

Acrolein

sc-214491

Material Safety Data Sheet



The Power is Question

Hazard Alert Code Key:

EXTREME

HIGH

MODERATE

LOW

Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME

Acrolein

STATEMENT OF HAZARDOUS NATURE

CONSIDERED A HAZARDOUS SUBSTANCE ACCORDING TO OSHA 29 CFR 1910.1200.

NFPA



SUPPLIER

Santa Cruz Biotechnology, Inc.
2145 Delaware Avenue
Santa Cruz, California 95060
800.457.3801 or 831.457.3800

EMERGENCY:

ChemWatch
Within the US & Canada: 877-715-9305
Outside the US & Canada: +800 2436 2255
(1-800-CHEMCALL) or call +613 9573 3112

SYNONYMS

C3-H4-O, H2C=CCHO, prop-2-en-1-al, 2-propen-1-one, "propylene aldehyde", Acquinite, acraldehyde, trans-acrolein, acrylaldehyde, "acrylic aldehyde", "allyl aldehyde", Aqualin, biocide, Crolean, "ethylene aldehyde", Magnacide, "Magnacide H", propenal, 2-propenal, Slimicide

Section 2 - HAZARDS IDENTIFICATION

CHEMWATCH HAZARD RATINGS

		Min	Max
Flammability:	4		
Toxicity:	4		
Body Contact:	3		
Reactivity:	2		
Chronic:	3		

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



CANADIAN WHMIS SYMBOLS



EMERGENCY OVERVIEW

RISK

Very toxic by inhalation.

Causes burns.

Risk of serious damage to eyes.

HARMFUL - May cause lung damage if swallowed.

Toxic in contact with skin and if swallowed.

Highly flammable.

Very toxic to aquatic organisms.

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS

SWALLOWED

- Toxic effects may result from the accidental ingestion of the material; animal experiments indicate that ingestion of less than 40 gram may be fatal or may produce serious damage to the health of the individual.
- The material can produce chemical burns within the oral cavity and gastrointestinal tract following ingestion.
- Swallowing of the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis; serious consequences may result. (ICSC13733).
- Ingestion of acrolein may cause severe gastrointestinal distress with pulmonary congestion and oedema in some individuals.

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.
- Irritation of the eyes may produce a heavy secretion of tears (lachrymation).
- Splashes of acrolein, in the eye, can cause corneal damage, palpebral damage and purulent discharge. 1 ppm of acrolein produces marked irritation of eyes and nose in 5 minutes or less.
- Precautions for handling reactive unsaturated aldehydes should be the same as for those of highly active eye and pulmonary irritants such as phosgene. Sufficient engineering controls, with monitoring where possible, are of importance.

SKIN

- Skin contact with the material may produce toxic effects; systemic effects may result following absorption.
- The material can produce chemical burns following direct contact with the skin.
- 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.
- 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.

INHALED

- If inhaled, this material can irritate the throat and lungs of some persons.
- Inhalation of vapors or aerosols (mists, fumes), generated by the material during the course of normal handling, may produce severely toxic effects; these may be fatal.
- Inhalation of vapours may cause drowsiness and dizziness. This may be accompanied by narcosis, reduced alertness, loss of reflexes, lack of coordination and vertigo.
- Severe inhalation exposure to acrolein may result in shortness of breath, nausea, pulmonary oedema, tracheobronchitis, vomiting, diarrhoea, prostration and loss of consciousness. The irritation threshold of acrolein in man is reported to be 0.25 ppm to all mucous membranes within 5 minutes and fatalities have been reported at concentrations of 10 ppm, with 150 ppm being lethal after 10 minutes exposure.
- Exposure to aldehydes causes neurological symptoms such as headache, drowsiness, dizziness, seizures, depression and coma. Cardiovascular involvement may result in increased heart rate, collapse and low blood pressure; respiratory effects include throat spasms, irritation, difficulty swallowing, pulmonary edema and an asthma-like condition. Gastrointestinal signs include nausea, blood in vomit, diarrhea, ulcers and abdominal pain. Massive exposures may damage the kidney and liver.

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.

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.

There is limited evidence that, skin contact with this product is more likely to cause a sensitization reaction in some persons compared to the general population.

There is some evidence that human exposure to the material may result in developmental toxicity. This evidence is based on animal studies where effects have been observed in the absence of marked maternal toxicity, or at around the same dose levels as other toxic effects but which are not secondary non-specific consequences of the other toxic effects.

Lungs of monkeys exposed repeatedly to low concentrations of acrolein (0.7 ppm) showed chronic inflammatory changes, including necrotising bronchitis and emphysema. In some animals non-specific inflammation was seen in liver and kidney with focal calcification of

renal tubular epithelium. Monkeys, dogs and guinea pigs exposed continuously to concentrations of 0.22 ppm for 90 days did not exhibit toxic symptoms. At autopsy however many animals showed emphysema, and non-specific inflammatory changes in liver, lung, kidney and heart. Glycidaldehyde, a potential metabolite of acrolein, is considered to be a carcinogen. Exposure to Aliphatic aldehydes can cause irritation of the skin.

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

NAME	CAS RN	%
acrolein	107-02-8	>98
inhibitor *		0.10-0.025
* inhibited (typically) by		
hydroquinone	123-31-9	

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.

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 formaldehyde:

INGESTION:

· Patients present early with severe corrosion of the gastro-intestinal tract and systemic effects.
 · Inflammation and ulceration may progress to strictures.
 · Severe acidosis results from rapid conversion of formaldehyde to formic acid. Coma, hypotension, renal failure and apnea complicate ingestion.
 · Decontaminate by dilution with milk or water containing ammonium acetate; vomiting should be induced. Follow with gastric lavage using a weak ammonia solution (converts formaldehyde to relatively inert pentamethylenetetramine)
 · Gastric lavage is warranted only in first 15 minutes following ingestion.

SKIN:

· Formaldehyde can combine with epidermal protein to produce a hapten-protein complex capable of sensitizing T-lymphocytes. Subsequent exposures cause a type IV hypersensitivity reaction (i.e. allergic contact dermatitis).
 [Ellenhorn Barceloux: Medical Toxicology].

for poisons (where specific treatment regime is absent):

BASIC TREATMENT

· Establish a patent airway with suction where necessary.
 · Watch for signs of respiratory insufficiency and assist ventilation as necessary.
 · Administer oxygen by non-rebreather mask at 10 to 15 l/min.
 · Monitor and treat, where necessary, for pulmonary edema.
 · Monitor and treat, where necessary, for shock.
 · Anticipate seizures.
 · DO NOT use emetics. Where ingestion is suspected rinse mouth and give up to 200 ml water (5 ml/kg recommended) for dilution where patient is able to swallow, has a strong gag reflex and does not drool.

ADVANCED TREATMENT

- Consider orotracheal or nasotracheal intubation for airway control in unconscious patient or where respiratory arrest has occurred.
- Positive-pressure ventilation using a bag-valve mask might be of use.
- Monitor and treat, where necessary, for arrhythmias.
- Start an IV D5W TKO. If signs of hypovolemia are present use lactated Ringers solution. Fluid overload might create complications.
- Drug therapy should be considered for pulmonary edema.
- Hypotension with signs of hypovolemia requires the cautious administration of fluids. Fluid overload might create complications.
- Treat seizures with diazepam.
- Proparacaine hydrochloride should be used to assist eye irrigation.

BRONSTEIN, A.C. and CURRANCE, P.L.

EMERGENCY CARE FOR HAZARDOUS MATERIALS EXPOSURE: 2nd Ed. 1994.

Formaldehyde intoxications often bear similarity to those produced by acrolein.

Section 5 - FIRE FIGHTING MEASURES

Vapor Pressure (mmHg):	219.993 @ 20C
Upper Explosive Limit (%):	31.0
Specific Gravity (water=1):	0.8427
Lower Explosive Limit (%):	2.8

EXTINGUISHING MEDIA

- Alcohol stable foam.
- Dry chemical powder.
- BCF (where regulations permit).
- Carbon dioxide.
- Water spray or fog - Large fires only.

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.
- Consider evacuation (or protect in place).
- 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.
- Equipment should be thoroughly decontaminated after use.

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 monoxide (CO), carbon dioxide (CO₂), other pyrolysis products typical of burning organic material.

Contains low boiling substance: Closed containers may rupture due to pressure buildup under fire conditions.

May emit poisonous fumes.

WARNING: Long standing in contact with air and light may result in the formation of potentially explosive peroxides.

FIRE INCOMPATIBILITY

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

PERSONAL PROTECTION

Glasses:

Full face- shield.

Gloves:

1.BUTYL 2.TEFLON

Respirator:

Type AX Filter of sufficient capacity

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.

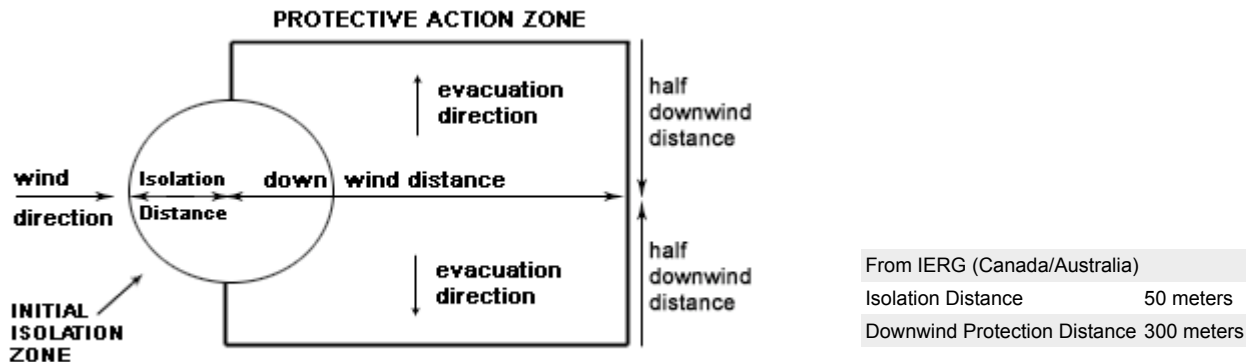
MAJOR SPILLS

- 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

WARNING

MAY POLYMERISE VIOLENTLY UNDER CERTAIN CONDITIONS.



From US Emergency Response Guide 2000

Guide 131P

SMALL SPILLS

Name Isolation Distance Downwind Day Protection Night

Acrolein, inhibited 200 ft (60 m) 0.3 mile (0.5 km) 1 mile (1.6 km)

LARGE SPILLS

Name Isolation Distance Downwind Day Protection Night

Acrolein, inhibited 1300 ft (400 m) 2.4 mile (3.9 km) 4.9 mile (7.9 km)

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 131P is taken from the US DOT emergency response guide book.

6 IERG information is derived from CANUTEC - Transport Canada.

EMERGENCY RESPONSE PLANNING GUIDELINES (ERPG)

The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour WITHOUT experiencing or developing

life-threatening health effects is:

acrolein	1.5ppm
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irreversible or other serious effects or symptoms which could impair an individual's ability to take protective action is:

acrolein	0.15ppm
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other than mild, transient adverse effects without perceiving a clearly defined odour is:

acrolein	0.05ppm
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American Industrial Hygiene Association (AIHA)

Ingredients considered according exceed the following cutoffs

Very Toxic (T+)	>= 0.1%	Toxic (T)	>= 3.0%
R50	>= 0.25%	Corrosive (C)	>= 5.0%
R51	>= 2.5%		
else	>= 10%		

where percentage is percentage of ingredient found in the mixture

Section 7 - HANDLING AND STORAGE

PROCEDURE FOR HANDLING

· DO NOT allow clothing wet with material to stay in contact with skin.

The substance forms explosive levels of peroxides without concentration by evaporation or distillation.

Purchases of peroxidizable chemicals should be restricted to ensure that the chemical is used completely before it can become peroxidized.

· A responsible person should maintain an inventory of peroxidizable chemicals or annotate the general chemical inventory to indicate which chemicals are subject to peroxidation. An expiration date should be determined. The chemical should either be treated to remove peroxides or disposed of before this date.

· The person or laboratory receiving the chemical should record a receipt date on the bottle. The individual opening the container should add an opening date.

· Unopened containers received from the supplier should be safe to store for 18 months.

· Opened containers should not be stored for more than 3 months.

Contains low boiling substance:

Storage in sealed containers may result in pressure buildup causing violent rupture of containers not rated appropriately.

· Check for bulging containers.

· Vent periodically

· Always release caps or seals slowly to ensure slow dissipation of vapors.

· Avoid all personal contact, including inhalation.

· Wear protective clothing when risk of exposure occurs.

· Use in a well-ventilated area.

· Prevent concentration in hollows and sumps.

· DO NOT enter confined spaces until atmosphere has been checked.

· DO NOT allow material to contact humans, exposed food or food utensils.

· 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

· 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, there must be sufficient inert cushioning material in contact with inner and outer packages * . - In addition, where inner packagings are glass and contain liquids of packing group I and II there must be sufficient inert absorbent to absorb any spillage *. - * unless the outer packaging is a close fitting molded plastic box and the substances are not incompatible with the plastic.

All inner and sole packagings for substances that have been assigned to Packaging Groups I or II on the basis of inhalation toxicity criteria, must be hermetically sealed.

STORAGE REQUIREMENTS

- Store in original containers.
- Keep containers securely sealed.
- Store in a cool, dry, well-ventilated area.
- Store away from incompatible materials and foodstuff containers.
- Protect containers against physical damage and check regularly for leaks.
- Observe manufacturer's storing and handling recommendations.

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	Notes
US - Minnesota Permissible Exposure Limits (PELs)	acrolein (Acrolein)	0.1	0.25	0.3	0.8			
US ATSDR Minimal Risk Levels for Hazardous Substances (MRLs)	acrolein (ACROLEIN)	0.003						
US ATSDR Minimal Risk Levels for Hazardous Substances (MRLs)	acrolein (ACROLEIN)	0.00004						
Canada - Ontario Occupational Exposure Limits	acrolein (Acrolein)					0.1		
US NIOSH Recommended Exposure Limits (RELs)	acrolein (Acrolein)	0.1	0.25	0.3	0.8			See Appendix C (Aldehydes)
Canada - Alberta Occupational Exposure Limits	acrolein (Acrolein)					0.1	0.2	
Canada - British Columbia Occupational Exposure Limits	acrolein (Acrolein)					0.1		Skin
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants	acrolein (Acrolein)	0.1	0.25	0.3	0.8			
US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits	acrolein (Acrolein)	0.1	0.25					

for Air Contaminants						
US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants	acrolein (Acrolein)	0.1	0.25	0.3	0.8	
US - Idaho - Limits for Air Contaminants	acrolein (Acrolein)	0.1	0.25			
US - California Permissible Exposure Limits for Chemical Contaminants	acrolein (Acrolein)	0.1	0.25			C
US - Alaska Limits for Air Contaminants	acrolein (Acrolein)	0.1	0.25	0.3	0.8	
US - Michigan Exposure Limits for Air Contaminants	acrolein (Acrolein)	0.1	0.25	0.3	0.8	
US - Oregon Permissible Exposure Limits (Z-1)	acrolein (Acrolein)	0.1	0.25			
US - Hawaii Air Contaminant Limits	acrolein (Acrolein)	0.1	0.25	0.3	0.8	
Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances	acrolein (Acrolein)	0.1	0.25	0.3	0.8	
US - Washington Permissible exposure limits of air contaminants	acrolein (Acrolein)	0.1		0.3		
Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits	acrolein (Acrolein)					0.1 Skin
Canada - Northwest Territories Occupational Exposure Limits (English)	acrolein (Acrolein)	0.1	0.23	0.3	0.69	
US OSHA Permissible Exposure Levels (PELs) - Table Z1	acrolein (Acrolein)	0.1	0.25			
US ACGIH Threshold Limit Values (TLV)	acrolein (Acrolein)				0.1	TLV Basis: Eye & upper respiratory tract irritation; pulmonary edema; pulmonary emphysema

Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)	acrolein (Acrolein)	0.1	0.23	0.3	0.69	
Canada - Nova Scotia Occupational Exposure Limits	acrolein (Acrolein)				0.1	TLV Basis: Eye & upper respiratory tract irritation; pulmonary edema; pulmonary emphysema
Canada - Prince Edward Island Occupational Exposure Limits	acrolein (Acrolein)				0.1	TLV Basis: Eye & upper respiratory tract irritation; pulmonary edema; pulmonary emphysema
US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants	acrolein (Acrolein)	0.1	0.25			
Canada - Alberta Occupational Exposure Limits	hydroquinone (Dihydroxybenzene (Hydroquinone))		2			
Canada - British Columbia Occupational Exposure Limits	hydroquinone (Hydroquinone Revised 2008)		1			S
Canada - Ontario Occupational Exposure Limits	hydroquinone (1,4-Dihydroxybenzene)		2			
US OSHA Permissible Exposure Levels (PELs) - Table Z1	hydroquinone (Hydroquinone)		2			
US ACGIH Threshold Limit Values (TLV)	hydroquinone (Hydroquinone)		1			TLV Basis: eye irritation; eye damage
US NIOSH Recommended Exposure Limits (RELs)	hydroquinone (Hydroquinone)				2	(Ceiling ([15-minute]))
US - Minnesota Permissible Exposure Limits (PELs)	hydroquinone (Hydroquinone)		2			
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants	hydroquinone (Hydroquinone)		2			
US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants	hydroquinone (Hydroquinone)		2			

US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants	hydroquinone (Hydroquinone)		2			
US - California Permissible Exposure Limits for Chemical Contaminants	hydroquinone (Hydroquinone; 1,4-benezendiol)		2			
US - Idaho - Limits for Air Contaminants	hydroquinone (Hydroquinone)		2			
US - Hawaii Air Contaminant Limits	hydroquinone (Hydroquinone)		2		4	
US - Alaska Limits for Air Contaminants	hydroquinone (Hydroquinone)		2			
US - Michigan Exposure Limits for Air Contaminants	hydroquinone (Hydroquinone)		2			
Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances	hydroquinone (Dihydroxybenzene, see Hydroquinone)	-	2	-	3	
Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances	hydroquinone (Hydroquinone)	-	2	-	3	
Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits	hydroquinone (Hydroquinone)		2		4	
US - Oregon Permissible Exposure Limits (Z-1)	hydroquinone (Hydroquinone)		2			
Canada - Prince Edward Island Occupational Exposure Limits	hydroquinone (Hydroquinone)		1			TLV Basis: eye irritation; eye damage
US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants	hydroquinone (Hydroquinone)		2			
Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)	hydroquinone (Hydroquinone)		2			
Canada - Northwest Territories Occupational	hydroquinone (Dihydroxybenzene (Hydroquinone))		2		4	

Exposure Limits (English)

Canada -
Northwest
Territories
Occupational
Exposure Limits
(English)

hydroquinone
(Hydroquinone)

2

4

Canada - Nova
Scotia
Occupational
Exposure Limits

hydroquinone
(Hydroquinone)

1

TLV Basis: eye
irritation; eye
damage

ENDOELTABLE

EMERGENCY EXPOSURE LIMITS

Material Revised IDLH Value (mg/m3) Revised IDLH Value (ppm)

acrolein 2

hydroquinone 50

MATERIAL DATA

ACROLEIN:

HYDROQUINONE:

■ The recommended TLV-TWA for hydroquinone takes into account the toxicology of hydroquinone and experience of industrial exposures to benzenediols. Exposure at or below the limit is thought to minimise the risk to workers of eye injury, dermatitis and central nervous system effects. A short-term duration exposure value has not been recommended, because no quantitative data as to the levels of hydroquinone which produce eye irritation or more serious corneal changes has been identified.

ACROLEIN:

■ For acrolein:

Odour Threshold Value: 1.8 ppm (detection)

NOTE: Detection tubes for acrolein, measuring in excess of 0.005%, are available commercially.

Exposure at or below the TLV-TWA is thought to be sufficiently low to minimise but not to prevent irritation of the eyes, nose and more severe signs and symptoms of respiratory tract pathology to all exposed individuals.

Odour Safety Factor (OSF)

OSF=0.63 (ACROLEIN).

PERSONAL PROTECTION



Consult your EHS staff for recommendations

EYE

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

HANDS/FEET

■ Wear chemical protective gloves, eg. PVC.

Wear safety footwear or safety gumboots, eg. Rubber.

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

NOTE: The material may produce skin sensitization in predisposed individuals. Care must be taken, when removing gloves and other protective equipment, to avoid all possible skin contact.

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.
- Eyewash unit.
- Barrier cream.

- Skin cleansing cream.
- 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: acrolein

■ Protective Material CPI *

BUTYL	A
TEFLON	B

■ * 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	AX-1	-
1000	50	-	AX-1
5000	50	Airline*	-
5000	100	-	AX-2
10000	100	-	AX-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.

Toxic or noxious vapors/ gas.

State	Liquid	Molecular Weight	56.07
Melting Range (°F)	-125.86	Viscosity	Not Available
Boiling Range (°F)	126.5	Solubility in water (g/L)	Miscible
Flash Point (°F)	-14.8 (TOC)	pH (1% solution)	Not available
Decomposition Temp (°F)	Not Available	pH (as supplied)	Not applicable
Autoignition Temp (°F)	455	Vapor Pressure (mmHg)	219.993 @ 20C
Upper Explosive Limit (%)	31.0	Specific Gravity (water=1)	0.8427
Lower Explosive Limit (%)	2.8	Relative Vapor Density (air=1)	1.94
Volatile Component (%vol)	100	Evaporation Rate	Not available
Gas group	IIB		

■ log Kow (Prager 1995): - 0.09 ■ log Kow (Sangster 1997): - 0.01

ACROLEIN

APPEARANCE

Colourless or yellow liquid with a disagreeable, choking odour. Miscible with water. Polymerises readily in the presence of light, strong acids or strong alkali forming disacryl, a plastic solid.

■ log Kow (Prager 1995) - 0.09 ■ log Kow (Sangster 1997) - 0.01 log Kow 0.50-0.61

Material	Value
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Section 10 - CHEMICAL STABILITY

CONDITIONS CONTRIBUTING TO INSTABILITY

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

STORAGE INCOMPATIBILITY

■ Acrolein:

- is extremely reactive, unstable and polymerises readily, accelerating to violence in contact with acid or base catalysts - water or other contamination may shorten the induction period preceding the onset of polymerisation; uncatalysed polymerisation occurs at 200 deg. C
 - under weakly acidic conditions (nitrous fumes, sulfur dioxide, carbon dioxide, some hydrolysable salts or thiourea) may produce exothermic and violent polymerisation
 - in storage, over time, can form heat- and shock- sensitive compounds or acids
 - unless inhibited (usually by hydroquinone), readily forms explosive peroxides
 - may polymerise explosively, especially at elevated temperatures, on contact with oxidisers, strong acids, caustics, sunlight
 - is a strong reducing agent
 - reacts violently with amines, 2-aminoethanol, ammonia, bromine, ethylenediamine, ethyleneimine, hydroxides, metal salts, sulfur dioxide, thiourea
 - exploded violently whilst a sample was stored under refrigeration in the presence of a bottle of volatile amine (dimethylamine)
 - attacks most rubber (butyl has the highest resistance) and plastics
 - attacks metals: cadmium, copper and its alloys and zinc
 - may generate electrostatic charges, due to low conductivity, on flow or agitation
 - uninhibited vapours may form polymers in plug vents, confined spaces or flame arresters of storage tanks
- Hydroquinone, a stabiliser, ceases to exhibit a significant effect after a short period of time. Such unstabilised material may undergo violent polymerisation.
- Incidents involving interaction of active oxidants and reducing agents, either by design or accident, are usually very energetic and examples of so-called redox reactions.
 - Flammable and/or toxic gases are generated by the combination of aldehydes with azo, diazo compounds, dithiocarbamates, nitrides, and strong reducing agents.
 - Many aldehydes are incompatible with strong acids, amines, strong oxidizers, and alkaline materials.

Polymerization incidents might arise when thermally unstable initiators (including polymerization catalysts) are charged, preheated to reaction temperatures and held for considerable periods of time prior to the addition of monomers. The rate of polymerization may be affected by depleted initiator and the concentration of initiator may not be sufficient to produce controlled reaction for a particular addition rate of monomer; the concentration of the latter may reach levels at which uncontrollable polymerization occurs - this may lead to pressure-failure of the vessel seals.

BREThERICK L.: Handbook of Reactive Chemical Hazards.

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

Section 11 - TOXICOLOGICAL INFORMATION

ACROLEIN

TOXICITY AND IRRITATION

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

TOXICITY	IRRITATION
Oral (rat) LD50: 46 mg/kg	Eye (human): 500ppb/12m
Inhalation (human) LCLo: 5500 ppb.	Skin (rabbit): 5 mg (open)-SEVERE
Inhalation (man) TCLo: 1 ppm	Skin (rabbit): 500 mg/24h -SEVERE
Oral (mouse) LD50: 40 mg/kg	Eye (rabbit): 1 mg - SEVERE
Inhalation (mouse) LC50: 66 ppm/6h	Eye (rabbit): 1mg -SEVERE
Intraperitoneal (mouse) LD50: 9 mg/kg	Eye (rabbit): 50 ug/24h - SEVERE
Subcutaneous (mouse) LD50: 30 mg/kg	
Oral (rabbit) LD50: 7 mg/kg	
Dermal (rabbit) LD50: 562 mg/kg.	

■ For acrolein:

The overall evidence from acute, intermediate, and chronic duration studies in experimental animals indicates that the respiratory system is a target for acrolein. While the entire respiratory tract may be affected by acrolein vapors, the nasal epithelium appears to be more sensitive at lower exposures (<1 ppm), which is consistent with human perception of nasal irritation. The deeper respiratory regions (bronchiolar and alveolar regions) appear to be sensitive to higher exposure levels, with severe effects being observed from exposures of 100 ppm or higher. The available data do not suggest species differences in the respiratory toxicity of acrolein. Humans and animals appear to show similar low concentration effects (i.e., mild irritation). It should be noted, however, that rodents are obligate nosebreathers, while humans are mouth-breathers. As a result, the lower respiratory tract of rodents may not present as likely a target organ as that of humans.

The data in experimental animals clearly indicate that respiratory toxicity is a primary cause of acrolein lethality following inhalation and show an inverse relationship between the exposure concentration and the time it takes for death to occur after acute-duration exposures. Exposure of rats to airborne concentrations of acrolein of 100-40,000 ppm for short periods of time (

Volunteers exposed to increasing levels of acrolein vapors for 35 minutes reported statistically significant nose irritation at 0.26 ppm, throat irritation at 0.43 ppm, and a decrease in respiratory rate at 0.60 ppm. No statistically significant difference was observed between controls and subjects exposed to 0.17 ppm. In the same study, constant exposure to 0.3 ppm acrolein for 40 minutes resulted in reports of mild nose irritation shortly after onset of exposure, while throat irritation was reported after 10 minutes. Severity of irritation was subjectively scored as "not at all" to "a little". A 20% decrease in respiratory rate was also observed. The significance of the decrease in respiratory rate is not clear, but in animals, particularly rodents, it is considered to represent a reflex response to protect the respiratory tract from toxicants.

Intermediate-duration exposures to acrolein concentrations between 0.4 and 5.0 ppm for up to 180 days caused increased relative lung weights, as well as histological alterations, inflammation across the entire respiratory tract, and oedema of rats, monkeys, guinea pigs, and dogs, and rabbits and hamsters. Decreased pulmonary function was observed in rats exposed to 4 ppm for up to 62 days. Daily 10-minute exposures of 262 ppm for 8 weeks resulted in peribronchial hemorrhage and bronchial lumen obstruction in rats.

Gastrointestinal effects: Gastrointestinal irritation is the primary effect of oral exposure to acrolein. Though the clinical signs are consistent and dose-related across acute and intermediate exposures, possible adaptation to irritating effects may have important implications for chronic exposures. Rats administered a single gavage dose of 25 mg/kg of acrolein in saline showed severe multifocal ulceration of the forestomach and glandular stomach 48 hours after dosing. The areas of ulceration showed severe inflammation, focal hemorrhage, and oedema.

Neurological effects: Acrolein may induce release of peptides that could play a role in the physiological response to irritants. Concentrations of acrolein between 22 and 249 ppm for 10 minutes induced a dose-related decrease in substance P (a short-chain polypeptide that functions as a neurotransmitter or neuromodulator) and calcitonin gene-related peptide in nerve terminals innervating the trachea of rats. No change was seen in total nerve distribution and number or in vasoactive intestinal peptide. Likewise, substance P-mediated vasodilation of the rat upper respiratory tract was observed at 20 ppm, but not at 2-10 ppm, for 50 minutes.

Reproductive effects: Male and female rats exposed to 0.55 ppm acrolein continuously for 26 days prior to mating and presumed gestational days 0 through 22 showed no effect on the number of pregnancies or the number and weights of the fetuses. In another study no effect was seen on the reproductive fitness of rats exposed to 0.4-4 ppm for 62 days.

Carcinogenicity: Hamsters exposed to a single acrolein concentration of 4.0 ppm for 7 hours/day, 5 days/week for 52 weeks showed no evidence of respiratory tract tumors or tumors in other tissues and organs. Rats exposed to 8 ppm acrolein for 1 hour/day, 7 days/week for 18 months showed no evidence of tumors in the respiratory tract or in other tissues and organs.

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.

Asthma-like symptoms may continue for months or even years after exposure to the material ceases. This may be due to a non-allergic 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 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.

Lachrymation, general anaesthesia, convulsions, changes in trachea/bronchii, acute pulmonary oedema, respiratory obstruction, dyspnea, fatty liver degeneration, effects on fertility recorded.

ADI: 0.0005 mg/kg/day

NOEL: 0.05 mg/kg/day

CARCINOGEN

ACROLEIN	US Environmental Defense Scorecard Suspected Carcinogens	Reference(s)	EPA-HEN, OPP-CAN
HYDROQUINONE	US Environmental Defense Scorecard Suspected Carcinogens	Reference(s)	CPDB

SKIN

acrolein	Canada - Alberta Occupational Exposure Limits - Skin	Substance Interaction	1
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Section 12 - ECOLOGICAL INFORMATION

Refer to data for ingredients, which follows:

HYDROQUINONE:

ACROLEIN:

■ The material is classified as an ecotoxin* because the Fish LC50 (96 hours) is less than or equal to 0.1 mg/l

* Classification of Substances as Ecotoxic (Dangerous to the Environment)

Appendix 8, Table 1

Compiler's Guide for the Preparation of International Chemical Safety Cards: 1993 Commission of the European Communities.

■ Do NOT allow product to come in contact with surface waters or to intertidal areas below the mean high water mark. Do not contaminate water when cleaning equipment or disposing of equipment wash-waters.

Wastes resulting from use of the product must be disposed of on site or at approved waste sites.

■ Very toxic to aquatic organisms.

ACROLEIN:

Marine Pollutant: Yes

■ Hazardous Air Pollutant: Yes

■ Fish LC50 (96hr.) (mg/l): 0.17- 0.22

■ Daphnia magna EC50 (48hr.) (mg/l): 0.034

■ BCF<100: 334

■ log Kow (Prager 1995): - 0.09

■ log Kow (Sangster 1997): - 0.01

■ Half- life Soil - High (hours): 672

■ Half- life Soil - Low (hours): 168

■ Half- life Air - High (hours): 33.7

■ Half- life Air - Low (hours): 3.4

■ Half- life Surface water - High (hours): 672

■ Half- life Surface water - Low (hours): 168

■ Half- life Ground water - High (hours): 1344

■ Half- life Ground water - Low (hours): 336

■ Aqueous biodegradation - Aerobic - High (hours): 672

■ Aqueous biodegradation - Aerobic - Low (hours): 168

■ Aqueous biodegradation - Anaerobic - High (hours): 2880

■ Aqueous biodegradation - Anaerobic - Low (hours): 672

■ Aqueous biodegradation - Removal secondary treatment - High (hours): 99.90%

■ Aqueous biodegradation - Removal secondary treatment - Low (hours): 45.00%

■ Photooxidation half- life air - High (hours): 33.7

■ Photooxidation half- life air - Low (hours): 3.4

■ For acrolein:

Koc: 24

Half-life (hr) air: 10-13.0

Half-life (hr) H2O surface water: 48-144

Henry's atm m3 /mol: 4.40E-06

BOD 5 if unstated: nil

COD: 1.72

BCF: 344

Environmental fate:

Transport and Partitioning: Acrolein is relatively unstable in the atmosphere; therefore, transport within the atmosphere is expected to be limited. The relatively high vapor pressure of acrolein (274 mm Hg at 25 C suggests that this compound will not partition from the vapor phase to particulates in the atmosphere. Occurrence of acrolein in rainwater indicates that this compound may be removed from the atmosphere by washout.

Volatilisation is expected to be a significant removal process for any acrolein released to surface waters Based on a measured Henry's law constant of 1.22×10^{-4} atm-m³/mol at 25 C the volatilisation half-life from a model river 1 m deep, flowing 1 m/set with a wind speed of 3 m/second was estimated to be 23 hours.

A bioconcentration factor (BCF) of 344 was measured for acrolein in bluegill sunfish; however, this may be an overestimate, since total 14C was measured in the fish, which may have resulted in the measurement of acrolein metabolites. A BCF of 0.6 was estimated for acrolein based on a log octanol/water partition coefficient (Kow) of -0.01. These BCFs, as well as the relatively high water solubility of this compound, suggest that acrolein does not bioconcentrate significantly in aquatic organisms.

An estimated adsorption coefficient (Koc) of 24 suggests that adsorption of acrolein to suspended solids and sediments in water would not be significant. This does not take into account the reactivity of acrolein which could lead to the removal of acrolein from water through chemical binding of the compound to dissolved or suspended organics in water and sediments. The relatively low estimated Koc value suggests that acrolein will be highly mobile in soil and that this compound has the potential to leach significantly.

The relatively high vapor pressure of acrolein and its volatility from water suggest that this compound will evaporate rapidly from soil surfaces and that volatilization is probably a major removal process from soil. The relatively low Koc value for acrolein indicates high mobility in soil and suggests that this compound has the potential to leach significantly. Degradation processes and volatilisation, however, are expected to significantly retard movement of acrolein through soil.

Air: The dominant removal process for acrolein in ambient air is predicted to be reaction with photochemically generated hydroxyl radicals in the troposphere. The atmospheric half-life for acrolein is estimated to be 15-20 hours, based on experimentally determined hydroxyl radical reaction rate constants ranging between 1.90×10^{-11} and 2.53×10^{-11} cm³/molecules-sec at 25-26 C and an average ambient hydroxyl radical concentration of 5.0×10^5 molecules/cm³. Acrolein reacts with hydroxyl radicals as both an olefin and an aldehyde. Products of this reaction include carbon monoxide, formaldehyde, glyoxal, and glycolaldehyde. In the presence of nitrogen oxides, products include peroxyxynitrate, nitric acid, glycidaldehyde, malonaldehyde, and 3-hydroxypropanaldehyde.

Direct photolysis in the ambient atmosphere occurs but is expected to be of minor importance. The quantum yields for irradiation of acrolein at low air pressures were 0.0066 at 313 nm and 0.0044 at 334 nm. A computer analysis of their photodissociation data estimated the half-life of acrolein to be 10 days in the lower troposphere and <5 days in the upper troposphere.

Experimental data indicate that reaction of acrolein with ozone ($k = 2.8 \times 10^{-19}$ cm³/molecules-sec at 25 C; half-life, 59 days) or nitrate radicals ($k = 5.9 \pm 2.8 \times 10^{-16}$ cm³/molecules-sec at 25 C; half-life, 16 days) in the troposphere would be too slow to be environmentally significant. The fate of acrolein in indoor air is expected to be different from its fate in outdoor air because of differences in the concentrations of oxidants in indoor air compared to outdoor air and the possibility of other mechanisms of removal.

Water: Based on the reactivity and nucleophilicity of acrolein, it is expected that acrolein has the potential to react with dissolved and suspended organics in water. This removal process would become increasingly important for determining the fate of acrolein in water as the concentration of organics in water increased. Low concentrations of acrolein may degrade in natural water by either aerobic biodegradation or reversible hydration to beta-hydroxypropionaldehyde, which subsequently undergoes aerobic biodegradation. Acrolein at a concentration of 5–10 mg/L was completely degraded in 7–10 days in a static culture flask screening procedure. Studies suggest that the degradation of the hydration product of acrolein, 3-hydroxypropanal, occurs after the concentration of acrolein falls below 2–3 ppm. The degradation of 3-hydroxypropanal was also preceded by a 100-hour lag period, suggesting that biodegradation was occurring through the action of acclimated cultures.

Based on fish kill bioassays in natural river water at pH 8.1, >93% degradation of acrolein occurred within 6 days. The half-lives of acrolein in aerobic test systems that were treated at an application rate of 15 mg/L were 9.5 hours in water and 7.6 hours in sediment. The half-lives of acrolein in anaerobic test systems treated at the same rate were 10.3 hours in water and approximately 10 days in sediment. Degradation products included 3-hydroxypropanal, acrylic acid, and allyl alcohol, which indicate that both hydrolysis and biodegradation contributed to the degradation of acrolein during this study.

The ultraviolet (UV) spectrum of acrolein in hexane shows moderate absorption of UV light in the environmentally significant range (wavelengths >290 nm), suggesting that acrolein might undergo photolysis in natural waters; however, hydration of acrolein destroys the chromophores that absorb UV light and the equilibrium appears to be far on the side of the hydration product. Thus, the potential for direct photolysis of acrolein in natural waters is probably slight. Oxidation of small amounts of acrolein in natural waters would not be environmentally significant; however, highly concentrated acrolein solutions (i.e., spills) may be polymerised by oxidation or hydration processes.

Ecotoxicity:

Fish LC50 (24 h): goldfish (*Carassius auratus*) <0.08 mg/l; bluegill sunfish (*Lepomis macrochirus*) 0.079 mg/l; brown trout (*Salmo trutta*) 0.046 mg/l

Fish LC50 (96 h): bluegill sunfish (*Lepomis macrochirus*) 0.09 mg/l

Bird Acute LD50: mallard duck 9.11 mg/kg.

■ Substances containing unsaturated carbons are ubiquitous in indoor environments. They result from many sources (see below). Most are reactive with environmental ozone and many produce stable products which are thought to adversely affect human health. The potential for surfaces in an enclosed space to facilitate reactions should be considered.

Source of unsaturated substances	Unsaturated substances (Reactive Emissions)	Major Stable Products produced following reaction with ozone.
Occupants (exhaled breath, ski oils, personal care products)	Isoprene, nitric oxide, squalene, unsaturated sterols, oleic acid and other unsaturated fatty acids, unsaturated oxidation products	Methacrolein, methyl vinyl ketone, nitrogen dioxide, acetone, 6MHQ, geranyl acetone, 4OPA, formaldehyde, nonanol, decanal, 9-oxo-nonanoic acid, azelaic acid, nonanoic acid.
Soft woods, wood flooring, including cypress, cedar and silver fir boards, houseplants	Isoprene, limonene, alpha-pinene, other terpenes and sesquiterpenes	Formaldehyde, 4-AMC, pinoaldehyde, pinic acid, pinonic acid, formic acid, methacrolein, methyl vinyl ketone, SOAs including ultrafine particles
Carpets and carpet backing	4-Phenylcyclohexene, 4-vinylcyclohexene, styrene, 2-ethylhexyl acrylate, unsaturated fatty acids and esters	Formaldehyde, acetaldehyde, benzaldehyde, hexanal, nonanal, 2-nonenal

Linoleum and paints/polishes containing linseed oil	Linoleic acid, linolenic acid	Propanal, hexanal, nonanal, 2-heptenal, 2-nonenal, 2-decenal, 1-pentene-3-one, propionic acid, n-butyric acid
Latex paint	Residual monomers	Formaldehyde
Certain cleaning products, polishes, waxes, air fresheners	Limonene, alpha-pinene, terpinolene, alpha-terpineol, linalool, linalyl acetate and other terpenoids, longifolene and other sesquiterpenes	Formaldehyde, acetaldehyde, glycoaldehyde, formic acid, acetic acid, hydrogen and organic peroxides, acetone, benzaldehyde, 4-hydroxy-4-methyl-5-hexen-1-al, 5-ethenyl-dihydro-5-methyl-2(3H)-furanone, 4-AMC, SOAs including ultrafine particles
Natural rubber adhesive	Isoprene, terpenes	Formaldehyde, methacrolein, methyl vinyl ketone
Photocopier toner, printed paper, styrene polymers	Styrene	Formaldehyde, benzaldehyde
Environmental tobacco smoke	Styrene, acrolein, nicotine	Formaldehyde, benzaldehyde, hexanal, glyoxal, N-methylformamide, nicotinaldehyde, cotinine
Soiled clothing, fabrics, bedding	Squalene, unsaturated sterols, oleic acid and other saturated fatty acids	Acetone, geranyl acetone, 6MHO, 4OPA, formaldehyde, nonanal, decanal, 9-oxo-nonanoic acid, azelaic acid, nonanoic acid
Soiled particle filters	Unsaturated fatty acids from plant waxes, leaf litter, and other vegetative debris; soot; diesel particles	Formaldehyde, nonanal, and other aldehydes; azelaic acid; nonanoic acid; 9-oxo-nonanoic acid and other oxo-acids; compounds with mixed functional groups (=O, -OH, and -COOH)
Ventilation ducts and duct liners	Unsaturated fatty acids and esters, unsaturated oils, neoprene	C5 to C10 aldehydes
"Urban grime"	Polycyclic aromatic hydrocarbons	Oxidized polycyclic aromatic hydrocarbons
Perfumes, colognes, essential oils (e.g. lavender, eucalyptus, tea tree)	Limonene, alpha-pinene, linalool, linalyl acetate, terpinene-4-ol, gamma-terpinene	Formaldehyde, 4-AMC, acetone, 4-hydroxy-4-methyl-5-hexen-1-al, 5-ethenyl-dihydro-5-methyl-2(3H) furanone, SOAs including ultrafine particles
Overall home emissions	Limonene, alpha-pinene, styrene	Formaldehyde, 4-AMC, pinonaldehyde, acetone, pinic acid, pinonic acid, formic acid, benzaldehyde, SOAs including ultrafine particles

Abbreviations: 4-AMC, 4-acetyl-1-methylcyclohexene; 6MHQ, 6-methyl-5-heptene-2-one, 4OPA, 4-oxopentanal, SOA, Secondary Organic Aerosols

Reference: Charles J Weschler; Environmental Health Perspectives, Vol 114, October 2006.

■ DO NOT discharge into sewer or waterways.

HYDROQUINONE:

Marine Pollutant: Yes

■ Hydroquinone is a naturally occurring substance found in several foods (e.g., wheat products, fruits) and beverages (e.g., brewed coffee, some teas, beer, red wine). Hydroquinone is formed as a byproduct of metabolism in several bacteria and marine species. It is estimated that approximately 5 x 10⁴ kg of hydroquinone is generated per year during cigarette smoking.

Hydroquinone is considered to be readily biodegradable and photodegradable.

The aquatic toxicity of hydroquinone to fresh water fish, Daphnia, and algae was between 0.050-0.335 mg/l; the predicted chronic values for these fresh water taxa were calculated to be < 0.100.

The 84 hr LC50 for the salt water shrimp, *C. septemspinosa*, was selected as the only salt water species for analysis. Based on these data and on the predicted aquatic toxicity values, the USEPA identified concern concentrations or predicted no effect concentrations (PNECs) at 1.0 ug/l for fresh water species and 8.0 ug/l for salt water species. Alternatively, a PNEC can be derived using the assessment factors recommended in the SIDS Manual. As only acute effect data for fish and daphnids are available, an assessment factor of 100-1000 would be appropriate. Due to the large available database, a factor of 100 would be acceptable. Applied to the lowest experimental value of 0.044 mg/l (fathead minnow), a PNEC of 0.44 ug/l can be derived.

Physicochemical parameters:

Water solubility: 73 g/l (25 C)

log Kow: 0.50-0.61

Vapour pressure: 2.34 x 10⁻³ Pa (25 C)

BOD5: 1.0 g O₂/g

COD5: 1.83 gO₂/g

BOD5/COD5: 0.55

Degradation: Hydroquinone degrades by both biotic and abiotic mechanisms. Biodegradation is affected by pH, temperature, aerobic/anaerobic conditions, and acclimation of the microorganisms involved. Under aerobic conditions 74% of the radioactivity from the incubation of activated sludge and 14C- hydroquinone was recovered as carbon dioxide in 5-10 days. Small amounts of 1,4-benzoquinone, 2-hydroxy-1,4-benzoquinone, and beta-ketoadipic acid are formed as metabolites of hydroquinone. A maximum concentration of 0.11% (1.05 mg/L) 1,4-benzoquinone was detected at 2 hr during incubation of 950 mg/L hydroquinone by yeast cultures. At later time points 1,4-benzoquinone levels were lower and benzoquinone was not detected in the effluent from the activated sludge unit. In another study 82% of hydroquinone was converted to CO₂ in a 28-day Sturm test ; 97% of the dissolved organic carbon was removed in 28 days. Thus hydroquinone is primarily converted to CO₂ or mineralised during aerobic degradation.

Under anaerobic conditions, hydroquinone is metabolized through phenol, instead of 1,4-benzoquinone, prior to mineralisation.

As the organisms which biodegrade hydroquinone are widely distributed in the environment in sludges, soils, sediments, and composts, hydroquinone is expected to readily biodegrade in soils and water.

Photolysis: Due to its intrinsic properties, hydroquinone is relatively rapidly photodegraded; phototransformations may occur from direct excitation or from induced or photocatalytic reactions.

Bioaccumulation: With measured partition coefficients $\log P_{ow} = 0.50-0.61$, hydroquinone is not considered to undergo bioaccumulation. Bioaccumulation factors of 40 have been determined for algae and fish.

Distribution between environmental compartments and occurrence in the environment: The environmental transport of hydroquinone can be partially predicted based on its physicochemical properties. With a melting point of 169 C, a vapor pressure of 2.34×10^{-3} Pa at 25 C and a relative vapor density of 3.81 (air=1), it is not expected to transport into the atmosphere. A calculation of fugacity using Mackay's model I indicates that hydroquinone will be distributed to the water compartment (99.6%) when released into the environment.

Air: Hydroquinone is essentially non-volatile in its solid form. Its solubility in water (which increases with temperature), low vapor pressure, and high relative vapor density, and low Henry's law constant (3.84×10^{-11} atm-m³/mole) indicate that hydroquinone will not evaporate from water into the atmosphere. The half-life of hydroquinone in the air is 14 hr (U.S.E.P.A., 1990).

In its dry solid form, hydroquinone is stable and darkens only slowly if exposed to the air. In the presence of moisture and ambient levels of oxygen, hydroquinone can undergo oxidation to 1,4-benzoquinone which is more likely to volatilise because of its higher vapor pressure. As this potential reaction is well recognised, manufacturing plants do not let hydroquinone powders stand in open environments prior to bagging or drumming operations. For the same reason, hydroquinone-containing products such as photographic developers contain stabilizers such as sodium sulfite to prevent or retard oxidation.

Water: Due to its physical chemical properties, hydroquinone can be expected to partition to the water compartment. As its melting point is 169 C, vapor pressure is low, Henry's law constant is relatively low, and its solubility in water increases with temperature, hydroquinone is not likely to be volatilised to the air compartment from water. In waste water, hydroquinone would be expected to be readily biodegradable. If hydroquinone were present in an open body of water, it would be expected to both biodegrade and photodegrade. Hydroquinone half-life in surface water is 20 hr. While 1,4-benzoquinone would be expected to be one of the degradation products of hydroquinone, its ready degradation would not be expected to impact the toxicity of a hydroquinone release.

Soil: Hydroquinone released to the soil would be expected to mineralize as organisms which can degrade hydroquinone are commonly found in soils and compost. Half-life in soil is 2-14 days and depends on photo-oxidation and bacterial degradation. Hydroquinone present in soil could be expected to partition to water in the soil and be mobile. Half-life values in ground water are 4-14 days (aerobic conditions) and up to a month (anaerobic conditions). However, hydroquinone and its immediate degradation product, 1,4-benzoquinone may also be absorbed to the soil. Since hydroquinone and 1,4-benzoquinone are electron donor and electron acceptor molecules respectively, they could form charge transfer complexes with soil particles. Hydroquinone and its biodegradation products may contribute to the formation of humic acids which are polymerisation products of polyphenols commonly formed during the biodegradation of plants. Much of the naturally occurring hydroquinone in plants may be reincorporated into soils in this manner.

Effects on the Environment

Aquatic effects

Fish LC50 (96 h): Pimephales promelas 0.044 mg/l

Daphnia magna LC50 (48 h): 0.096 mg/l (interpolated results from several researchers)

Salt water shrimp (Crangon septemspinosa) LC50 (84 h): 0.833 mg/l

Algal EC50 (3 d): S. capricornutum 0.355 mg/l

Based on these numbers hydroquinone has a high acute toxicity for aquatic organisms.

Koc: 9-50

ThOD: 1.89

BCF: 40-65

Ecotoxicity

Ingredient	Persistence: Water/Soil	Persistence: Air	Bioaccumulation	Mobility
acrolein	LOW	LOW	LOW	HIGH
hydroquinone	LOW		LOW	MED

GESAMP/EHS COMPOSITE LIST - GESAMP Hazard Profiles

Name / EHS TRN A1a A1b A1 A2 B1 B2 C1 C2 C3 D1 D2 D3 E1 E2 E3 Cas No / RTECS No _____
 _____ [Heavy 226 282 5 2 (2) NR 1 NI 0 0 (1) 1 1 FE 2 Oxo 6 5 Fraction] / CAS:107- 02- 8 /

Legend: EHS=EHS Number (EHS=GESAMP Working Group on the Evaluation of the Hazards of Harmful Substances Carried by Ships)
 NRT=Net Register Tonnage, A1a=Bioaccumulation $\log P_{ow}$, A1b=Bioaccumulation BCF, A1=Bioaccumulation, A2=Biodegradation,
 B1=Acuteaquatic toxicity LC/EC1C50 (mg/l), B2=Chronic aquatic toxicity NOEC (mg/l), C1=Acute mammalian oral toxicity LD50 (mg/kg),
 C2=Acute mammalian dermal toxicity LD50 (mg/kg), C3=Acute mammalian inhalation toxicity LC50 (mg/kg), D1=Skin irritation & corrosion,
 D2=Eye irritation & corrosion, D3=Long-term health effects, E1=Tainting, E2=Physical effects on wildlife & benthic habitats, E3=Interference
 with coastal amenities, For column A2: R=Readily biodegradable, NR=Not readily biodegradable. For column D3: C=Carcinogen,
 M=Mutagenic, R=Reprotoxic, S=Sensitising, A=Aspiration hazard, T=Target organ systemic toxicity, L=Lung injury, N=Neurotoxic,
 I=Immunotoxic. For column E1: NT=Not tainting (tested), T=Tainting test positive. For column E2: Fp=Persistent floater, F=Floater, S=Sinking
 substances. The numerical scales start from 0 (no hazard), while higher numbers reflect increasing hazard. (GESAMP/EHS Composite List
 of Hazard Profiles - Hazard evaluation of substances transported by ships)

Section 13 - DISPOSAL CONSIDERATIONS

US EPA Waste Number & Descriptions

A. General Product Information

Ignitability characteristic: use EPA hazardous waste number D001 (waste code I)

B. Component Waste Numbers

When acrolein is present as a solid waste as a discarded commercial chemical product, off-specification species, as a container residue, or a spill residue, use EPA waste number P003 (waste code T).

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.
- Dispose of by: Burial in a licensed land-fill or Incineration in a licensed apparatus (after admixture with suitable combustible material)
- Decontaminate empty containers. Observe all label safeguards until containers are cleaned and destroyed.

Section 14 - TRANSPORTATION INFORMATION



DOT:

Symbols: None Hazard class or Division: 6.1

Identification Numbers: UN1092 PG: I

Label Codes: 6.1, 3 Special provisions: 1, B9,

B14, B30,

B42, B77,

T22, TP2,

TP7, TP13,

TP38, TP44

Packaging: Exceptions: None Packaging: Non- bulk: 226

Packaging: Exceptions: None Quantity limitations: Forbidden

Passenger aircraft/rail:

Quantity Limitations: Cargo Forbidden Vessel stowage: Location: D
aircraft only:

Vessel stowage: Other: 40 S.M.P.: YES

Hazardous materials descriptions and proper shipping names:

Acrolein, stabilized

Air Transport IATA:

ICAO/IATA Class: 6.1 ICAO/IATA Subrisk: 3

UN/ID Number: 1092 Packing Group: -

Special provisions: None

Cargo Only

Packing Instructions: Forbidden Maximum Qty/Pack: Forbidden

Passenger and Cargo Passenger and Cargo

Packing Instructions: Forbidden Maximum Qty/Pack: Forbidden

Passenger and Cargo Limited Quantity Passenger and Cargo Limited Quantity

Packing Instructions: - Maximum Qty/Pack: -

Shipping Name: ACROLEIN, STABILIZED

Maritime Transport IMDG:

IMDG Class: 6.1 IMDG Subrisk: 3-P

UN Number: 1092 Packing Group: I

EMS Number: F-E , S-D Special provisions: None

Limited Quantities: 0 Marine Pollutant: Yes

Shipping Name: ACROLEIN, STABILIZED

Section 15 - REGULATORY INFORMATION



REGULATIONS

ND

Ingredient CAS % de minimus concentration
hydroquinone 123-31-9 1.0

ND

Ingredient CAS RQ
hydroquinone 123-31-9 100 lb (45.4 kg)

acrolein (CAS: 107-02-8) 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 - Prince Edward Island Occupational Exposure Limits - Carcinogens", "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 ARET (Accelerated Reduction / Elimination of Toxics) Substance List", "Canada Environmental Protection Act (CEPA) 1999 - Schedule 1 Toxic Substances List", "Canada Ingredient Disclosure List (SOR/88-64)", "Canada National Pollutant Release Inventory (NPRI)", "Canada Priority Substances List (PSL1, PSL 2)", "Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (English)", "International Agency for Research on Cancer (IARC) - Agents Reviewed by the IARC Monographs", "International Air Transport Association (IATA) Dangerous Goods Regulations", "International Air Transport Association (IATA) Dangerous Goods Regulations - Prohibited List", "OECD Representative List of High Production Volume (HPV) Chemicals", "US - Alaska Limits for Air Contaminants", "US - California Air Toxics ""Hot Spots"" List (Assembly Bill 2588) Substances for which emissions must be quantified", "US - California Occupational Safety and Health Regulations (CAL/OSHA) - Hazardous Substances List", "US - California OEHH/ARB - Acute Reference Exposure Levels and Target Organs (RELs)", "US - California OEHH/ARB - Chronic Reference Exposure Levels and Target Organs (CRELs)", "US - California Permissible Exposure Limits for Chemical Contaminants", "US - California Toxic Air Contaminant List Category II", "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 Hazardous Materials", "US - Oregon Permissible Exposure Limits (Z-1)", "US - Pennsylvania - Hazardous Substance List", "US - Rhode Island Hazardous Substance List", "US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants", "US - Vermont Hazardous Constituents", "US - Vermont Hazardous Waste - Acutely Hazardous Wastes", "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 Dangerous waste constituents list", "US - Washington Discarded Chemical Products List - ""P"" Chemical Products", "US - Washington Permissible exposure limits of air contaminants", "US - Wyoming List of Highly Hazardous Chemicals, Toxics and Reactives", "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 ATSDR Minimal Risk Levels for Hazardous Substances (MRLs)", "US CAA (Clean Air Act) - HON Rule - Organic HAPs (Hazardous Air Pollutants)", "US CERCLA Priority List of Hazardous Substances", "US Clean Air Act - Hazardous Air Pollutants", "US CWA (Clean Water Act) - List of Hazardous Substances", "US CWA (Clean Water Act) - Priority Pollutants", "US CWA (Clean Water Act) - Reportable Quantities of Designated Hazardous Substances", "US CWA (Clean Water Act) - Toxic Pollutants", "US Department of Homeland Security Chemical Facility Anti-Terrorism Standards - Chemicals of Interest", "US Department of Transportation (DOT) List of Hazardous Substances and Reportable Quantities - Hazardous Substances Other Than Radionuclides", "US Department of Transportation (DOT) Marine Pollutants - Appendix B", "US DOE Temporary Emergency Exposure Limits (TEELs)", "US EPA Acute Exposure Guideline Levels (AELs) - Interim", "US EPA Carcinogens Listing", "US EPA High Production Volume Program Chemical List", "US EPA Master Testing List - Index I Chemicals Listed", "US EPA National Priorities List - Superfund Chemical Data Matrix (SCDM) - Hazard Ranking System - Hazardous Substance Benchmarks", "US EPCRA Section 313 Chemical List", "US Food Additive Database", "US List of Lists - Consolidated List of Chemicals Subject to EPCRA, CERCLA and Section 112(r) of the Clean Air Act", "US NIOSH Recommended Exposure Limits (RELs)", "US OSHA List of Highly Hazardous Chemicals, Toxics and Reactives", "US OSHA Permissible Exposure Levels (PELs) - Table Z1", "US RCRA (Resource Conservation & Recovery Act) - Appendix IX to Part 264 Ground-Water Monitoring List 1", "US RCRA (Resource Conservation & Recovery Act) - Hazardous Constituents - Appendix VIII to 40 CFR 261", "US RCRA (Resource Conservation & Recovery Act) - List of Hazardous Inorganic and Organic Constituents 1", "US RCRA (Resource Conservation & Recovery Act) - List of Hazardous Wastes", "US RCRA (Resource Conservation & Recovery Act) - Phase 4 LDR Rule - Universal Treatment Standards", "US SARA Section 302 Extremely Hazardous Substances", "US Spacecraft Maximum Allowable Concentrations (SMACs) for Airborne Contaminants", "US -Texas Air Monitoring Comparison Values for Evaluating VOCs", "US Toxic Substances Control Act (TSCA) - Inventory", "US TSCA Section 8 (a) - Preliminary Assessment Information Rules (PAIR) - Reporting List", "US TSCA Section 8 (d) - Health and Safety Data Reporting", "USA: Chemical Facility Anti-Terrorism Standards - List Appendix A - 6CFR 27"

Regulations for ingredients

hydroquinone (CAS: 123-31-9) 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 - Prince Edward Island Occupational Exposure Limits - Carcinogens", "Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)", "Canada - Saskatchewan Industrial Hazardous Substances", "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)", "International Agency for Research on Cancer (IARC) - Agents Reviewed by the IARC Monographs", "International Fragrance Association (IFRA) Survey: Transparency List", "OECD Representative List of High Production Volume (HPV) Chemicals", "US - Alaska Limits for Air Contaminants", "US - California Air Toxics ""Hot Spots"" List (Assembly Bill 2588) Substances for which emissions must be quantified", "US - California Occupational Safety and Health Regulations (CAL/OSHA) - Hazardous Substances List", "US - California Permissible Exposure Limits for Chemical Contaminants", "US - California Toxic Air Contaminant List Category IV", "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 (Z-1)", "US - Pennsylvania - Hazardous Substance List", "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 - 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 CAA (Clean Air Act) - HON Rule - Organic HAPs (Hazardous Air Pollutants)","US Clean Air Act - Hazardous Air Pollutants","US Cosmetic Ingredient Review (CIR) Cosmetic ingredients found safe, with qualifications","US Department of Transportation (DOT) List of Hazardous Substances and Reportable Quantities - Hazardous Substances Other Than Radionuclides","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 EPCRA Section 313 Chemical List","US FDA Indirect Food Additives: Adhesives and Components of Coatings - Substances for Use Only as Components of Adhesives - Adhesives","US List of Lists - Consolidated List of Chemicals Subject to EPCRA, CERCLA and Section 112(r) of the Clean Air Act","US NIOSH Recommended Exposure Limits (RELs)","US OSHA Permissible Exposure Levels (PELs) - Table Z1","US SARA Section 302 Extremely Hazardous Substances","US Toxic Substances Control Act (TSCA) - Inventory","US TSCA Section 4/12 (b) - Sunset Date/Status","US TSCA Section 8 (d) - Health and Safety Data Reporting"

Section 16 - OTHER INFORMATION

LIMITED EVIDENCE

- Potentially explosive peroxides may form on standing*.
 - Cumulative effects may result following exposure*.
 - Limited evidence of a carcinogenic effect*.
 - Possible skin sensitizer*.
 - May be harmful to the fetus/ embryo*.
 - Vapors potentially cause drowsiness and dizziness*.
- * (limited evidence).

REPRODUCTIVE HEALTH GUIDELINES

Ingredient ORG UF Endpoint CR Adeq TLV acrolein 0.12 mg/m3 100 D NA - ■ These exposure guidelines have been derived from a screening level of risk assessment and should not be construed as unequivocally safe limits. ORGS represent an 8-hour time-weighted average unless specified otherwise. CR = Cancer Risk/10000; UF = Uncertainty factor: TLV believed to be adequate to protect reproductive health: LOD: Limit of detection Toxic endpoints have also been identified as: D = Developmental; R = Reproductive; TC = Transplacental carcinogen Jankovic J., Drake F.: A Screening Method for Occupational Reproductive Health Risk: American Industrial Hygiene Association Journal 57: 641-649 (1996).

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- 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.

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Issue Date: Jan-24-2010

Print Date: Oct-1-2010