Morpholine

sc-203142

Material Safety Data Sheet

Hazard Alert Code Key: EXTREME HIGH MODERATE LOW

Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME
Morpholine

STATEMENT OF HAZARDOUS NATURE
CONSIDERED A HAZARDOUS SUBSTANCE ACCORDING TO OSHA 29 CFR 1910.1200.

NFPA

SUPPLIER
Company: Santa Cruz Biotechnology, Inc.
Address:
2145 Delaware Ave
Santa Cruz, CA 95060
Telephone: 800.457.3801 or 831.457.3800
Emergency Tel: CHEMWATCH: From within the US and Canada: 877-715-9305
Emergency Tel: From outside the US and Canada: +800 2436 2255 (1-800-CHEMCALL) or call +613 9573 3112

PRODUCT USE
Solvent for resins, waxes, casein, dyes. Morpholine fatty acid salts are used as surface active agents and emulsifiers. Other morpholine compounds are used as corrosion inhibitors, antioxidants, plasticisers. Morpholine compounds are also used as viscosity improvers, insecticides, fungicides, herbicides, local anaesthetics and antiseptics. Morpholine has a volatility similar to water. It is therefore widely used as a neutralising amine in combating carbonic acid corrosion in condensate return lines in steam boiler systems as well as in aqueous hydraulic liquids and similar systems. Morpholine vapours protect silver and other metals against corrosion and tarnish by acid fumes such as SO2 and H2S. Corrosion of metal aerosol containers and valves can also be prevented by the use of low levels of morpholine. Morpholine is effective in hydraulic system fluids based on glycols, where various metals are in contact with the fluid at the same time. Morpholine derivatives have been used as corrosion inhibitors in mineral lubricating oil, turbine oils, for protecting storage tanks, pipes and other devices used in handling petroleum distillates, and for inhibiting the corrosive action of grease-proof paper on steel and other metals Intermediate

SYNONYMS
C4-H9-O-N, C4-H9-O-N, OCH2-CH2-NHCH2-CH2, "diethyleneimide oxide", "diethylene imideoxide", "diethylene oximide", "diethylenimide oxide", Drewamine, "p-isoxamine, tetrahydro-", "p-isoxamine, tetrahydro-", 1-oxa-4-azacyclohexane, 1-oxa-4-azacyclohexane, "2H-1, 4-oxazine, tetrahydro-", "2H-1, 4-oxazine, tetrahydro-", "4H-1, 4-oxazine, tetrahydro-", "4H-1, 4-oxazine, tetrahydro-", "tetrahydro-1, 4-isoxazine", "tetrahydro-1, 4-isoxazine", tetrahydro-p-oxazine, tetrahydro-p-oxazine, "tetrahydro-2H-1, 4-oxazine", "tetrahydro-2H-1, 4-oxazine", "BASF 238"

Section 2 - HAZARDS IDENTIFICATION

CANADIAN WHMIS SYMBOLS

EMERGENCY OVERVIEW

RISK

Causes burns.
Risk of serious damage to eyes.
HARMFUL - May cause lung damage if swallowed.
Harmful by inhalation, in contact with skin and if swallowed.
Flammable.

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS

SWALLOWED

■ The material can produce chemical burns within the oral cavity and gastrointestinal tract following ingestion.

■ Accidental ingestion of the material may be harmful; animal experiments indicate that ingestion of less than 150 gram may be fatal or may produce serious damage to the health of the individual.

■ Ingestion of alkaline corrosives may produce burns around the mouth, ulcerations and swellings of the mucous membranes, profuse saliva production, with an inability to speak or swallow. Both the esophagus and stomach may experience burning pain; vomiting and diarrhea may follow. Epiglottal swelling may result in respiratory distress and asphyxia; shock can occur. Narrowing of the esophagus, stomach or stomach valve may occur immediately or after a long delay (weeks to years). Severe exposure can perforate the esophagus or stomach leading to infections of the chest or abdominal cavity, with low chest pain, abdominal stiffness and fever. All of the above can cause death.

■ Amines without benzene rings when swallowed are absorbed throughout the gut. Corrosive action may cause damage throughout the gastrointestinal tract. They are removed through the liver, kidney and intestinal mucosa by enzyme breakdown.

EYE

■ The material can produce chemical burns to the eye following direct contact. Vapors or mists may be extremely irritating.

■ If applied to the eyes, this material causes severe eye damage.

■ Direct eye contact with corrosive bases can cause pain and burns. There may be swelling, epithelium destruction, clouding of the cornea and inflammation of the iris. Mild cases often resolve; severe cases can be prolonged with complications such as persistent swelling, scarring, permanent cloudiness, bulging of the eye, cataracts, eyelids glued to the eyeball and blindness.

■ Workers exposed to morpholine for several hours at low vapour concentrations complained of foggy vision with rings around lights (resulting in transient corneal oedema) which cleared within 3 to 4 hours after cessation of exposure.

■ Vapors of volatile amines irritate the eyes, causing excessive secretion of tears, inflammation of the conjunctiva and slight swelling of the cornea, resulting in "halos" around lights. This effect is temporary, lasting only for a few hours. However this condition can reduce the efficiency of undertaking skilled tasks, such as driving a car. Direct eye contact with liquid volatile amines may produce eye damage, permanent for the lighter species.

SKIN

■ The material can produce chemical burns following direct contactwith the skin.

■ Skin contact with the material may be harmful; systemic effects may resultfollowing absorption.

■ The material can produce severe chemical burns following direct contactwith the skin.

■ The material may cause moderate inflammation of the skin either following direct contact or after a delay of some time. Repeated exposure can cause contact dermatitis which is characterized by redness, swelling and blistering.

■ Skin contact with alkaline corrosives may produce severe pain and burns; brownish stains may develop. The corroded area may be soft, gelatinous and necrotic; tissue destruction may be deep.

■ Open cuts, abraded or irritated skin should not be exposed to this material.

■ Entry into the blood-stream, through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects. Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.

■ Concentrated morpholine readily permeates the skin. Dilutions of 25% or less represent less of a health hazard in relation to skin penetration.

INHALED

■ Inhalation of vapors or aerosols (mists, fumes), generated by the material during the course of normal handling, may be harmful.

■ The material can cause respiratory irritation in some persons. The body's response to such irritation can cause further lung damage.

■ Inhaling corrosive bases may irritate the respiratory tract. Symptoms include cough, choking, pain and damage to the mucous membrane. In severe cases, lung swelling may develop, sometimes after a delay of hours to days. There may be low blood pressure, a weak and rapid pulse, and crackling sounds.

- Inhalation of amine vapors may cause irritation of the mucous membrane of the nose and throat, and lung irritation with respiratory distress and cough. Swelling and inflammation of the respiratory tract is seen in serious cases; with headache, nausea, faintness and anxiety There may also be wheezing.
- Exposure to the morpholine vapour produces nasal and bronchial irritation (as with ammonia gas). Liver damage may also result. In rats very high vapour concentrations produced pulmonary oedema, liver necrosis and renal tubular damage. These effects only occurred when the vapour was intensely irritating.

CHRONIC HEALTH EFFECTS

- Repeated or prolonged exposure to corrosives may result in the erosion of teeth, inflammatory and ulcerative changes in the mouth and necrosis (rarely) of the jaw. Bronchial irritation, with cough, and frequent attacks of bronchial pneumonia may ensue. Gastrointestinal disturbances may also occur. Chronic exposures may result in dermatitis and/or conjunctivitis.

Long-term exposure to respiratory irritants may result in disease of the airways involving difficult breathing and related systemic problems.

There has been some concern that this material can cause cancer or mutations but there is not enough data to make an assessment.

Limited evidence suggests that repeated or long-term occupational exposure may produce cumulative health effects involving organs or biochemical systems.

Long term exposure to morpholine and some of its congeners may produce liver and kidney damage. Obvious evidence of chronic nasal irritation and inflammation and ocular injury (including retinal degeneration, corneal irritation, uveitis and corneal damage) has been documented in rats exposed to 150 ppm, 6 hours/day, 5 days/week for 104 weeks.

At sublethal doses, morpholine caused tearing of the eyes, irritation and inactivity. Repeated skin applications with morpholine caused skin, liver, and kidney injury in rabbits. Rats and guinea pigs exposed to 18,000 ppm morpholine exhibited eye and respiratory irritation. Repeated exposures caused lung, liver and kidney injury. In a 13-week inhalation study with rats morpholine caused nasal lesions at 100 and 250 ppm; no effects were seen at 25 ppm. In an industry sponsored study, morpholine was not carcinogenic to rats at 10, 50 or 100 ppm; but did cause opthalmic and nasal lesions.

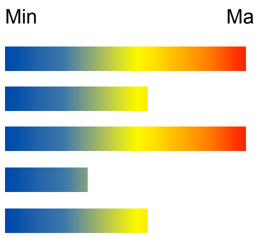
Earlier reports linking exposure to morpholine with an increased incidence of hepatocellular carcinoma and pulmonary angiosarcoma, probably resulted from exposure to the carcinogenic contaminant, N-nitrosomorpholine. It must be noted, however, that there is a potential to convert morpholine, (a secondary amine), in the body, to the potentially carcinogenic N-nitrosomorpholine. N-nitroso-compounds represent a major class of important chemical carcinogens and mutagens. The induction of tumours by single doses of these substances testify to their potency. Whilst it is difficult to extrapolate animal carcinogenicity data to humans, such data strongly suggests that these compounds are human carcinogens. As a rule the N-nitrosamines as a group are carcinogenic in a multitude of organs and tissues. This is also true for the individual N-nitrosamines where the tumour localisation does not depend only on the kind of nitrosamine but also the species and dose. Mostly, however, a preferred target organ (or even several) can be identified. This is frequently the liver. In animal experiments the oesophagus is shown to be the most important target organ for nitrosamines, independent of the route of application. The mechanism of this organotrophy cannot be explained sufficiently. The high oesophageal epithelium metabolic activation of nitrosamines, together with a comparatively low DNA repair, probably plays the most important role. In addition chronic stress factors, which lead to high stimulation of epithelial turnover, are a pacemaker for malignant progression. In some countries, the traditional consumption of extremely hot drinks leads to constant burns of the oesophagus, which increases the risk. Mate, a non-alcoholic brew, frequently consumed as tea in Uruguay, appears to be a high risk factor for oesophageal cancer.

Secondary amines may react with nitrites to form potentially carcinogenicN-nitrosamines.

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

HAZARD RATINGS

Flammability:	4
Toxicity:	2
Body Contact:	4
Reactivity:	1
Chronic:	2



Min/Nil=0
Low=1
Moderate=2
High=3
Extreme=4

NAME	CAS RN	%
morpholine	110-91-8	>99

Section 4 - FIRST AID MEASURES

SWALLOWED

■
- For advice, contact a Poisons Information Center or a doctor at once.
- Urgent hospital treatment is likely to be needed.
- If swallowed do NOT induce vomiting.
- If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration.
- Observe the patient carefully.
- Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious.
- Give water to rinse out mouth, then provide liquid slowly and as much as casualty can comfortably drink.
- Transport to hospital or doctor without delay.
- Avoid giving milk or oils.
- Avoid giving alcohol.
- If spontaneous vomiting appears imminent or occurs, hold patient's head down, lower than their hips to help avoid possible aspiration of vomitus.

EYE

■ If this product comes in contact with the eyes:
- Immediately hold eyelids apart and flush the eye continuously with running water.
- Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
- Continue flushing until advised to stop by the Poisons Information Center or a doctor, or for at least 15 minutes.
- Transport to hospital or doctor without delay.
- Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

SKIN

■ If skin or hair contact occurs:
- Immediately flush body and clothes with large amounts of water, using safety shower if available.
- Quickly remove all contaminated clothing, including footwear.
- Wash skin and hair with running water. Continue flushing with water until advised to stop by the Poisons Information Center.
- Transport to hospital, or doctor.

INHALED

■
- If fumes or combustion products are inhaled remove from contaminated area.
- Lay patient down. Keep warm and rested.
- Prostheses such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures.
- Apply artificial respiration if not breathing, preferably with a demand valve resuscitator, bag-valve mask device, or pocket mask as trained. Perform CPR if necessary.
- Transport to hospital, or doctor, without delay.

Inhalation of vapors or aerosols (mists, fumes) may cause lung edema. Corrosive substances may cause lung damage (e.g. lung edema, fluid in the lungs). As this reaction may be delayed up to 24 hours after exposure, affected individuals need complete rest (preferably in semi-recumbent posture) and must be kept under medical observation even if no symptoms are (yet) manifested. Before any such manifestation, the administration of a spray containing a dexamethasone derivative or beclomethasone derivative may be considered. This must definitely be left to a doctor or person authorized by him/her. (ICSC13719).

NOTES TO PHYSICIAN

■ Any material aspirated during vomiting may produce lung injury. Therefore emesis should not be induced mechanically or pharmacologically. Mechanical means should be used if it is considered necessary to evacuate the stomach contents; these include gastric lavage after endotracheal intubation. If spontaneous vomiting has occurred after ingestion, the patient should be monitored for difficult breathing, as adverse effects of aspiration into the lungs may be delayed up to 48 hours.

For acute or short-term repeated exposures to highly alkaline materials:
- Respiratory stress is uncommon but present occasionally because of soft tissue edema.
- Unless endotracheal intubation can be accomplished under direct vision, cricothyroidotomy or tracheotomy may be necessary.
- Oxygen is given as indicated.
- The presence of shock suggests perforation and mandates an intravenous line and fluid administration.
- Damage due to alkaline corrosives occurs by liquefaction necrosis whereby the saponification of fats and solubilization of proteins allow deep penetration into the tissue.

Alkalis continue to cause damage after exposure.

INGESTION:
- Milk and water are the preferred diluents

No more than 2 glasses of water should be given to an adult.
- Neutralizing agents should never be given since exothermic heat reaction may compound injury.

* Catharsis and emesis are absolutely contra-indicated.
* Activated charcoal does not absorb alkali.
* Gastric lavage should not be used.
Supportive care involves the following:

- Withhold oral feedings initially.
- If endoscopy confirms transmucosal injury start steroids only within the first 48 hours.
- Carefully evaluate the amount of tissue necrosis before assessing the need for surgical intervention.
- Patients should be instructed to seek medical attention whenever they develop difficulty in swallowing (dysphagia).

SKIN AND EYE:

- Injury should be irrigated for 20-30 minutes.
- Eye injuries require saline. [Ellenhorn & Barceloux: Medical Toxicology]

Section 5 - FIRE FIGHTING MEASURES

Vapor Pressure (mmHg):	9.751 @ 23 deg.C
Upper Explosive Limit (%):	11.0
Specific Gravity (water=1):	0.998 @ 20 C
Lower Explosive Limit (%):	1.8

EXTINGUISHING MEDIA

■

- Water spray or fog.
- Alcohol stable foam.
- Dry chemical powder.
- Carbon dioxide.

FIRE FIGHTING

■

- Alert Emergency Responders and tell them location and nature of hazard.
- May be violently or explosively reactive.
- Wear full body protective clothing with breathing apparatus.
- Prevent, by any means available, spillage from entering drains or water course.
- If safe, switch off electrical equipment until vapor fire hazard removed.
- Use water delivered as a fine spray to control fire and cool adjacent area.
- Avoid spraying water onto liquid pools.
- DO NOT approach containers suspected to be hot.
- Cool fire exposed containers with water spray from a protected location.
- If safe to do so, remove containers from path of fire.

GENERAL FIRE HAZARDS/HAZARDOUS COMBUSTIBLE PRODUCTS

■

- Liquid and vapor are flammable.
- Moderate fire hazard when exposed to heat or flame.
- Vapor forms an explosive mixture with air.
- Moderate explosion hazard when exposed to heat or flame.
- Vapor may travel a considerable distance to source of ignition.
- Heating may cause expansion or decomposition leading to violent rupture of containers.
- On combustion, may emit toxic fumes of carbon monoxide (CO).

Combustion products include: carbon dioxide (CO_2), carbon monoxide (CO), nitrogen oxides (NO_x), other pyrolysis products typical of burning organic material.
May emit corrosive fumes.

FIRE INCOMPATIBILITY

■ Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids,chlorine bleaches, pool chlorine etc. as ignition may result.

PERSONAL PROTECTION

Glasses:
Chemical goggles.
Full face- shield.

Section 6 - ACCIDENTAL RELEASE MEASURES

MINOR SPILLS

■

- Remove all ignition sources.
- Clean up all spills immediately.
- Avoid breathing vapors and contact with skin and eyes.
- Control personal contact by using protective equipment.
- Contain and absorb small quantities with vermiculite or other absorbent material.
- Wipe up.
- Collect residues in a flammable waste container.

MAJOR SPILLS

■ Chemical Class: amines, alkyl

For release onto land: recommended sorbents listed in order of priority.

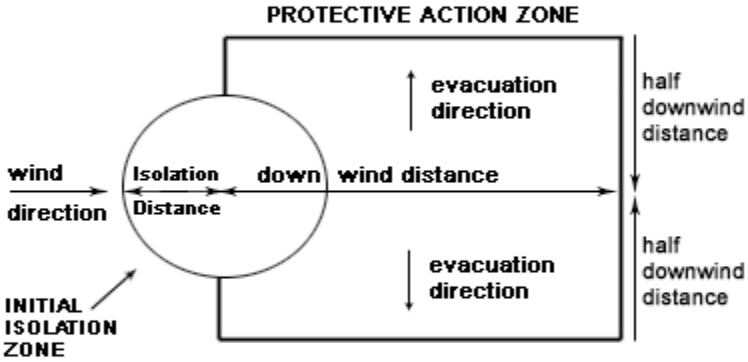
SORBENT TYPE	RANK	APPLICATION	COLLECTION	LIMITATIONS
LAND SPILL - SMALL				
cross-linked polymer - particulate	1	shovel	shovel	R, W, SS
cross-linked polymer - pillow	1	throw	pitchfork	R,DGC, RT
sorbent clay - particulate	2	shovel	shovel	R, I, P
wood fiber - pillow	3	throw	pitchfork	R, P, DGC, RT,
treated wood fibre - pillow	3	throw	pitchfork	DGC, RT
foamed glass - pillow	4	throw	pitchfork	R, P, DGC, RT
LAND SPILL - MEDIUM				
cross-linked polymer -particulate	1	blower	skiploader	R, W, SS
cross-linked polymer - pillow	2	throw	skiploader	R, DGC, RT
sorbent clay - particulate	3	blower	skiploader	R, I, P
polypropylene - particulate	3	blower	skiploader	W, SS, DGC
expanded mineral - particulate	4	blower	skiploader	R, I, W, P, DGC
polypropylene - mat	4	throw	skiploader	DGC, RT

Legend
DGC: Not effective where ground cover is dense
R; Not reusable
I: Not incinerable
P: Effectiveness reduced when rainy
RT:Not effective where terrain is rugged
SS: Not for use within environmentally sensitive sites
W: Effectiveness reduced when windy
Reference: Sorbents for Liquid Hazardous Substance Cleanup and Control;
R.W Melvold et al: Pollution Technology Review No. 150: Noyes Data Corporation 1988
NOTE:

- Organic absorbents have been known to ignite when contaminated with amines in closed containers. Certain cellulosic materials used for spill cleanup such as wood chips or sawdust have shown reactivity with ethyleneamines and should be avoided.
- Clear area of personnel and move upwind.
- Alert Emergency Responders and tell them location and nature of hazard.
- May be violently or explosively reactive.
- Wear breathing apparatus plus protective gloves.
- Prevent, by any means available, spillage from entering drains or water course.

- No smoking, naked lights or ignition sources. Increase ventilation.
- Stop leak if safe to do so.
- Water spray or fog may be used to disperse / absorb vapor.
- Contain spill with sand, earth or vermiculite.
- Use only spark-free shovels and explosion proof equipment.
- Collect recoverable product into labeled containers for recycling.
- Absorb remaining product with sand, earth or vermiculite.
- Collect solid residues and seal in labeled drums for disposal.
- Wash area and prevent runoff into drains.
- If contamination of drains or waterways occurs, advise emergency services.

PROTECTIVE ACTIONS FOR SPILL



From IERG (Canada/Australia)	
Isolation Distance	25 meters
Downwind Protection Distance	250 meters

FOOTNOTES

1 PROTECTIVE ACTION ZONE is defined as the area in which people are at risk of harmful exposure. This zone assumes that random changes in wind direction confines the vapour plume to an area within 30 degrees on either side of the predominant wind direction, resulting in a crosswind protective action distance equal to the downwind protective action distance.
2 PROTECTIVE ACTIONS should be initiated to the extent possible, beginning with those closest to the spill and working away from the site in the downwind direction. Within the protective action zone a level of vapour concentration may exist resulting in nearly all unprotected persons becoming incapacitated and unable to take protective action and/or incurring serious or irreversible health effects.
3 INITIAL ISOLATION ZONE is determined as an area, including upwind of the incident, within which a high probability of localised wind reversal may expose nearly all persons without appropriate protection to life-threatening concentrations of the material.
4 SMALL SPILLS involve a leaking package of 200 litres (55 US gallons) or less, such as a drum (jerrican or box with inner containers). Larger packages leaking less than 200 litres and compressed gas leaking from a small cylinder are also considered "small spills". LARGE SPILLS involve many small leaking packages or a leaking package of greater than 200 litres, such as a cargo tank, portable tank or a "one-tonne" compressed gas cylinder.
5 Guide 132 is taken from the US DOT emergency response guide book.
6 IERG information is derived from CANUTEC - Transport Canada.

ACUTE EXPOSURE GUIDELINE LEVELS (AEGL) (in ppm)

AEGL 1: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic nonsensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.
AEGL 2: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.
AEGL 3: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

Section 7 - HANDLING AND STORAGE

PROCEDURE FOR HANDLING

■

- DO NOT allow clothing wet with material to stay in contact with skin
- Avoid all personal contact, including inhalation.
- Wear protective clothing when risk of exposure occurs.
- Use in a well-ventilated area.
- WARNING: To avoid violent reaction, ALWAYS add material to water and NEVER water to material.
- Avoid smoking, naked lights or ignition sources.
- Avoid contact with incompatible materials.
- When handling, DO NOT eat, drink or smoke.
- Keep containers securely sealed when not in use.
- Avoid physical damage to containers.
- Always wash hands with soap and water after handling.
- Work clothes should be laundered separately.
- Launder contaminated clothing before re-use.
- Use good occupational work practice.
- Observe manufacturer's storing and handling recommendations.
- Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
- Containers, even those that have been emptied, may contain explosive vapors.
- Do NOT cut, drill, grind, weld or perform similar operations on or near containers.

RECOMMENDED STORAGE METHODS

■ Glass container.

- Lined metal can, Lined metal pail/drum
- Plastic pail
- Polyliner drum
- Packing as recommended by manufacturer.
- Check all containers are clearly labeled and free from leaks.

For low viscosity materials

- Drums and jerricans must be of the non-removable head type.
- Where a can is to be used as an inner package, the can must have a screwed enclosure.

For materials with a viscosity of at least 2680 cSt. (23 deg. C) and solids (between 15 C deg. and 40 deg C.):

- Removable head packaging;
- Cans with friction closures and
- low pressure tubes and cartridges may be used.

\- Where combination packages are used, and the inner packages are of glass, porcelain or stoneware, there must be sufficient inert cushioning material in contact with inner and outer packages unless the outer packaging is a close fitting molded plastic box and the substances are not incompatible with the plastic. Morpholine can be stored for an unlimited time in iron or steel containers if protected from atmospheric moisture and carbon dioxide. However, it is unstable in the presence of copper, zinc and their alloys and these metals should not be used in storage containers for morpholine.

STORAGE REQUIREMENTS

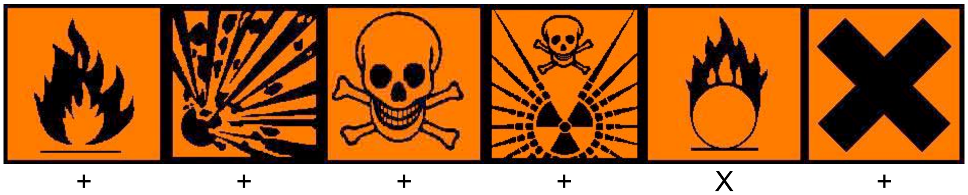
■

- Store in approved flammable liquid storage area.
- No smoking, naked lights/ignition sources.
- Keep containers securely sealed.
- Store away from incompatible materials in a cool, dry, well-ventilated area.
- Protect containers against physical damage and check regularly for leaks.
- Storage areas should be clearly identified, well illuminated, clear of obstruction and accessible only to trained and authorised personnel - adequate security must be provided so that unauthorised personnel do not have access.
- Store in grounded, properly designed and approved vessels and away from incompatible materials
- Store according to applicable regulations for flammable materials for storage tanks, containers, piping, buildings, rooms, cabinets, allowable quantities and minimum storage distances.
- Use non-sparking ventilation systems, approved explosion proof equipment and intrinsically safe electrical systems.
- Have appropriate extinguishing capability in storage area (e.g. portable fire extinguishers - dry chemical, foam or carbon dioxide) and flammable gas detectors.
- Keep adsorbents for leaks and spills readily available
- For bulk storages, consider use of floating roof or nitrogen blanketed vessels; where venting to atmosphere is possible, equip storage tank vents with flame arrestors; inspect tank vents during winter conditions for vapour/ ice build-up; storage tanks should be above ground and diked to hold entire contents

- Observe manufacturer's storing and handling recommendations.

DO NOT store near acids, or oxidizing agents.

SAFE STORAGE WITH OTHER CLASSIFIED CHEMICALS



X: Must not be stored together
O: May be stored together with specific preventions
+: May be stored together

Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE CONTROLS

Source	Material	TWA ppm	TWA mg/m^3	STEL ppm	STEL mg/m^3	Peak ppm	Peak mg/m^3	TWA F/CC	Notes
Canada - Alberta Occupational Exposure Limits	morpholine (Morpholine)	20	71						
Canada - British Columbia Occupational Exposure Limits	morpholine (Morpholine)	20							Skin
Canada - Ontario Occupational Exposure Limits	morpholine (Morpholine)	20	70	30	105				Skin
US OSHA Permissible Exposure Levels (PELs) - Table Z1	morpholine (Morpholine)	20	70						
US ACGIH Threshold Limit Values (TLV)	morpholine (Morpholine)	20							TLV Basis: eye damage; upper respiratory tract irritation
US NIOSH Recommended Exposure Limits (RELs)	morpholine (Morpholine)	20	70	30	105				
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants	morpholine (Morpholine)	20	70	30	105				
US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants	morpholine (Morpholine)	20	70						
US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants	morpholine (Morpholine)	20	70	30	105				
US - Minnesota Permissible Exposure Limits (PELs)	morpholine (Morpholine)	20	70	30	105				
US - California Permissible Exposure Limits for Chemical Contaminants	morpholine (Morpholine; tetrahydro-4H-1, 4-oxazine)	20	70	30	105				
US - Idaho - Limits for Air Contaminants	morpholine (Morpholine)	20	70						

US - Hawaii Air Contaminant Limits	morpholine (Morpholine)	20	70	30	105	
US - Alaska Limits for Air Contaminants	morpholine (Morpholine)	20	70	30	105	
US - Michigan Exposure Limits for Air Contaminants	morpholine (Morpholine)	20	70	30	105	
Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances	morpholine (Morpholine - Skin)	20	70	30	105	
US - Washington Permissible exposure limits of air contaminants	morpholine (Morpholine)	20		30		
Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits	morpholine (Morpholine)	20		30		Skin
Canada - Prince Edward Island Occupational Exposure Limits	morpholine (Morpholine)	20				TLV Basis: eye damage; upper respiratory tract irritation
US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants	morpholine (Morpholine)	20	70			
Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)	morpholine (Morpholine)	20	71			
US - Oregon Permissible Exposure Limits (Z1)	morpholine (Morpholine)	20	70			
Canada - Northwest Territories Occupational Exposure Limits (English)	morpholine (Morpholine - Skin)	20	70	30	105	
Canada - Nova Scotia Occupational Exposure Limits	morpholine (Morpholine)	20				TLV Basis: eye damage; upper respiratory tract irritation

EMERGENCY EXPOSURE LIMITS

Material	Revised IDLH Value (mg/m3)	Revised IDLH Value (ppm)
morpholine		1,400 [LEL]

NOTES
Values marked LEL indicate that the IDLH was based on 10% of the lower explosive limit for safety considerations even though the relevant toxicological data indicated that irreversible health effects or impairment of escape existed only at higher concentrations.

MATERIAL DATA

MORPHOLINE:

■ for morpholine:

Odour Threshold Value: 0.011 ppm (detection), 0.070 ppm (recognition)

Morpholine vapour irritates eyes, nose and throat, following repeated exposure of rats to 25 ppm. Exposure at or below the TLV-TWA is thought to significantly reduce the risk of eye and respiratory tract irritation in workers. Because morpholine permeates the skin, in sufficient quantities to produce systemic effects, a skin notation has been added.

Odour Safety Factor(OSF)

OSF=1E3 (MORPHOLINE).

PERSONAL PROTECTION

Consult your EHS staff for recommendations

EYE

■

- Chemical goggles.
- Full face shield.
- Contact lenses pose a special hazard; soft contact lenses may absorb irritants and all lenses concentrate them.

HANDS/FEET

■ Elbow length PVC gloves.

- When handling corrosive liquids, wear trousers or overalls outside of boots, to avoid spills entering boots.

Suitability and durability of glove type is dependent on usage. Important factors in the selection of gloves include: such as:

- frequency and duration of contact,
- chemical resistance of glove material,
- glove thickness and
- dexterity

Select gloves tested to a relevant standard (e.g. Europe EN 374, US F739).

- When prolonged or frequently repeated contact may occur, a glove with a protection class of 5 or higher (breakthrough time greater than 240 minutes according to EN 374) is recommended.
- When only brief contact is expected, a glove with a protection class of 3 or higher (breakthrough time greater than 60 minutes according to EN 374) is recommended.
- Contaminated gloves should be replaced.

Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturiser is recommended.

OTHER

■

- Overalls.
- PVC Apron.
- PVC protective suit may be required if exposure severe.
- Eyewash unit.
- Ensure there is ready access to a safety shower.
- Some plastic personal protective equipment (PPE) (e.g. gloves, aprons, overshoes) are not recommended as they may produce static electricity.
- For large scale or continuous use wear tight-weave non-static clothing (no metallic fasteners, cuffs or pockets), non sparking safety footwear.

GLOVE SELECTION INDEX

■ Glove selection is based on a modified presentation of the:

"Forsberg Clothing Performance Index".

The effect(s) of the following substance(s) are taken into account in the computer-generated selection: morpholine

■ Protective Material CPI *.

BUTYL	A
PVA	B
NATURAL RUBBER	C

■ * CPI - Chemwatch Performance Index

A: Best Selection

B: Satisfactory; may degrade after 4 hours continuous immersion

C: Poor to Dangerous Choice for other than short term immersion

NOTE: As a series of factors will influence the actual performance of the glove, a final selection must be based on detailed observation. -

* Where the glove is to be used on a short term, casual or infrequent basis, factors such as "feel" or convenience (e.g. disposability), may dictate a choice of gloves which might otherwise be unsuitable following long-term or frequent use. A qualified practitioner should be consulted.

RESPIRATOR

■ Selection of the Class and Type of respirator will depend upon the level of breathing zone contaminant and the chemical nature of the contaminant. Protection Factors (defined as the ratio of contaminant outside and inside the mask) may also be important.

Breathing Zone Level ppm (volume)	Maximum Protection Factor	Half-face Respirator	Full-Face Respirator
1000	10	AK-1	-
1000	50	-	AK-1
5000	50	Airline*	-
5000	100	-	AK-2
10000	100	-	AK-3
	100+		Airline* *

* - Continuous Flow ** - Continuous-flow or positive pressure demand.

The local concentration of material, quantity and conditions of use determine the type of personal protective equipment required.

Use appropriate NIOSH-certified respirator based on informed professional judgement. In conditions where no reasonable estimate of exposure can be made, assume the exposure is in a concentration IDLH and use NIOSH-certified full face pressure demand SCBA with a minimum service life of 30 minutes, or a combination full facepiece pressure demand SAR with auxiliary self-contained air supply. Respirators provided only for escape from IDLH atmospheres shall be NIOSH-certified for escape from the atmosphere in which they will be used.

ENGINEERING CONTROLS

■ Local exhaust ventilation usually required. If risk of overexposure exists, wear an approved respirator. Correct fit is essential to obtain adequate protection an approved self contained breathing apparatus (SCBA) may be required in some situations. Provide adequate ventilation in warehouse or closed storage area.

Air contaminants generated in the workplace possess varying "escape" velocities which, in turn, determine the "capture velocities" of fresh circulating air required to effectively remove the contaminant.

Type of Contaminant:	Air Speed:
solvent, vapors, degreasing etc., evaporating from tank (in still air).	0.25-0.5 m/s (50-100 f/min.)
aerosols, fumes from pouring operations, intermittent container filling, low speed conveyer transfers, welding, spray drift, plating acid fumes, pickling (released at low velocity into zone of active generation)	0.5-1 m/s (100-200 f/min.)
direct spray, spray painting in shallow booths, drum filling, conveyer loading, crusher dusts, gas discharge (active generation into zone of rapid air motion)	1-2.5 m/s (200-500 f/min.)
grinding, abrasive blasting, tumbling, high speed wheel generated dusts (released at high initial velocity into zone of very high rapid air motion).	2.5-10 m/s (500-2000 f/min.)

Within each range the appropriate value depends on:

Lower end of the range	Upper end of the range
1: Room air currents minimal or favorable to capture	1: Disturbing room air currents
2: Contaminants of low toxicity or of nuisance value only.	2: Contaminants of high toxicity
3: Intermittent, low production.	3: High production, heavy use
4: Large hood or large air mass in motion	4: Small hood-local control only

Simple theory shows that air velocity falls rapidly with distance away from the opening of a simple extraction pipe. Velocity generally decreases with the square of distance from the extraction point (in simple cases). Therefore the air speed at the extraction point should be adjusted, accordingly, after reference to distance from the contaminating source. The air velocity at the extraction fan, for example, should be a minimum of 1-2 m/s (200-400 f/min) for extraction of solvents generated in a tank 2 meters distant from the extraction point. Other mechanical considerations, producing performance deficits within the extraction apparatus, make it essential that theoretical air velocities are multiplied by factors of 10 or more when extraction systems are installed or used.

Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL PROPERTIES

Liquid.
Mixes with water.
Corrosive.
Alkaline.

State	Liquid	Molecular Weight	87.12
Melting Range (°F)	23	Viscosity	2.230 cSt@40°C
Boiling Range (°F)	264.02	Solubility in water (g/L)	Miscible
Flash Point (°F)	100.4	pH (1% solution)	11.0 @ 25% soln.
Decomposition Temp (°F)	Not Available	pH (as supplied)	Not available
Autoignition Temp (°F)	590	Vapor Pressure (mmHg)	9.751 @ 23 deg.C
Upper Explosive Limit (%)	11.0	Specific Gravity (water=1)	0.998 @ 20 C
Lower Explosive Limit (%)	1.8	Relative Vapor Density (air=1)	3.0
Volatile Component (%vol)	Not available.	Evaporation Rate	Slow

APPEARANCE

Mobile, oily, hygroscopic liquid, with characteristic "fishy" amine odour. A mild base. Mixes with water, acetone, benzene, ether, castor oil, ethanol, ethylene glycol, 2-hexanone, linseed oil, turpentine, pine oil. Viscosity @ 20 deg.C, cp : 2.23

Section 10 - CHEMICAL STABILITY

CONDITIONS CONTRIBUTING TO INSTABILITY

■

- Presence of incompatible materials.
- Product is considered stable.
- Hazardous polymerization will not occur.

STORAGE INCOMPATIBILITY

■ Morpholine

- reacts violently with strong oxidising and may ignite
- reacts violently with acids, cellulose nitrate, nitromethane
- reacts with aqueous solutions of nitrite or gaseous nitrogen oxides to form N-nitrosomorpholine (NMOR)
- reacts with inorganic acids and acid gases such as CO2, H2S or HCN to form morpholine salts
- can react with oxidising agents, undergo direct chlorination, and form complexes with metallic halides
- reacts with carboxylic acids, anhydrides, chlorides and esters to form morpholides -alkyl morpholides are formed by reaction with alkyl halides, dialkyl sulfates, or trialkyl phosphates; the N-alkylmorpholides (N-methyl- and N-ethyl- morpholides) are used polyurethane catalysts
- reacts with formaldehyde to form N-formlymorpholine (a selective solvent for aromatic compound extraction)
- is incompatible with organic anhydrides, isocyanates, vinyl acetate, acrylates, substituted allyls, alkylene oxides, epichlorohydrin, ketones, aldehydes, alcohols, glycols, phenols, cresols, caprolactam solution, nitrocompounds, perchlorates
- reacts with fatty acids to form soaps used in household and automotive waxes and polishes
- reacts with sulfur and sulfur-containing compounds to produce vulcanising agents
- attacks coper, lead, tin, zinc, and their alloys, and some plastics, rubber and coatings
- Avoid oxidizing agents, acids, acid chlorides, acid anhydrides.
- Avoid contact with copper, aluminium and their alloys.

For incompatible materials - refer to Section 7 - Handling and Storage.

Section 11 - TOXICOLOGICAL INFORMATION

morpholine

TOXICITY AND IRRITATION

■ unless otherwise specified data extracted from RTECS - Register of Toxic Effects of Chemical Substances.

TOXICITY	IRRITATION
Oral (rat) LD50: 1050 mg/kg	Skin (rabbit): 995 mg/24hr-SEVERE
Inhalation (rat) LC50: 8000 ppm/8 hr	Skin (rabbit):500mg open-Moderate
Dermal (rabbit) LD50: 500 mg/kg	Eye (rabbit): 2 mg - SEVERE
Oral (Rat) LD50: 1450 mg/kg	
Oral (Mouse) LD50: 525 mg/kg	
Inhalation (Mouse) LC50: 1320 mg/m^3/2h	
Intraperitoneal (Mouse) LD50: 413 mg/kg	
Subcutaneous (Mouse) LD50: 458 mg/kg	
Oral (Guinea) pig: LD 100 mg/kg	

■ Asthma-like symptoms may continue for months or even years after exposure to the material ceases. This may be due to a non-allergenic condition known as reactive airways dysfunction syndrome (RADS) which can occur following exposure to high levels of highly irritating compound. Key criteria for the diagnosis of RADS include the absence of preceding respiratory disease, in a non-atopic individual, with abrupt onset of persistent asthma-like symptoms within minutes to hours of a documented exposure to the irritant. A reversible airflow pattern, on spirometry, with the presence of moderate to severe bronchial hyperreactivity on methacholine challenge testing and the lack of minimal lymphocytic inflammation, without eosinophilia, have also been included in the criteria for diagnosis of RADS. RADS (or asthma) following an irritating inhalation is an infrequent disorder with rates related to the concentration of and duration of exposure to the irritating substance. Industrial bronchitis, on the other hand, is a disorder that occurs as result of exposure due to high concentrations of irritating substance (often particulate in nature) and is completely reversible after exposure ceases. The disorder is characterised by dyspnea, cough and mucus production.

The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

The material may cause severe skin irritation after prolonged or repeated exposure and may produce on contact skin redness, swelling, the production of vesicles, scaling and thickening of the skin. Repeated exposures may produce severe ulceration.

for morpholine:

There have been no reports on incidents of acute poisoning or on the effects of short- or long-term exposure to morpholine by the general population. The phenomenon known as blue vision or glaucopsia, as well as some instances of skin and respiratory tract irritation, have been described in reports of occupational exposure to morpholine; however, no atmospheric concentrations of morpholine were given. It was reported that the number of chromosomal aberrations in the lymphocytes of peripheral blood of workers exposed for 3-10 years to morpholine at concentrations of 0.54-0.93 mg/m3 did not differ significantly from controls. Undiluted morpholine is strongly irritant to skin; a dilute solution (1 to 40) was mildly irritant. The potential carcinogenicity of morpholine in exposed human populations has not been investigated.

Morpholine is absorbed after oral, dermal and inhalation exposure. In the rat following oral and intravenous administration, morpholine is rapidly distributed, the highest concentrations being found in the intestine and muscle. In the rabbit, following intravenous and inhalation exposure, morpholine is preferentially distributed to the kidneys, lower concentrations reaching the lung, liver and blood. Morpholine does not bind significantly to plasma proteins. Plasma half-lives have been reported to be 115 (rat), 120 (hamster), and 300 min (guinea-pig). Morpholine is excreted mainly via the renal route, as the unchanged compound, in a variety of species. One day after administration, 70-90% of morpholine was found in urine. Neutralisation of morpholine enhances the rate of excretion of the compound. A small percentage of morpholine is excreted in expired air and faeces. Studies in rats, mice, hamster and rabbit indicate that morpholine is eliminated almost completely as the unmetabolised compound. In the guinea-pig, N-methylation followed by N-oxidation can occur, with up to 20% of the administered dose being metabolized. In the presence of nitrite, morpholine can be converted to NMOR both in vitro and in vivo. Depending on the dose, 0-12% of morpholine administered to rats with nitrites may be nitrosated. Immunostimulation, involving macrophage activation, may increase the extent of nitrosation.

Morpholine is not highly toxic under conditions of acute exposure. The LD50 after oral administration is 1-1.9 g/kg body weight in rats and 0.9 g/kg body weight in guinea-pigs. LC50 values of 7.8 mg/m3 (rats) and 4.9-6.9 g/m3 (mice) have been reported. In the conditions of short-term and long-term inhalation exposure, the critical effects appear to be irritation of the eyes and respiratory tract. A concentration of 90 mg/m3 may be considered the NOAEL in the conditions of the 13-week experiment in rats (6 h/day, 5 days/week). In a long-term inhalation study (104 weeks), increased incidences of inflammation of the cornea, and inflammation and necrosis of the nasal cavity were observed in rats at 540 mg/m3. Increased incidence of irritation of eyes and nose was also observed at 36 and 180 mg/m3. High exposures to morpholine causes severe damage to the liver and kidneys of rats and guinea-pigs. Fatty degeneration of the liver was reported in rats after feeding morpholine (0.5 g/kg body weight) daily for 56 days. When administered morpholine oleic acid salt in the drinking-water at a dose of about 0.7 g/kg body weight per day for 13 weeks, mice showed cloudy swelling of the kidney proximal tubules. Decreased body weight gain was observed in female mice in the long- term (672 days) feeding experiment at dose levels between 0.05 and 0.4 g morpholine (as oleic acid salt). At the reported levels of the present occupational and environmental exposures, morpholine does not seem to create any significant risk of systemic toxic effects. Local effects (irritation) of the eyes and respiratory tract may occur in non-controlled occupational and incidental exposures to high concentrations of airborne morpholine, and skin irritation may result from contact with liquid (even diluted) morpholine.

Morpholine does not appear to be mutagenic or carcinogenic in animals. However, it can be easily nitrosated to form NMOR, which is mutagenic and carcinogenic in several species of experimental animals. Morpholine fed to rats sequentially with nitrite caused an increase in tumours, mostly hepatocellular carcinoma and sarcomas of the liver and lungs. It is therefore prudent to consider exposure to morpholine as increasing the carcinogenic risk in exposed populations.

The substance is classified by IARC as Group 3:

NOT classifiable as to its carcinogenicity to humans.
Evidence of carcinogenicity may be inadequate or limited in animal testing.

CARCINOGEN

Morpholine	International Agency for Research on Cancer (IARC) - Agents Reviewed by the IARC Monographs	Group	3
Morpholine	US ACGIH Threshold Limit Values (TLV) - Carcinogens	Carcinogen Category	A4

SKIN

morpholine	Canada - Ontario Occupational Exposure Limits - Skin	Notes	Skin
morpholine	US AIHA Workplace Environmental Exposure Levels (WEELs) - Skin	Notes	Skin
morpholine	US NIOSH Recommended Exposure Limits (RELs) - Skin	Skin	Yes
morpholine	Canada - Quebec Permissible Exposure Values for Airborne Contaminants - Skin (French)	Notes	Skin
morpholine	US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants - Skin	Skin Designation	X
morpholine	US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants - Skin	Skin Designation	X
morpholine	US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants - Skin	Skin Designation	X
morpholine	US - Washington Permissible exposure limits of air contaminants - Skin	Skin	X
morpholine	US ACGIH Threshold Limit Values (TLV) - Skin	Skin Designation	Yes
morpholine	Canada - British Columbia Occupational Exposure Limits - Skin	Notation	Skin
morpholine	US - Minnesota Permissible Exposure Limits (PELs) - Skin	Skin Designation	X
morpholine	US - Hawaii Air Contaminant Limits - Skin Designation	Skin Designation	X
morpholine	ND	Skin Designation	X
morpholine	US OSHA Permissible Exposure Levels (PELs) - Skin	Skin Designation	X
morpholine	US - California Permissible Exposure Limits for Chemical Contaminants - Skin	Skin	X
morpholine	US - California Permissible Exposure Limits for Chemical Contaminants - Skin	Skin	S
morpholine	Canada - Alberta Occupational Exposure Limits - Skin	Substance Interaction	1

Section 12 - ECOLOGICAL INFORMATION

Refer to data for ingredients, which follows:
MORPHOLINE:

■ Fish LC50 (96hr.) (mg/l):	350- 400
■ Algae IC50 (72hr.) (mg/l):	1.7- 4.1
■ log Kow (Prager 1995):	0.42
■ log Pow (Verschueren 1983):	- 1.08
■ BOD5:	0.02 (0.9%
■ ThOD:	2.6

■ for morpholine:
log Kow: -1.08- -0.86
Koc: 8
Half-life (hr) air: 4
Henry's atm m3 /mol: 1.41E-07

BOD 5: 0.02,0.9%
ThOD: 2.6
Environmental fate:
Morpholine is chemically stable in the biosphere although it is subject to chemical and biological nitrosation to N-nitosomorpholine (NMOR). Morpholine is inherently biodegradable. Under the conditions of model activated sludge plants, morpholine is biodegradable. However, under non-adapted conditions there is probably no significant degradation of morpholine. The mean solid retention time in activated sludge plants is of crucial importance and must be over 8 days if reliable morpholine degradation is to be achieved. Morpholine seems to be degraded only by a restricted range of microbes, mostly Mycobacterium spp., which have specially adapted (acclimated) themselves to this substrate under specific conditions
There are inadequate data on the bioaccumulation of morpholine in aquatic and terrestrial organisms. From the n-octanol/water partition coefficient for morpholine (log Kow = -2.55 at pH7), no bioaccumulation would be expected.
Morpholine is released into the environment through volatilisation. It is quickly adsorbed by moisture. The main compartment for accumulation of morpholine is therefore the hydrosphere. The limited data suggest that morpholine does not accumulate in the hydrosphere.
Photochemical degradation Amines react rapidly with hydroxyl radicals, and the irradiation of amine-Nox mixtures in air results in the rapid conversion of NO to NO2 and in the formation of ozone, carbonyls and other products . The rate constant for the degradation of morpholine in the atmosphere by hydroxyl radicals has not yet been measured experimentally. A rate constant of 2-10 × 10-11 cm3.mol-1.sec-1 has been postulated; a half-life (for morpholine) of less than one day has been calculated. As morpholine shows no absorption in the UV spectrum (lambda > 260 nm), direct photochemical degradation in the atmosphere or in the hydrosphere is unlikely
Physicochemical degradation: Upon combustion in the presence of sufficient oxygen, carbon monoxide, carbon dioxide and nitrogen gases are produced. Combustion under oxygen-starved conditions can result in the production of carbon monoxide, hydrogen cyanide, nitriles, cyanic acid, isocyanates, cyanogens, nitrosamines, amides and carbamates
As morpholine is freely miscible with water, a Henry's constant cannot be reliably calculated. However, estimates for this constant have been published. The distribution coefficient (between vapour and liquid phase) for morpholine as a function of temperature (50 to 130 C) has been measured. The rate of volatilisation was dependent on the concentration of morpholine in the liquid phase. Extrapolation of the curve to 20 C for morpholine concentrations of 10-15 mg per litre gives a value of 0.02, corresponding to a Henry constant value of 49 Pa.m3.mol-1. Calculations give a value corresponding to 244 Pa.m3.mol-1.
Hydrolytic degradation Morpholine can thermally decompose at temperatures used in boiler steam cycles. At 316 C, morpholine decomposed in 12 h by 2-5% only, when used in boilers at 95 kg/cm2 and 108 kg/cm2, the decomposition products being ammonia and carbonic acid products.
Ecotoxicity:
Among the aquatic organisms tested, certain cyanobacteria (Microcystis) and unicellular green algae (Scenedesmus) appear to be the most sensitive taxa as toxicity threshold values (criterion: inhibition of population growth) of 1.7 mg/litre for Microcystis and 4.1 mg/litre for Scenedesmus have been reported (duration of exposure: 8 days). Aerobic bacteria like Pseudomonas proved to be much more resistant: the 16-h toxicity threshold and the NOEC for population growth have been cited as 310 and 8700 mg/litre, respectively. However, 1000 mg/litre inhibited respiration and dehydrogenase activity (up to 20%) in activated sludge from industrial treatment plants. Among aquatic protozoans tested , representatives of the genera Entosiphon and Chilomonas (with threshold values of 12 and 18 mg/litre, respectively, for the inhibition of population growth) turned out to be the most sensitive. The 24-h EC values (E=immobilisation) for Daphnia were in the range of 100-120 mg/litre. The 48- to 96-h LC50 values reported for fish tested in fresh, brackish or seawater were > 180 mg/litre, rainbow trout being the most sensitive species.
■ Prevent, by any means available, spillage from entering drains or watercourses.
■ DO NOT discharge into sewer or waterways.

Ecotoxicity

Ingredient	Persistence: Water/Soil	Persistence: Air	Bioaccumulation	Mobility
morpholine	LOW		LOW	HIGH

Section 13 - DISPOSAL CONSIDERATIONS

US EPA Waste Number & Descriptions

A. General Product Information
Ignitability characteristic: use EPA hazardous waste number D001 (waste code I)
Corrosivity characteristic: use EPA hazardous waste number D002 (waste code C)

Disposal Instructions

All waste must be handled in accordance with local, state and federal regulations.
¦ Puncture containers to prevent re-use and bury at an authorized landfill.
Legislation addressing waste disposal requirements may differ by country, state and/ or territory. Each user must refer to laws operating in their area. In some areas, certain wastes must be tracked.
A Hierarchy of Controls seems to be common - the user should investigate:

- Reduction
- Reuse

- Recycling
- Disposal (if all else fails)

This material may be recycled if unused, or if it has not been contaminated so as to make it unsuitable for its intended use. If it has been contaminated, it may be possible to reclaim the product by filtration, distillation or some other means. Shelf life considerations should also be applied in making decisions of this type. Note that properties of a material may change in use, and recycling or reuse may not always be appropriate.

DO NOT allow wash water from cleaning equipment to enter drains. Collect all wash water for treatment before disposal.

- Recycle wherever possible.
- Consult manufacturer for recycling options or consult Waste Management Authority for disposal if no suitable treatment or disposal facility can be identified.
- Treat and neutralize at an approved treatment plant.
- Treatment should involve: Neutralization with suitable dilute acid followed by: Burial in a licensed land-fill or Incineration in a licensed apparatus
- Decontaminate empty containers. Observe all label safeguards until containers are cleaned and destroyed.

Section 14 - TRANSPORTATION INFORMATION

DOT:

Symbols:	None	Hazard class or Division:	8
Identification Numbers:	UN2054	PG:	I
Label Codes:	8, 3	Special provisions:	A6, T10, TP2
Packaging: Exceptions:	None	Packaging: Non-bulk:	201
Packaging: Exceptions:	None	Quantity limitations: Passenger aircraft/rail:	0.5 L
Quantity Limitations: Cargo aircraft only:	2.5 L	Vessel stowage: Location:	A
Vessel stowage: Other:	None		

Hazardous materials descriptions and proper shipping names:
Morpholine

Air Transport IATA:

ICAO/IATA Class:	8 (3)	ICAO/IATA Subrisk:	None
UN/ID Number:	2054	Packing Group:	I
Special provisions:	None		

Shipping Name: MORPHOLINE

Maritime Transport IMDG:

IMDG Class:	8	IMDG Subrisk:	3
UN Number:	2054	Packing Group:	I
EMS Number:	F-E,S-C	Special provisions:	None
Limited Quantities:	None		

Shipping Name: MORPHOLINE

Section 15 - REGULATORY INFORMATION

morpholine (CAS: 110-91-8) is found on the following regulatory lists;

"Canada - Alberta Occupational Exposure Limits","Canada - British Columbia Occupational Exposure Limits","Canada - Northwest Territories Occupational Exposure Limits (English)","Canada - Nova Scotia Occupational Exposure Limits","Canada - Ontario Occupational Exposure Limits","Canada - Prince Edward Island Occupational Exposure Limits","Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)","Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits","Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances","Canada Domestic Substances List (DSL)","Canada Ingredient Disclosure List (SOR/88-64)","Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (English)","Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (French)","GESAMP/EHS Composite List - GESAMP Hazard Profiles","IMO IBC Code Chapter 17: Summary of minimum requirements","IMO MARPOL 73/78 (Annex II) - List of Noxious Liquid Substances Carried in Bulk","International Agency for Research on Cancer (IARC) - Agents Reviewed by the IARC Monographs","International Council of Chemical Associations (ICCA) - High Production Volume List","OECD Representative List of High Production Volume (HPV) Chemicals","US - Alaska Limits for Air Contaminants","US - California Occupational Safety and Health Regulations (CAL/OSHA) - Hazardous Substances List","US - California Permissible Exposure Limits for Chemical Contaminants","US - Connecticut Hazardous Air Pollutants","US - Hawaii Air Contaminant Limits","US - Idaho - Limits for Air Contaminants","US - Massachusetts Oil & Hazardous Material List","US - Michigan Exposure Limits for Air Contaminants","US - Minnesota Hazardous Substance List","US - Minnesota Permissible Exposure Limits (PELs)","US - New Jersey Right to Know Hazardous Substances","US - Oregon Permissible Exposure Limits (Z1)","US - Rhode Island Hazardous Substance List","US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants","US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants","US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants","US - Washington Permissible exposure limits of air contaminants","US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants","US ACGIH Threshold Limit Values (TLV)","US ACGIH Threshold Limit Values (TLV) - Carcinogens","US Cosmetic Ingredient Review (CIR) Cosmetic ingredients with insufficient data to support safety","US DOE Temporary Emergency Exposure Limits (TEELs)","US EPA High Production Volume Program Chemical List","US EPA Master Testing List - Index I Chemicals Listed","US EPA Master Testing List - Index II Chemicals Removed","US FDA Indirect Food Additives: Adhesives and Components of Coatings - Substances for Use Only as Components of Adhesives - Adhesives","US Food Additive Database","US NIOSH Recommended Exposure Limits (RELs)","US OSHA Permissible Exposure Levels (PELs) - Table Z1","US Postal Service (USPS) Hazardous Materials Table: Postal Service Mailability Guide","US Toxic Substances Control Act (TSCA) - Inventory"

Section 16 - OTHER INFORMATION

LIMITED EVIDENCE

- Cumulative effects may result following exposure*.
- Limited evidence of a carcinogenic effect*.

* (limited evidence).

- Classification of the mixture and its individual components has drawn on official and authoritative sources as well as independent review by the Chemwatch Classification committee using available literature references.
A list of reference resources used to assist the committee may be found at:
www.chemwatch.net/references.

- The (M)SDS is a Hazard Communication tool and should be used to assist in the Risk Assessment. Many factors determine whether the reported Hazards are Risks in the workplace or other settings. Risks may be determined by reference to Exposures Scenarios. Scale of use, frequency of use and current or available engineering controls must be considered.

Issue Date: Aug-11-2008

Print Date:May-6-2010