FIBER PRODUCTION

[SRI]**QC REVIEWED**

Manufacturers:

Air Products and Chemicals, Inc, Hq, PO Box 538, Allentown, PA 18195, (215) 481-4911; Industrial

Chemicals Division; Production site: Wichita, KS 67200

[SRI. 1989 Directory of Chemical Producers - United States of America. Menlo Park, CA: SRI International, 1989. 547]**QC REVIEWED**

Hoechst Celanese Corp, Hq, Route 202-206 North, Somerville, NJ 08876, (201) 231-2000; Specialty Chemicals Group; Production site: Bucks, AL 36512

[SRI. 1989 Directory of Chemical Producers - United States of America. Menlo Park, CA: SRI International, 1989. 547]**QC REVIEWED**

Methods of Manufacturing:

PREPARED BY CATALYTIC HYDROGENATION OF ANILINE AT ELEVATED TEMP & PRESSURES. FRACTIONATION OF CRUDE REACTION PRODUCT YIELDS **CYCLOHEXYLAMINE**, UNCHANGED ANILINE, & HIGH-BOILING RESIDUE CONTAINING N-PHENYLCYCLOHEXYLAMINE (CYCLOHEXYLANILINE) & DICYCLOHEXYLAMINE.

[The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 392]**QC REVIEWED**

REACTION OF AMMONIA & CYCLOHEXANOL AT ELEVATED TEMPERATURE & PRESSURE IN THE PRESENCE OF A SILICA-ALUMINA CATALYST; CATALYTIC HYDROGENATION OF ANILINE

[SRI]**QC REVIEWED**

Impurities:

AVAILABLE COMMERCIALY IN THE US...WITH PURITY, 98% MINIMUM; AND 0.5% MAXIMUM BY WEIGHT MOISTURE CONTENT.

[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work) .,p. V22 60]**QC REVIEWED**

Consumption Patterns:

CORROSION INHIBITOR IN BOILER WATER TREATMENT, 60%; CHEM INT FOR RUBBER-PROCESSING CHEMS, 25%; OTHER USES (EG, CORROSION INHIBITOR IN OIL FIELD APPLICATIONS), 15% (1982)

[SRI]**QC REVIEWED**

CHEMICAL PROFILE: **Cyclohexylamine**. Boiler water treatment, 70%; rubber chemicals, 17%; chain terminator, 6%; miscellaneous, including oilfield corrosion inhibitors, photographic chemicals, catalysts, intermediates and metal extraction, 7%.

[Kavaler AR; Chemical Marketing Reporter 231 (3): 50 (1987)]**QC REVIEWED**

CHEMICAL PROFILE: **Cyclohexylamine**. Demand: 1986: 9.2 million lb; 1987: 9.4 million lb; 991 /projected/: 10.4 million lb.

[Kavaler AR; Chemical Marketing Reporter 231 (3): 50 (1987)]**QC REVIEWED**

CHEMICAL PROFILE: **Cyclohexylamine**. Boiler water treatment, 60%; rubber chemicals, 12%; nylon chain terminator, 10%; agricultural chemicals, 10%; miscellaneous (including oilfield corrosion inhibitors, photographic chemicals, catalysts, intermediates, metal extraction and exports), 8%.

[Kavaler AR; Chemical Marketing Reporter 237 (8): 46 (1990)]**QC REVIEWED**

CHEMICAL PROFILE: **Cyclohexylamine**. Demand: 1989: 13 million lb; 1990 /projected/: 13.4 million lb; 1994 /projected/: 14.5 million lb. (Includes exports of 3.5 million lb, but not imports which amounted to about 2 million lb last year.)

[Kavaler AR; Chemical Marketing Reporter 237 (8): 46 (1990)]**QC REVIEWED**

U. S. Production:

(1978) PROBABLY GREATER THAN 6.81X10+6 G
[SRI]**QC REVIEWED**

(1982) PROBABLY GREATER THAN 4.54X10+6 G
[SRI]**QC REVIEWED**

U. S. Imports:

(1978) 2.54X10+8 G
[SRI]**QC REVIEWED**

(1982) 7.40X10+8 G
[SRI]**QC REVIEWED**

U. S. Exports:

(1978) ND
[SRI]**QC REVIEWED**

(1982) ND
[SRI]**QC REVIEWED**

Laboratory Methods:

Analytic Laboratory Methods:

ANALYTE: ALIPHATIC AMINES; MATRIX: AIR; PROCEDURE ADSORPTION ON SILICA GEL; ELUTION WITH ACID; GAS CHROMATOGRAPHIC ANALYSIS; RANGE 1 TO 2400 MG/CU M IN A 10-LITER SAMPLE OF AIR. /ALIPHATIC AMINES/

[U.S. Department of Health, Education Welfare, Public Health Service. Center for Disease Control, National Institute for Occupational Safety Health. NIOSH Manual of Analytical Methods. 2nd ed. Volumes 1-7. Washington, DC: U.S. Government Printing Office, 1977-present.,p. V1 221-1]**QC REVIEWED**

CYCLOHEXYLAMINE...IN CYCLAMATES & ARTIFICIALLY SWEETENED PRODUCTS & FOODS /BY GAS CHROMATOGRAPHY/.

[Association of Official Analytical Chemists. Official Methods of Analysis. 10th ed. and supplements. Washington, DC: Association of Official Analytical Chemists, 1965. New editions through 13th ed. plus supplements, 1982.,p. 13/348 20.163]**QC REVIEWED**

GAS CHROMATOGRAPHIC DETERMINATION OF CYCLIC AMINES IN URINE SAMPLES.

[BENSON GA, SPILLANE WJ; GAS CHROMATOGRAPHIC DETERMINATION OF CYCLIC AMINES, KETONES & ALCOHOLS, POSSIBLE METABOLITES OF SWEET SULFAMATES; J CHROMATOGR 136(2) 318 (1977)]**QC REVIEWED**

DETERMINATION OF CYCLOHEXYLAMINE IN RIVER WATER BY FLAME THERMOIONIC DETECTOR-GAS CHROMATOGRAPHY.

[MURAYAMA H ET AL; DETERMINATION OF CYCLOHEXYLAMINE IN ENVIRONMENTAL SAMPLES BY FLAME THERMOIONIC DETECTOR-GAS CHROMATOGRAPHY; NIIGATA-KEN KOGAI KENKYUSHO KENKYU HOKOKU 7: 16-9 (1983)]**QC REVIEWED**

ION CHROMATOGRAPHIC DETERMINATION OF CYCLOHEXYLAMINE IN WATER

CONTAINING AMMONIA & HYDRAZINE.

[GILBERT R ET AL; ION CHROMATOGRAPHIC DETERMINATION OF MORPHOLINE AND CYCLOHEXYLAMINE IN AQUEOUS SOLUTIONS CONTAINING AMMONIA AND HYDRAZINE; ANAL CHEM 56 (1): 106-9 (1984)]**QC REVIEWED**

Special References:**Synonyms and Identifiers:****Synonyms:****AMINOCYCLOHEXANE**

QC REVIEWED

AMINOHEXAHYDROBENZENE

QC REVIEWED

BENZENAMINE, HEXAHYDRO-

QC REVIEWED

CHA

QC REVIEWED

CYCLOHEXANAMINE

QC REVIEWED

HEXAHYDROANILINE

QC REVIEWED

HEXAHYDROBENZENAMINE

QC REVIEWED

RTECS Number:

NIOSH/GX0700000

Administrative Information:

Hazardous Substances Databank Number: 918

Last Revision Date: 20000208

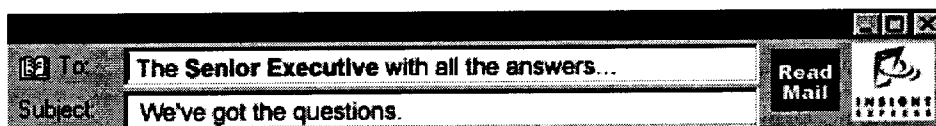
Update History:

Field Update on 02/08/2000, 1 field added/edited/deleted.
Field Update on 02/02/2000, 1 field added/edited/deleted.
Field Update on 11/18/1999, 1 field added/edited/deleted.
Field Update on 09/21/1999, 1 field added/edited/deleted.
Field Update on 08/26/1999, 1 field added/edited/deleted.
Field Update on 03/17/1999, 1 field added/edited/deleted.
Field Update on 11/17/1998, 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 10/20/1997, 1 field added/edited/deleted.
Field Update on 05/08/1997, 1 field added/edited/deleted.

Field Update on 05/01/1997, 2 fields added/edited/deleted.
Complete Update on 03/19/1997, 1 field added/edited/deleted.
Complete Update on 10/13/1996, 1 field added/edited/deleted.
Complete Update on 09/04/1996, 10 fields added/edited/deleted.
Field Update on 05/07/1996, 1 field added/edited/deleted.
Field Update on 01/19/1996, 1 field added/edited/deleted.
Field Update on 01/18/1995, 1 field added/edited/deleted.
Field Update on 12/22/1994, 1 field added/edited/deleted.
Field Update on 11/03/1994, 1 field added/edited/deleted.
Field Update on 11/02/1994, 1 field added/edited/deleted.
Complete Update on 07/20/1994, 1 field added/edited/deleted.
Complete Update on 03/25/1994, 1 field added/edited/deleted.
Complete Update on 08/07/1993, 1 field added/edited/deleted.
Field update on 12/16/1992, 1 field added/edited/deleted.
Complete Update on 01/23/1992, 1 field added/edited/deleted.
Complete Update on 01/21/1991, 20 fields added/edited/deleted.
Field Update on 05/04/1990, 1 field added/edited/deleted.
Field Update on 01/15/1990, 1 field added/edited/deleted.
Complete Update on 01/11/1990, 17 fields added/edited/deleted.
Express Update on 05/10/1988, 2 fields added/edited/deleted.
Complete Update on 03/01/1985

Record Length: 73308

C-9



[CambridgeSoft](#) [ChemFinder.Com](#) [ChemStore.Com](#) [ChemNews.Com](#) [ChemClub.Com](#)
[ChemQuote.Com](#) [ChemACX.Com](#) [SciStore.Com](#) [LabEquip.Com](#) [ChemSell.Com](#)

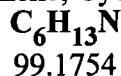
Enter a chemical name, CAS Number, molecular formula, or molecular weight

Or choose: [Substructure Query with Plug-In](#) or [Structure Query with Java](#)

You're on the Web!

cyclohexyl amine [108-91-8]

Synonyms: Cyclohexanamine; Aminocyclohexane; Hexahydroaniline; CHA; Hexahydrobenzenamine; aminohexahydrobenzene; Cyclohexylamine ;



99.1754

[View with ChemDraw Plugin](#)
[Save in CDX format](#)



[BUY AT CHEMACX.COM](#)
[VIEW CHEM3D MODEL](#)

ACX Number	X1001523-3	CAS RN	108-91-8
Melting Point (°C)	-17.7	Density	0.867
Boiling Point (°C)	134.5	Vapor Density	3.4
Refractive Index	1.4585	Vapor Pressure	
Evaporation Rate		Water Solubility	Very soluble
Flash Point (°C)	27	EPA Code	
DOT Number	UN 2357 Flammable liquid	RTECS	GX0700000
Comments	colorless to yellow liquid with an ammonia-like odor. POSSIBLE MUTAGEN.		

More information about the chemical is available in these categories:

[Biochemistry](#) [Chemical Online Order](#) [Health](#) [Misc](#)
[MSDS](#) [Physical Properties](#) [Regulations](#) [Structures](#)

Biochemistry

[Ligand Chemical Database for Enzyme Reactions](#)

[Information about this particular compound](#)

Chemical Online Order

[Available Chemicals Exchange](#)

[Information about this particular compound](#)

Health

[NTP Chemical Health and Safety Data](#)

[Information about this particular compound](#)

[RAIS Nonradionuclides Toxicity Values](#)

[International Toxicity Estimates for Risk](#)

[Information about this particular compound](#)

[Hazardous Chemicals Database at the University of Akron](#)

[Information about this particular compound](#)

[8\(e\) TRIAGE Chemical Studies Database](#)

[Industrial Chemicals for which Methemoglobinemia Is the Primary Toxic Effect](#)

[UMCP Partial list of mutagens](#)

[UMCP Partial list of teratogens](#)

[International Chemical Safety Cards](#)

[Information about this particular compound](#)

[North American Emergency Response Guidebook 1996 \(NAERG96\)](#)

[Information about this particular compound](#)

[Australian Atmospheric Exposure Standards](#)

[Information about this particular compound](#)

[Australian Hazardous Substances Database](#)

[Information about this particular compound](#)

[Information about this particular compound](#)

[Information about this particular compound](#)

Misc

[Chemical management](#)

[Information about this particular compound](#)

MSDS

[New Jersey Right to Know Hazardous Substance Fact Sheets](#)

[Information about this particular compound](#)

Physical Properties

[Environmental Science Center database with Experimental Log P coefficients etc.](#)

[Information about this particular compound](#)

[JICST Mass Spectral Database](#)

[Information about this particular compound](#)

[NIST Chemistry WebBook](#)

[Information about this particular compound](#)

[ABCR GmbH&Co KG](#)

[Cyclohexylamine, 98+%](#)

[Dielectric Constant Reference Guide](#)

[Organic Compounds Database](#)

[Proton NMR Spectral Molecular Formula Index](#)

[Information about this particular compound](#)

[DuPont TYVEK® Protective Apparel Information Service](#)

[Information about this particular compound](#)

[Pollution Prevention Progress Measurement Method \(3P2M\) Hazard Ranking](#)

[Galactic Industries Corporation Spectral Database](#)

[FTIR SPECTRUM of CYCLOHEXYLAMINE](#)

[Genium's Chemical Container Label Database](#)

[Information about this particular compound](#)

[NFPA Chemical Hazard Labels](#)

[Information about this particular compound](#)

Regulations

[NASA Department of Environmental Services List Of Lists of Regulated Chemicals](#)

[Information about this particular compound](#)

[University of California-Riverside list of compounds that must be reported](#)

[Texas Clean Air Act](#)

[California EPA List of Lists](#)

[List of Regulated Substances Under the LDEQ Chemical Accident Prevention Program](#)

[Substances in IRIS \(Integrated Risk Information System\) \(main EPA site\)](#)

[Information about this particular compound](#)

[Title III List of Lists](#)

[Regulated Substances under Section 112\(r\) of the Clean Air Act](#)

[OSHA Chemical Sampling and Methods](#)

[Information about this particular compound](#)

[Guide to NIOSH/OSHA Air Sampling Methods](#)

[Information about this particular compound](#)

Structures

[CyberMol collection of molecules in VRML format](#)

[Information about this particular compound](#)

[DCU Chime Pages](#)

[This substance in PDB format](#)

Enter a chemical name, CAS Number, molecular formula, or molecular weight

[Substructure Query with Plug-In](#) or [Substructure Query with Java](#)

To: Robert Pooler
USDA/AMS/TM/NOP
email: Bob.Pooler@USDA.gov

From: Co-petitioners
Date: 12/5/00

re; additional information for petitions of Cyclohexylamine, Diethylaminoethanol, and Morpholine

➤ **Justification Statement:**

Boiler water additives are essential to prevent the corrosion of steam generating and distribution systems. These additives prevent corrosion by neutralizing carbonic acid as it forms from the carbon dioxide captured within the steam. Most manufactures have one boiler system serving their entire plant and therefore producing steam for all the operating needs. These steam generating and distribution systems represent significant capital investments for food manufacturers. As an example; a 500-hp boiler costs roughly \$200,000.00. Typically, a boiler this size will provide enough steam to operate a small processing facility with one or two production lines and fruit/vegetable processing area. The larger the operation the more boiler capacity is needed. Large operations will take multiple boiler systems, which will take on the average three boiler systems. This is an investment of approximately \$600,000.00 for the boilers alone. Additional capitol investment of the entire production area is at risk if the steam is not treated to neutralize the carbonic acid. Effective and safe boiler/steam additives are vital to protect these systems. A poorly maintained system will require replacement every 5 to 8 years as opposed to lasting between 50 to 100 years. Additionally, Most State's and private insurance companies require inspections to verify that a boiler is being properly maintained. This includes a proper chemical documentation program. Worker safety is also an issue as a poorly maintained boiler system can result in steam leaks and equipment failure under load.

The only effective steam and condensate line corrosion inhibitors available are amine based with the exception or ammonium hydroxide which is the only approved steam line treatment in dairy. The code of Federal Regulations lists only three approved volatile amines; **Cyclohexylamine, Diethylaminoethanol, and Morpholine.** For the most complete and economical protection of a steam system, it is advisable to design a blend of these amines which will accommodate to the specific yet changing conditions in a boiler system. Suppliers of these materials are familiar with the conditions needed for proper distribution ratio's and will create an optimum blend for their client.

➤ **Non-synthetic Substances**

There are no approved non-synthetic substances.

➤ **Alternative Control Methods**

1. Many operations **discontinue the use of boiler water additives** only during the production of organic products minimizing the corrosive impact of not using boiler water additives. Below are some of the reasons why this is not feasible for all operations:
 - This would only be possible for manufacturers of both organic and non-organic products whose organic production represented a relatively small portion of their running time.

- This would be impractical for producers targeting a national distribution. To achieve production volumes for national distribution organic production lines would have to run virtually continuously.
 - For perspective, a 500-hp system running without boiler water additives would increase fuel requirements by about \$100,000.00. This would result in 2 additional tons of nitrogen oxide and 1 additional ton of sulfur dioxide released into the atmosphere each year. As corrosion builds up the efficiency of heat transfer decreases requiring more energy to run the boiler.
2. **Culinary steam filters** (as suggested by prior NOSB addendum Number 7 – Orlando, 1995) do not remove the volatile amines and therefore are not an alternative.
 3. Placing a **steam to steam heat exchanger** between the existing boiler water system and the production line system .
 - Not a solution for all applications, the temperature differential has to be sufficient to maintain the required temperature and pressure to serve the production system
 - The cost of installation would present a significant expense. (Average cost for a line of national distribution is \$500,000.00. Life span of equipment is 5-8 years.)

Beneficial effects to the environment from the use of the synthetic substance.

The environment benefits from the proper maintenance and boiler water treatment program. A poorly maintained boiler will increase fuel requirements as corrosion builds up and the efficiency of heat transfer decreases requiring more energy to run the boiler. These results in additional nitrogen oxide and sulfur dioxide release into the atmosphere and promotes an unsafe work environment due to deterioration and possible catastrophic steam into the work places.

Pooler , Bob

To: joehall@ccalifornianatural.com; jim.pierce@organicvalley.com;
greg.cunningham@genmills.com
Cc: kellys@horizonorganic.com; kim.burton@jmsmucker.com; cliff@spraychem.com; Jones,
Keith; cwbrickey@aol.com; ebr@omri.org
Subject: National List petitioned substances

Dear Co-petitioners,

I have received National List substance petitions for the addition of Cyclohexamine, Octadecylamine, Diethylaminoethanol, Morpholine, Ammonium hydroxide and Hydroxyquinoline sulfate (Horizon, sole petitioner) to the National List.

These petitions have been reviewed for completeness according to the petition process guidelines published in the Federal Register on July 13, 2000, which is available on the NOP website: www.ams.usda.gov/nop.

Three substances require additional information, Cyclohexamine, Diethylaminoethanol, and Morpholine. The preliminary information for these petitions did not provide a "Petition Justification Statement." For substances to be included onto the National List, the Justification Statements must provide information for the following areas: why the synthetic substance is necessary for the production and handling of an organic product; describe any nonsynthetic substances or alternative control methods; and summarize the beneficial effects to the environment from the use of the synthetic substance.

Please provide the Petition Justification Statement information ASAP, the reviews for these petitioned substances will remain incomplete until this information is provided.

The remaining petitions will be forwarded for consideration.

Thank you

Robert Pooler

To: Robert Pooler
USDA/AMS/TM/NOP
email: Bob.Pooler@USDA.gov

From: Co-petitioners
Date: 12/5/00

re; additional information for petitions of Cyclohexylamine, Diethylaminoethanol, and Morpholine

➤ **Justification Statement;**

Boiler water additives are essential to prevent the corrosion of steam generating and distribution systems. These additives prevent corrosion by neutralizing carbonic acid as it forms from the carbon dioxide captured within the steam. Most manufactures have one boiler system serving their entire plant and therefore producing steam for all the operating needs. These steam generating and distribution systems represent significant capital investments for food manufacturers. As an example; a 500-hp boiler costs roughly \$200,000.00. Typically, a boiler this size will provide enough steam to operate a small processing facility with one or two production lines and fruit/vegetable processing area. The larger the operation the more boiler capacity is needed. Large operations will take multiple boiler systems, which will take on the average three boiler systems. This is an investment of approximately \$600,000.00 for the boilers alone. Additional capitol investment of the entire production area is at risk if the steam is not treated to neutralize the carbonic acid. Effective and safe boiler/steam additives are vital to protect these systems. A poorly maintained system will require replacement every 5 to 8 years as opposed to lasting between 50 to 100 years. Additionally, Most State's and private insurance companies require inspections to verify that a boiler is being properly maintained. This includes a proper chemical documentation program. Worker safety is also an issue as a poorly maintained boiler system can result in steam leaks and equipment failure under load.

The only effective steam and condensate line corrosion inhibitors available are amine based with the exception or ammonium hydroxide which is the only approved steam line treatment in dairy. The code of Federal Regulations lists only three approved volatile amines; **Cyclohexylamine, Diethylaminoethanol, and Morpholine.** For the most complete and economical protection of a steam system, it is advisable to design a blend of these amines which will accommodate to the specific yet changing conditions in a boiler system. Suppliers of these materials are familiar with the conditions needed for proper distribution ratio's and will create an optimum blend for their client.

➤ **Non-synthetic Substances**

There are no approved non-synthetic substances.

➤ **Alternative Control Methods**

1. Many operations **discontinue the use of boiler water additives** only during the production of organic products minimizing the corrosive impact of not using boiler water additives. Below are some of the reasons why this is not feasible for all operations:
 - This would only be possible for manufacturers of both organic and non-organic products whose organic production represented a relatively small portion of their running time.

- This would be impractical for producers targeting a national distribution. To achieve production volumes for national distribution organic production lines would have to run virtually continuously.
 - For perspective, a 500-hp system running without boiler water additives would increase fuel requirements by about \$100,000.00. This would result in 2 additional tons of nitrogen oxide and 1 additional ton of sulfur dioxide released into the atmosphere each year. As corrosion builds up the efficiency of heat transfer decreases requiring more energy to run the boiler.
2. **Culinary steam filters** (as suggested by prior NOSB addendum Number 7 – Orlando, 1995) do not remove the volatile amines and therefore are not an alternative.
 3. Placing a **steam to steam heat exchanger** between the existing boiler water system and the production line system .
 - Not a solution for all applications, the temperature differential has to be sufficient to maintain the required temperature and pressure to serve the production system
 - The cost of installation would present a significant expense. (Average cost for a line of national distribution is \$500,000.00. Life span of equipment is 5-8 years.)

Beneficial effects to the environment from the use of the synthetic substance.

The environment benefits from the proper maintenance and boiler water treatment program. A poorly maintained boiler will increase fuel requirements as corrosion builds up and the efficiency of heat transfer decreases requiring more energy to run the boiler. These results in additional nitrogen oxide and sulfur dioxide release into the atmosphere and promotes an unsafe work environment due to deterioration and possible catastrophic steam into the work places.