tert-Butyl acrylate

sc-253632

Material Safety Data Sheet

Hazard Alert Code Key:	EXTREME	HIGH	MODERATE	LOW

Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME
tert-Butyl acrylate

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
C7-H12-O2, H2C=CHCO2C(CH3)3, "1, 1-dimethylethyl 2-propenoate"

Section 2 - HAZARDS IDENTIFICATION

CHEMWATCH HAZARD RATINGS

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

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

CANADIAN WHMIS SYMBOLS

EMERGENCY OVERVIEW

RISK

May cause SENSITISATION by skin contact.
Harmful by inhalation, in contact with skin and if swallowed.
Irritating to eyes, respiratory system and skin.
Highly flammable.
Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS

SWALLOWED

■ 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.

EYE

■ This material can cause eye irritation and damage in some persons.
■ Irritation of the eyes may produce a heavy secretion of tears (lachrymation).

SKIN

■ Skin contact with the material may be harmful; systemic effects may resultfollowing absorption.
■ This material can cause inflammation of the skin oncontact in some persons.
■ The material may accentuate any pre-existing dermatitis condition.
■ 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.

INHALED

■ Inhalation of 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.
■ Inhalation hazard is increased at higher temperatures.
■ If exposure to highly concentrated vapor atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and unless resuscitated - death.

CHRONIC HEALTH EFFECTS

■ Long-term exposure to respiratory irritants may result in disease of the airways involving difficult breathing and related systemic problems.
Skin contact with the material is more likely to cause a sensitization reaction in some persons compared to the general population.
Limited evidence suggests that repeated or long-term occupational exposure may produce cumulative health effects involving organs or biochemical systems.
There is some evidence that inhaling this product is more likely to cause a sensitization reaction in some persons compared to the general population.
Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes. [PATTYS].
Sensitization may give severe responses to very low levels of exposure, i.e. hypersensitivity.

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

NAME	CAS RN	%
tert-butyl acrylate	1663-39-4	99.5

stabilising inhibitor, may be		
hydroquinone	123-31-9	0.2
or		
4-methoxyphenol (MEHQ)	150-76-5	0.2

Section 4 - FIRST AID MEASURES

SWALLOWED

■

- IF SWALLOWED, REFER FOR MEDICAL ATTENTION, WHERE POSSIBLE, WITHOUT DELAY.
- Where Medical attention is not immediately available or where the patient is more than 15 minutes from a hospital or unless instructed otherwise

EYE

■ If this product comes in contact with the eyes

- Wash out immediately with fresh 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.

SKIN

■ If skin contact occurs

- Immediately remove all contaminated clothing, including footwear
- Flush skin and hair with running water (and soap if available).

INHALED

■

- If fumes or combustion products are inhaled remove from contaminated area.
- Lay patient down. Keep warm and rested.

NOTES TO PHYSICIAN

■ 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.

Treat symptomatically.

Section 5 - FIRE FIGHTING MEASURES

Vapour Pressure (mmHG)	Not available
Upper Explosive Limit (%)	Not available
Specific Gravity (water=1)	0.875
Lower Explosive Limit (%)	Not available

EXTINGUISHING MEDIA

- Foam.
- Dry chemical powder.

FIRE FIGHTING

- Alert Emergency Responders and tell them location and nature of hazard.
- May be violently or explosively reactive.

When any large container (including road and rail tankers) is involved in a fire, consider evacuation by 500 metres in all directions.

GENERAL FIRE HAZARDS/HAZARDOUS COMBUSTIBLE PRODUCTS

Combustion products include carbon dioxide (CO_2).

- Liquid and vapor are highly flammable.
- Severe fire hazard when exposed to heat, flame and/or oxidizers.

, carbon monoxide (CO), nitrogen oxides (NOx), other pyrolysis products typical of burning organic material. Heat from a fire may cause a polymerisation reaction which can be explosive.

FIRE INCOMPATIBILITY

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

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Section 6 - ACCIDENTAL RELEASE MEASURES

MINOR SPILLS

- Remove all ignition sources.
- Clean up all spills immediately.

MAJOR SPILLS

- Clear area of personnel and move upwind.
- Alert Emergency Responders and tell them location and nature of hazard.

Section 7 - HANDLING AND STORAGE

PROCEDURE FOR HANDLING

- Most acrylic monomers have low viscosity therefore pouring, material transfer and processing of these materials do not necessitate heating.
- Viscous monomers may require heating to facilitate handling. To facilitate product transfer from original containers, product must be heated to no more than 60 deg. C. (140 F.), for not more than 24 hours.
- Containers, even those that have been emptied, may contain explosive vapours.
- Do NOT cut, drill, grind, weld or perform similar operations on or near containers.
- 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 overexposure occurs.

RECOMMENDED STORAGE METHODS

¦ Packing as supplied by manufacturer. Plastic containers may only be used if approved for flammable liquid.

- For low viscosity materials (i) Drums and jerricans must be of the non-removable head type. (ii) 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)

STORAGE REQUIREMENTS

- Store in original containers in approved flammable liquid storage area.
- DO NOT store in pits, depressions, basements or areas where vapors may be trapped.

Polymerization may occur slowly at room temperature.

- Storage requires stabilizing inhibitor content and dissolved oxygen content to be monitored. Refer to manufacturer's recommended levels.
- DO NOT overfill containers so as to maintain free head space above product.
- Store below 38 deg. C.

Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE CONTROLS

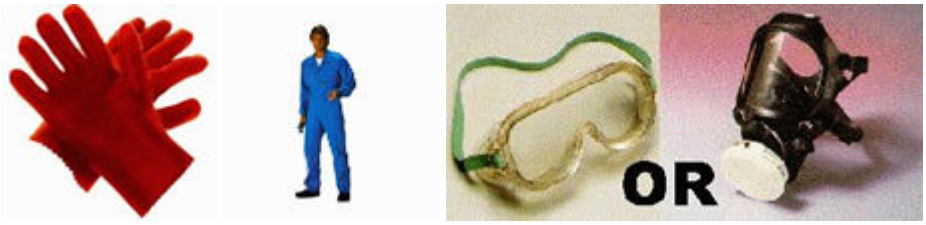
Source	Material	TWA ppm	TWA mg/m³	STEL ppm	STEL mg/m³	Peak ppm	Peak mg/m³	TWA F/CC	Notes
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants	tert-butyl acrylate (Butyl acrylate)	10	55						
US - California Permissible Exposure Limits for Chemical Contaminants	tert-butyl acrylate (Butyl acrylate)	2	11						
US NIOSH Recommended Exposure Limits (RELs)	tert-butyl acrylate (Butyl acrylate)	10	55						
Canada - Alberta Occupational Exposure Limits	hydroquinone (Dihydroxybenzene (Hydroquinone))		2						
Canada - British Columbia Occupational Exposure Limits	hydroquinone (Hydroquinone Revised 2008)		1						S
US - Minnesota Permissible Exposure Limits (PELs)	hydroquinone (Hydroquinone)		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 - 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				
Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)	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 - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits	hydroquinone (Hydroquinone)		2		4		
Canada - Nova Scotia Occupational Exposure Limits	hydroquinone (Hydroquinone)		1				TLV Basis eye irritation; eye damage
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	
US - Oregon Permissible Exposure Limits (Z-1)	hydroquinone (Hydroquinone)	-	2	
Canada - Northwest Territories Occupational Exposure Limits (English)	hydroquinone (Dihydroxybenzene (Hydroquinone))		2	4
US - Washington Permissible exposure limits of air contaminants	hydroquinone (Dihydroxybenzene (Hydroquinone))		2	4
Canada - British Columbia Occupational Exposure Limits	4-methoxyphenol (MEHQ) (4-Methoxyphenol)		5	
US - Minnesota Permissible Exposure Limits (PELs)	4-methoxyphenol (MEHQ) (4-Methoxyphenol)		5	
US NIOSH Recommended Exposure Limits (RELs)	4-methoxyphenol (MEHQ) (4-Methoxyphenol)		5	
Canada - Alberta Occupational Exposure Limits	4-methoxyphenol (MEHQ) (4-Methoxyphenol)		5	
US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants	4-methoxyphenol (MEHQ) (4-Methoxyphenol)		5	
US - California Permissible Exposure Limits for Chemical Contaminants	4-methoxyphenol (MEHQ) (4-Methoxyphenol)		5	
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants	4-methoxyphenol (MEHQ) (4-Methoxyphenol)		5	
US - Michigan Exposure Limits for Air Contaminants	4-methoxyphenol (MEHQ) (4-Methoxyphenol)		5	

US - Washington Permissible exposure limits of air contaminants	4-methoxyphenol (MEHQ) (4-Methoxyphenol)	5	10	
Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits	4-methoxyphenol (MEHQ) (4-Methoxyphenol)	5	10	
Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)	4-methoxyphenol (MEHQ) (4-Methoxyphenol)	5		
US ACGIH Threshold Limit Values (TLV)	4-methoxyphenol (MEHQ) (4-Methoxyphenol)	5		TLV Basis eye irritation; skin damage
Canada - Nova Scotia Occupational Exposure Limits	4-methoxyphenol (MEHQ) (4-Methoxyphenol)	5		TLV Basis eye irritation; skin damage
Canada - Prince Edward Island Occupational Exposure Limits	4-methoxyphenol (MEHQ) (4-Methoxyphenol)	5		TLV Basis eye irritation; skin damage

PERSONAL PROTECTION



RESPIRATOR

•Type A-P Filter of sufficient capacity. (AS/NZS 1716 & 1715, EN 1432000 & 1492001, ANSI Z88 or national equivalent)

EYE

- Safety glasses with side shields.
- Chemical goggles.

HANDS/FEET

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

- 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, AS/NZS 2161.1 or national equivalent).

- 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, AS/NZS 2161.10.1 or national equivalent) 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, AS/NZS 2161.10.1 or national equivalent) 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.
General warning Do NOT use latex gloves! Use only recommended gloves - using the wrong gloves may increase the risk

Exposure condition Short time use; (few minutes less than 0.5 hour) Little physical stress	Use of thin nitrile rubber gloves Nitrile rubber (0.1 mm) Excellent tactibility ("feel"), powder-free Disposable Inexpensive Give adequate protection to low molecular weigh acrylic monomers
Exposure condition Medium time use; less than 4 hours Physical stress (opening drums, using tools, etc.)	Use of medium thick nitrile rubber gloves Nitrile rubber, NRL (latex) free; <0.45 mm Moderate tactibility ("feel"), powder-free Disposable Moderate price Gives adequate protection for most acrylates up to 4 hours Do NOT give adequate protection to low molecular weight monomers at exposures longer than 1 hour
Exposure condition Long time Cleaning operations	Nitrile rubber, NRL (latex) free; >0.56 mm low tactibility ("feel"), powder free High price Gives adequate protection for most acrylates in combination with commonly used solvents up to 8 hours Do NOT give adequate protection to low molecular weight monomers at exposures longer than 1 hour Avoid use of ketones and acetates in wash-up solutions.

Where none of this gloves ensure safe handling (for example in long term handling of acrylates containing high levels of acetates and/ or ketones, use laminated multilayer gloves.
Guide to the Classification and Labelling of UV/EB Acrylates Third edition, 231 October 2007 - Cefic.

- Neoprene gloves

OTHER

- Overalls.
- PVC Apron.
- 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.

ENGINEERING CONTROLS

For flammable liquids and flammable gases, local exhaust ventilation or a process enclosure ventilation system may be required. Ventilation equipment should be explosion-resistant.

Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL PROPERTIES

Liquid.
Does not mix with water.
Floats on water.

State	Liquid	Molecular Weight	128.17
Melting Range (°F)	Not available	Viscosity	Not Available
Boiling Range (°F)	~142- 145 (60 mm)	Solubility in water (g/L)	Immiscible
Flash Point (°F)	63	pH (1% solution)	Not applicable
Decomposition Temp (°F)	Not Available	pH (as supplied)	Not applicable
Autoignition Temp (°F)	Not available	Vapour Pressure (mmHG)	Not available
Upper Explosive Limit (%)	Not available	Specific Gravity (water=1)	0.875

Lower Explosive Limit (%)	Not available	Relative Vapor Density (air=1)	>1
Volatile Component (%vol)	100	Evaporation Rate	< 1 BuAc=1

APPEARANCE

Flammable liquid; floats on water. Sharp, biting ester odour. Stabilised reactive monomer. Inhibitor level should be regularly checked. Inhibitor system requires oxygen to function, hence bulk storages may require aeration. Do NOT STORE under nitrogen as polymerisation will occur.

The water solubility of n-butyl acrylate is 2 g/L (25 deg C) and specific gravity is 0.898 g/cm3 at 20 deg C. The measured log Kow is 2.38. The vapor pressure (based on a regression analysis of measured values from several data sources) is 7.27 hPa at 25 deg C. The melting point is - 64 deg C and the boiling point is 148 deg C. n-Butyl acrylate is photodegraded by reaction with hydroxyl radicals in the atmosphere with a half-life of 1.2 days (calculated). The hydrolysis rate of n-butyl acrylate is extremely low. At pH 7, the approximate half-life is calculated to be 1100 days. The Henry's law constant is 4.7 x 10-4 atm/m3/mol, indicating the potential for moderate volatilisation from water. Distribution modeling using Mackay Level I indicates that the main target compartment will be air (94%) with smaller amounts partitioning into water (5.73%) soil (0.11%), and sediment (0.11%). Fugacity model Level III gives comparable results; the levels are 89.4% (air), 8.24% (water), 2.39% (soil) and 0.0963% (sediment). A BCF of 13 was determined, based on a log Kow of 2.38, indicating a low bioaccumulation potential. In a biodegradation assay according to OECD Guideline 301C (modified MITI-Test (I)) n-butyl acrylate was readily biodegradable (61% after 14 days). In another ready biodegradation test conducted according to OECD Guideline 301D, 57.8% of the chemical biodegraded after 28 days. Ecotoxicity of acrylates is a function of n-octanol/ water partition coefficient (log Pow, log Kow). Compounds with a log Pow >5 exhibit simple narcosis, but at lower log Pow the toxicity of acrylates is greater than predicted for simple narcotics. log Kow 0.50-0.61

Material	Value

Section 10 - CHEMICAL STABILITY

CONDITIONS CONTRIBUTING TO INSTABILITY

- Polymerisation may occur at elevated temperatures.
- Polymerisation may be accompanied by generation of heat as exotherm.

STORAGE INCOMPATIBILITY

¦ For acrylic and methacrylic acid esters

- Avoid contact with strong acids, strong alkalies, oxidising agents, polymerisation initiators (peroxides, persulfates), iron or rust
- Avoid heat, flame, sunlight, x-rays or ultra-violet radiation.
- Polymerisation may occur at elevated temperature and in presence of ignition sources - polymerisation of large quantities may be violent (even explosive)
- Store below 38 deg. C.
- Avoid any contamination of this material as it is very reactive and any contamination is potentially hazardous
- Stable under controlled storage conditions provided material contains adequate stabilizer / polymerization inhibitor.
- Bulk storages may have special storage requirements

Contamination with polymerization catalysts - peroxides, persulfates, oxidizing agents - also strong acids, strong alkalies, will cause polymerization with exotherm - generation of heat.
Polymerization of large quantities may be violent - even explosive.

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

Section 11 - TOXICOLOGICAL INFORMATION

tert-butyl acrylate

TOXICITY AND IRRITATION

■ unless otherwise specified data extracted from RTECS - Register of Toxic Effects of Chemical Substances.
■ Contact allergies quickly manifest themselves as contact eczema, more rarely as urticaria or Quincke's edema. The pathogenesis of contact eczema involves a cell-mediated (T lymphocytes) immune reaction of the delayed

type.
TERT-BUTYL ACRYLATE

TOXICITY	IRRITATION
Oral (rat) LD50 1060 mg/kg [BASF - CCINFO 2210307]	

■ 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.
Where no "official" classification for acrylates and methacrylates exists, there has been cautious attempts to create classifications in the absence of contrary evidence. For example
Monalkyl or monoarylesters of acrylic acids should be classified as R36/37/38 and R51/53
Monoalkyl or monoaryl esters of methacrylic acid should be classified as R36/37/38.
for n-butyl acrylate
Acute toxicity After oral administration, n-butyl acrylate is rapidly absorbed and metabolized in male rats (75% was eliminated as CO2, approximately 10% via urine and 2% via feces). The major portion of n-butyl acrylate was hydrolysed by carboxyesterase to acrylic acid and butanol.
Following acute exposure, n-butyl acrylate exhibits low toxicity. n-Butyl acrylate has oral LD50s of 3143 mg/kg bw (rats) and 9050 mg/kg bw (male rats), an inhalation LC50 (4-hour, rat) of 10.3 mg/L and a dermal LD50 (rabbit) of 2000 to 3024 mg/kg. n-Butyl acrylate is irritating to skin and eyes and showed a skin sensitising potential in animals. In humans, skin sensitisation to butyl acrylate was reported. Patch test concentration ranged from 0.1 to 0.5%. 6 out of 124 patients were positive, but the author stated that those results should be interpreted with caution, due to clinical history of the patients and purity of the different tested acrylates. Another publication describes that a data collection of 82 patients between 1987 and 1992 suspected of occupational acrylic sensitisation, showed in the patch test with 1% in petrolatum 2 patients to be sensitised to n-butyl acrylate
Repeat dose toxicity In an oral (drinking water) 90-day study in rats, using a satellite group (gavage) at 150 mg/kg bw/day, the only effects reported were a slight reduction in water consumption in all dose groups and a decrease in weight gain in the highest dose group. The NOAEL (males) = 84 mg/kg/bw/day and NOAEL (females) = 111 mg/kg/bw/day. The NOAEL (gavage) (males and females) = 150 mg/kg/bw/day.
In a 90-day inhalation study, rats were exposed to 0, 21, 108, 211, and 546 ppm (0, 0.11, 0.57, 1.12, 2.90 mg/L) n-butyl acrylate. The primary effects at 211 ppm (1.12 mg/L) were irritation of eyes and nasal mucosa, reduced body weights (13.3 percent in males and 3.76 percent in females compared with controls), decreased potassium values (females) and an increase in alkaline phosphatase activity (females.) At the highest dose of 546 ppm (2.90 mg/L) 31 of 40 animals died. The primary cause of death was due to the strong irritation of the substance on the respiratory tract. The NOAEL = 108 ppm (0.57 mg/L/day) and the LOAEL = 211 ppm (1.12 mg/L/day).
In a two-year inhalation study, rats (male/female) received whole body exposures of 0, 15, 45, or 135 ppm (0, 0.086, 0.258, 0.773 mg/L). There was a slight decrease in food consumption and slightly lower relative heart, kidney, liver and thyroid weights at the highest dose. A NOAEL was determined to be 45 ppm (0.258 mg/L/day) based upon localized and diffuse stippling of the corneal epithelium, cloudiness of the cornea, and various degrees of vascularization. The severity of nasal mucosa effects increased with dose and occurred at all doses in males and females. Effects ranged from slight atrophy of the neurogenic part of the olfactory epithelium at 15 ppm (0.086 mg/L) to partial loss of the columnar cell layer and stratified reserve-cell hyperplasia at 45 (0.258 mg/L) and 135 ppm (0.773 mg/L).
Reproductive toxicity In repeated-dose studies (noted above), no effects were seen in the reproductive organs.
Developmental toxicity In developmental toxicity studies with rats via inhalation, n-butyl acrylate caused foetotoxic effects (resorptions and reduced number of live fetuses at >135 ppm) at maternally toxic concentrations.
At exposures of 25, 135 and 250 ppm (0.13, 0.72 and 1.33 mg/L/day), the NOAEL (maternal) = 25 ppm (0.13 mg/L/day) based on reduced body weights and irritation to the eyes and nose. The NOAEL (developmental) = 25 ppm (0.13 mg/L/day), based on post-implantation loss and the NOAEL (teratogenicity) = 250 ppm. In a separate study, female rats were given 100, 200 and 300 ppm. A maternal NOAEL could not be determined based on a

reduction of absolute body weight gain at all doses; the maternal LOAEL was set at 100 ppm. At 200 and 300 ppm there was a reduction in foetal body weights. Sporadic malformations occurred at 300 ppm and in the control group.
The NOAEL (developmental) was 100 ppm and the NOAEL (teratogenicity) was 300 ppm (highest dose tested).
Genotoxicity n-Butyl acrylate was negative in the Ames test with Salmonella typhimurium TA98, TA100, TA1535 and TA1537 with and without metabolic activation tested up to 10,000 µg/plate. In a cytogenetic assay with Chinese Hamster Ovary Cells, n-butyl acrylate showed no clastogenic potential in concentrations where no cytotoxicity occurred.
Without metabolic activation an increase of aberrant cells was observed at cytotoxic concentrations. No genotoxic effects were found in an in vitro micronucleus test and an UDS-test with Syrian hamster fibroblasts. In an in vivo cytogenetic assay, n-butyl acrylate showed no clastogenic effect in rats and hamsters after inhalation exposure.
Carcinogenicity n-Butyl acrylate was not carcinogenic to rats via inhalation up to 135 ppm (0.773 mg/L/day), the highest dose tested.
Based on the available oncogenicity data and without a better understanding of the carcinogenic mechanism the Health and Environmental Review Division (HERD), Office of Toxic Substances (OTS), of the US EPA previously concluded that all chemicals that contain the acrylate or methacrylate moiety (CH2=CHCOO or CH2=C(CH3)COO) should be considered to be a carcinogenic hazard unless shown otherwise by adequate testing.
This position has now been revised and acrylates and methacrylates are no longer de facto carcinogens.

TOXICITY	IRRITATION
HYDROQUINONE	
Oral (human) LDLo 29 mg/kg	Skin (human) 2% - Mild
Oral (human) TDLo 170 mg/kg	Skin (human) 5% - SEVERE
Oral (rat) LD50 320 mg/kg	

■ 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.

Hydroquinone is rapidly and extensively absorbed from the gut and lungs of animals. Absorption via the skin is slow but may be accelerated with vehicles such as alcohols. Hydroquinone distributes rapidly and widely among tissues. It is metabolized to 1,4-benzoquinone and other oxidised products, and is detoxified by conjugation to monoglucuronide, monosulfate, and mercapturic derivatives. The excretion of hydroquinone and its metabolites is rapid, and occurs primarily via the urine.

Hydroquinone exhibits moderate acute oral toxicity for animals. Limited data suggest that powdered hydroquinone causes transient eye irritation and corneal opacity in dogs and guinea-pigs; in rabbits powdered hydroquinone induced slight irritation of the eye. Hydroquinone may be a skin sensitiser in animals. The ability to induce sensitization has been found to vary from "weak" to "strong" depending on the test procedure and vehicle used.

Repeated oral dosing caused tremors and reduced activity .>=64 mg/kg), reduced body weight gain (>=200 mg/kg), convulsions (..400 mg/kg), and nephropathy in F-344 rats (>=100 mg/kg). No adverse effects on the kidneys were reported in Sprague-Dawley rats treated for the same length of time with the same dose levels. Effects in mice include tremors and convulsions (400 mg/kg), increased liver weight (>=25 mg/kg), and irritation of the forestomach (>=200 mg/kg). A functional observational battery and neuropathological examinations of rats failed to give any evidence of persistent or structural neurotoxicity after repeated dosing for 90 days. A NOEL for all effects was 20 mg/kg per day.

Fourteen days of repeated dermal dosing caused reduced body weights of male rats at the 3840 mg/kg dose level (6% relative to the controls), but the body weights of female rats at this dose level and of mice at 4800 mg/kg were comparable to controls. There were no clinical signs of toxicity in

either species. Prolonged dermal dosing over 13 weeks with 2.0, 3.5, or 5.0% hydroquinone in an oil-in-water emulsion cream resulted in minimal to minor dermal irritation, but no overt toxicity. No adverse effects or compound-related effects occurred in organ weight, clinical pathology, or histopathology. A NOEL was not determined because of the dermal irritation in all treated groups, but the NOAEL was the highest dose level of 5% hydroquinone (74 mg/kg in males and 110 mg/kg in females) based on the lack of systemic effects.

Reproductive effects A two-generation reproduction study was conducted in rats. The NOAEL for reproductive effects through two generations was 150 mg/kg per day (the highest dose tested).

Genetic toxicity Numerous genotoxicity studies of hydroquinone have been conducted. Hydroquinone is not mutagenic in the Salmonella/microsome test. Other data indicate that hydroquinone induces structural chromosome aberrations and c-mitotic effects in vivo in mouse bone-marrow cells following ip injection. In vitro studies with various cell lines showed that hydroquinone was capable of inducing gene mutations, structural chromosome aberrations, sister-chromatid exchange, and DNA damage. Hydroquinone produces adducts with DNA in vitro, but recent in vivo studies were unable to produce DNA adducts. While several experiments with hydroquinone have shown mutagenic effects; the relevance of these results to human risk is uncertain . The majority of positive mutagenicity studies use routes of exposure (parenteral or in vitro) which are not relevant to human exposures. A dominant lethal assay in rats was negative.

Carcinogenicity Sprague-Dawley rats treated for two-years with hydroquinone in the diet showed "atrophy of the liver cord cells, lymphoid tissue of the spleen, adipose tissue, and striated muscle together with superficial ulceration and hemorrhage of the stomach mucosa" but no carcinogenesis. Two-year studies performed by the NTP reported that hydroquinone exposure was associated with some evidence of carcinogenicity in F-344 rats and B6C3F1 mice. In the NTP study, renal tubular cell adenomas occurred in male rats and mononuclear cell leukemia in female rats, and hepatocellular neoplasms, mainly adenomas, in female mice. The NTP concluded that these data indicated "some evidence of carcinogenic activity" in male and female rats and in female mice. In an another study using F-344 rats and B6C3F1 mice, renal tubular cell adenomas were also noted in male rats; hepatocellular adenomas and renal cell hyperplasia were noted in male mice; and hyperplasia of the forestomach was noted in both male and female mice fed 0.8% hydroquinone diets for two years. The evidence provided by cancer bioassay studies is considered limited A U.S.E.P.A. review of the NTP bioassay found the bioassay results provide limited evidence of carcinogenicity in animals.

Mechanisms Covalent binding and oxidative stress are mechanisms postulated to be associated with hydroquinone-induced toxicity. Oxidised hydroquinone metabolites may covalently bind cellular macromolecules or alkylate low molecular weight nucleophiles (e.g., glutathione (GSH)) resulting in enzyme inhibition, alterations in nucleic acids and oxidative stress; however, redox cycling is not likely to contribute significantly to oxidative stress. The reaction of hydroquinone metabolites with GSH results in the formation of conjugates which can be further processed to cysteine conjugates which are postulated to cause kidney toxicity	Cell proliferation associated nephrotoxicity in a sensitive strain and species of animal (male F344 rat) has been postulated to be involved in the production of renal tumors in rats.

Interaction with Phenols

A number of studies reporting interactive effects between hydroquinone and other phenolic compounds. Coadministration of hydroquinone and phenol (75 mg/kg), when given by intraperitoneal injection twice per day, produced a synergistic decrease in bone marrow cellularity in B6C3F1 mice that was similar to that induced by benzene. This compound treatment was significantly more myelotoxic than that observed when either hydroquinone or phenol was administered separately. Associated in vitro studies suggested that this interactive effect was due to a phenol-induced stimulation of the myeloperoxidase-mediated conversion of hydroquinone to 1,4-benzoquinone in the bone marrow.

Subsequent studies have indicated that interactions between hydroquinone and other phenolic compounds can result in a variety of cytotoxic, immunotoxic and genotoxic effects.

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.

4-METHOXYPHENOL (MEHQ)

Oral (rat) LD50 1600 mg/kg	Skin (rabbit) 6000 mg/12d-I Mild

■ The material may cause 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.

CARCINOGEN

Hydroquinone	International Agency for Research on Cancer (IARC) - Agents Reviewed by the IARC Monographs	Group	3
Hydroquinone	US ACGIH Threshold Limit Values (TLV) - Carcinogens	Carcinogen Category	A3
hydroquinone	US - Rhode Island Hazardous Substance List	IARC	
HYDROQUINONE	US Environmental Defense Scorecard Suspected Carcinogens	Reference(s)	CPDB
TWAPPM~	US - Maine Chemicals of High Concern List	Carcinogen	A3
VPVB_(VERY~	US - Maine Chemicals of High Concern List	Carcinogen	CA Prop 65; IARC; NTP 11th ROC
4-methoxyphenol (MEHQ)	US - Rhode Island Hazardous Substance List	IARC	

Section 12 - ECOLOGICAL INFORMATION

Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
This material and its container must be disposed of as hazardous waste.
Avoid release to the environment.
Refer to special instructions/ safety data sheets.

Section 13 - DISPOSAL CONSIDERATIONS

US EPA Waste Number & Descriptions
A. General Product Information
Ignitability characteristic: use EPA hazardous waste number D001 (waste code I)
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.

Section 14 - TRANSPORTATION INFORMATION

DOT:

Symbols:	None	Hazard class or Division:	3
Identification Numbers:	UN2348	PG:	III
Label Codes:	3	Special provisions:	B1, IB3, T2, TP1
Packaging: Exceptions:	150	Packaging: Non-bulk:	203
Packaging: Exceptions:	150	Quantity limitations: Passenger aircraft/rail:	60 L
Quantity Limitations: Cargo aircraft only:	220 L	Vessel stowage: Location:	A
Vessel stowage: Other:	None		

Hazardous materials descriptions and proper shipping names:
Butyl acrylates, stabilized

Air Transport IATA:

UN/ID Number:	2348	Packing Group:	III
Special provisions:	None		
Cargo Only			
Packing Instructions:	366	Maximum Qty/Pack:	220 L
Passenger and Cargo		Passenger and Cargo	
Packing Instructions:	Y344	Maximum Qty/Pack:	60 L
Passenger and Cargo Limited Quantity		Passenger and Cargo Limited Quantity	
Packing Instructions:	355	Maximum Qty/Pack:	10 L

Shipping Name: BUTYL ACRYLATES, STABILIZED

Maritime Transport IMDG:

IMDG Class:	3	IMDG Subrisk:	None
UN Number:	2348	Packing Group:	III
EMS Number:	F-E,S-D	Special provisions:	None
Limited Quantities:	5 L	Marine Pollutant:	Yes

Section 15 - REGULATORY INFORMATION

tert-butyl acrylate (CAS: 1663-39-4) is found on the following regulatory lists;
"International Council of Chemical Associations (ICCA) - High Production Volume List","US EPA High Production Volume Chemicals Additional List","US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory"
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 - 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 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","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) - Chemical Substance Inventory","US TSCA Section 4/12 (b) - Sunset Date/Status","US TSCA Section 8 (d) - Health and Safety Data Reporting"
4-methoxyphenol (MEHQ) (CAS: 150-76-5) is found on the following regulatory lists;
"Canada - Alberta Occupational Exposure Limits","Canada - British Columbia Occupational Exposure Limits","Canada - Nova Scotia 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 Domestic Substances List (DSL)","Canada Ingredient Disclosure List (SOR/88-64)","Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (English)","International Fragrance Association (IFRA) Standards Prohibited","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 - 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 - 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 - Washington Permissible exposure limits of air contaminants","US ACGIH Threshold Limit Values (TLV)","US Cosmetic Ingredient Review (CIR) Ingredients found unsafe for use in cosmetics","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 NIOSH Recommended Exposure Limits (RELs)","US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory","US TSCA Section 12(b) - List of Chemical Substances Subject to Export Notification Requirements","US TSCA Section 4/12 (b) - Sunset Date/Status","US TSCA Section 8 (a) - Preliminary Assessment Information Rules (PAIR) - Reporting List","US TSCA Section 8 (d) - Health and Safety Data Reporting"

Section 16 - OTHER INFORMATION

LIMITED EVIDENCE

■ Cumulative effects may result following exposure*.
■ Possible respiratory sensitiser*.
* (limited evidence).

Reasonable care has been taken in the preparation of this information, but the author makes no warranty of merchantability or any other warranty, expressed or implied, with respect to this information. The author makes no representations and assumes no liability for any direct, incidental or consequential damages resulting from its use. For additional technical information please call our toxicology department on +800 CHEMCALL.

■ Classification of the preparation 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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