

# Tetrabutylammonium perchlorate

sc-251160

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

Tetrabutylammonium perchlorate

### STATEMENT OF HAZARDOUS NATURE

CONSIDERED A HAZARDOUS SUBSTANCE ACCORDING TO OSHA 29 CFR 1910.1200.

### NFPA



### SUPPLIER

Company: Santa Cruz Biotechnology, Inc.

Address:

2145 Delaware Ave

Santa Cruz, CA 95060

Telephone: 800.457.3801 or 831.457.3800

Emergency Tel: CHEMWATCH: From within the US and Canada:

877-715-9305

Emergency Tel: From outside the US and Canada: +800 2436 2255

(1-800-CHEMCALL) or call +613 9573 3112

### PRODUCT USE

Supporting electrolyte. Reagent

### SYNONYMS

C16-H36-Cl-N-O4, C16-H36-Cl-N-O4, (CH<sub>3</sub>(CH<sub>2</sub>)<sub>3</sub>)<sub>4</sub>NClO<sub>4</sub>, "quaternary ammonium compound"

## Section 2 - HAZARDS IDENTIFICATION

### CANADIAN WHMIS SYMBOLS



### EMERGENCY OVERVIEW

#### RISK

Contact with combustible material may cause fire.

Harmful if swallowed.

Irritating to skin.

Risk of serious damage to eyes.

Toxic to aquatic organisms.

## 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.
- Symptoms of exposure to perchlorates include shortness of breath, difficulty breathing and a bluish discoloration of the skin. The effects may be delayed for several hours following exposure. Nausea, vomiting, rashes, fever may occur; there may be anemia (which can be fatal), loss of platelets and white blood cells.
- Nausea and vomiting are almost always apparent after chlorate poisonings usually with upper stomach pain. Diarrhea may also occur. Chlorates are poisonous to the kidney and this can cause death. Healing can be slow and kidney symptoms last weeks. Often there is severe blood cell damage.
- Concentrated solutions of many cationics may cause corrosive damage to mucous membranes and the esophagus. Nausea and vomiting (sometimes bloody) may follow ingestion. Serious exposures may produce an immediate burning sensation of the mouth, throat and abdomen with profuse salivation, ulceration of mucous membranes, signs of circulatory shock (hypotension, labored breathing, and cyanosis) and a feeling of apprehension, restlessness, confusion and weakness. Weak convulsive movements may precede central nervous system depression. Erosion, ulceration, and petechial hemorrhage may occur through the small intestine with glottic, brain and pulmonary edema. Death may result from asphyxiation due to paralysis of the muscles of respiration or cardiovascular collapse. Fatal poisoning may arise even when the only pathological signs are visceral congestion, swallowing, mild pulmonary edema or varying signs of gastrointestinal irritation. Individuals who survive a period of severe hypertension may develop kidney failure. Cloudy swelling, patchy necrosis and fatty infiltration in such visceral organs as the heart, liver and kidneys shows at death.

#### EYE

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

#### SKIN

- 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

- There is some evidence to suggest that the material can cause respiratory irritation in some persons. The body's response to such irritation can cause further lung damage.
- Persons with impaired respiratory function, airway diseases and conditions such as emphysema or chronic bronchitis, may incur further disability if excessive concentrations of particulate are inhaled.

### CHRONIC HEALTH EFFECTS

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

Based on experience with animal studies, there is a possibility that exposure to the material may result in toxic effects to the development of the fetus, at levels which do not cause significant toxic effects to the mother.

Long term exposure to high dust concentrations may cause changes in lung function i.e. pneumoconiosis; caused by particles less than 0.5 micron penetrating and remaining in the lung. Prime symptom is breathlessness; lung shadows show on X-ray.

Chronic and/or sub-lethal exposure to inorganic chlorate may have deleterious effects on human health, such as redness of the eyes and skin (including dermatitis), sore throat, abdominal pain, blue lips or skin, diarrhea, nausea, vomiting, shortness of breath, and unconsciousness. Sodium chlorate may damage the liver, kidneys, and blood cells of humans.

Subchronic chlorate exposure was associated with smaller body and organ weights, blood abnormalities and pituitary and thyroid abnormalities in one study using Sprague-Dawley rats.

Chlorate is a thyroid toxicant producing thyroid gland follicular cell hypertrophy in rats and mice following chronic exposures, and may produce follicular cell tumors in rats. The lack of mutagenicity indicates that the thyroid tumors are induced by a non-mutagenic mechanism and are therefore not likely to be carcinogenic. The effects may be attributed to changes in levels of thyroid hormones seen after administration of high doses of sodium chlorate. In female mice there was equivocal and marginal evidence of increased pancreatic islet carcinoma. Sodium chlorate was negative in most bacterial gene mutation assays and in several cytogenetics tests, including a hypoxanthineguanine phosphoribosyl-transferase (HGPRT) assay in Chinese hamster ovaries and a micronucleus assay.

Intramuscular administration of potassium chlorate to pregnant rats resulted in a prolonged gestation period in most cases, and reduced neonatal weight relative to the controls. According to the author, newborn rats also showed a "marked" increase of haematopoietic residue and lipid deposit over controls, and occasionally, exposure resulted in the appearance of hyaline droplets and casts in newborn kidneys. The number of animals per treatment group/number affected, duration of exposure, and information on dose levels was not available.

African green monkeys (five males and seven females) were used to study the thyroid effects of sodium chlorate when administered for 30-60 days as chlorate at concentrations of 4, 7.5, 15, 30 or 58.4 mg/kg bw per day. Chlorate did not induce thyroid depression. Chlorate did not induce a dose-dependent oxidative stress, as was observed in the case of chlorite.

Female rats were exposed to 1 or 10 mg chlorate/L in their drinking water for ten weeks. Fetuses were taken on the 20th day of gestation and examined for external, visceral and skeletal malformations. No significant adverse findings were reported.






No chromosomal abnormalities were seen in either the micronucleus test or a cytogenetic assay in mouse bone marrow cells following gavage dosing with chlorate.

Prolonged or repeated skin contact may cause degreasing with drying, cracking and dermatitis following.

Perchlorates may affect the use of iodine by the thyroid gland and chronic exposures may result in symptoms of thyroid dysfunction such as goiter.

## Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

### HAZARD RATINGS

	Min	Max	
Flammability:	1		
Toxicity:	2		
Body Contact:	3		Min/Nil=0
Reactivity:	2		Low=1
Chronic:	2		Moderate=2
			High=3
			Extreme=4



NAME	CAS RN	%
tetrabutylammonium perchlorate	1923-70-2	>98

## 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:
  - For advice, contact a Poisons Information Center or a doctor.
  - Urgent hospital treatment is likely to be needed.
  - If conscious, give water to drink.
  - INDUCE vomiting with fingers down the back of the throat, ONLY IF CONSCIOUS. Lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration.
- NOTE: Wear a protective glove when inducing vomiting by mechanical means.
  - In the mean time, qualified first-aid personnel should treat the patient following observation and employing supportive measures as indicated by the patient's condition.
  - If the services of a medical officer or medical doctor are readily available, the patient should be placed in his/her care and a copy of the MSDS should be provided. Further action will be the responsibility of the medical specialist.
  - If medical attention is not available on the worksite or surroundings send the patient to a hospital together with a copy of the MSDS.

### 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 contact occurs:
  - Immediately remove all contaminated clothing, including footwear
  - Flush skin and hair with running water (and soap if available).
  - Seek medical attention in event of irritation.

### INHALED

- If dust is inhaled, remove from contaminated area.
- Encourage patient to blow nose to ensure clear passage of breathing.
- If irritation or discomfort persists seek medical attention.

### NOTES TO PHYSICIAN

- Antithyroid effects produced by the perchlorates may be reversed with iodine. Patients should be warned to report the development of sore throat, fever or rashes since these are indicative of blood abnormalities.

For chlorates:

For severe intoxication: Empty the stomach by lavage and aspiration or by emesis, give demulcents or sweetened drinks and maintain respiration. Pethidine may be given if required. A 1% solution of sodium thiosulfate may be used for lavage and may also be given by intravenous infusion. Haemodialysis, peritoneal dialysis or exchange perfusions may be of value in removing chlorate from the blood. Forced diuresis should not be attempted if there is inadequate urine input.

MARTINDALE: The Extra Pharmacopoeia, 27th Edition

The high sensitivity of glucose-6-phosphate dehydrogenase to denaturation by chlorate explains the inefficacy of methylene blue to reduce methaemoglobin formed, as the antidotal effect of methylene blue depends on NADPH formed mainly by the oxidation of glucose-6-phosphate. The observed changes occur only in the presence of methaemoglobin which forms a destabilising complex with chlorate. Methaemoglobin thus autocatalytically increases methaemoglobin formation and destruction of the erythrocyte.

For exposures to quaternary ammonium compounds;

- For ingestion of concentrated solutions (10% or higher): Swallow promptly a large quantity of milk, egg whites / gelatin solution. If not readily available, a slurry of activated charcoal may be useful. Avoid alcohol. Because of probable mucosal damage omit gastric lavage and emetic drugs.
- For dilute solutions (2% or less): If little or no emesis appears spontaneously, administer syrup of Ipecac or perform gastric lavage.

- If hypotension becomes severe, institute measures against circulatory shock.
- If respiration laboured, administer oxygen and support breathing mechanically. Oropharyngeal airway may be inserted in absence of gag reflex. Epiglottic or laryngeal edema may necessitate a tracheotomy.
- Persistent convulsions may be controlled by cautious intravenous injection of diazepam or short-acting barbiturate drugs. [Gosselin et al, Clinical Toxicology of Commercial Products]

## Section 5 - FIRE FIGHTING MEASURES

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

### EXTINGUISHING MEDIA

#### • FOR SMALL FIRE:

- USE FLOODING QUANTITIES OF WATER.
- DO NOT use dry chemicals, CO2 or foam.

#### FOR LARGE FIRE:

- Flood fire area with water from a protected position.

### FIRE FIGHTING

- 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.
- Fight fire from a safe distance, with adequate cover.
- Extinguishers should be used only by trained personnel.
- 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.
- If fire gets out of control withdraw personnel and warn against entry.
- Equipment should be thoroughly decontaminated after use.

### GENERAL FIRE HAZARDS/HAZARDOUS COMBUSTIBLE PRODUCTS

- Combustible solid which burns but propagates flame with difficulty.
- Avoid generating dust, particularly clouds of dust in a confined or unventilated space as dusts may form an explosive mixture with air, and any source of ignition, i.e. flame or spark, will cause fire or explosion. Dust clouds generated by the fine grinding of the solid are a particular hazard; accumulations of fine dust may burn rapidly and fiercely if ignited.
- Dry dust can be charged electrostatically by turbulence, pneumatic transport, pouring, in exhaust ducts and during transport.
- Build-up of electrostatic charge may be prevented by bonding and grounding.
- Powder handling equipment such as dust collectors, dryers and mills may require additional protection measures such as explosion venting.

Combustion products include: carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>), hydrogen chloride, phosgene, nitrogen oxides (NO<sub>x</sub>), other pyrolysis products typical of burning organic material.

### FIRE INCOMPATIBILITY

- Avoid storage with reducing agents.
- Avoid any contamination of this material as it is very reactive and any contamination is potentially hazardous

### PERSONAL PROTECTION

Glasses:

Full face- shield.

Gloves:

Respirator:

Particulate dust filter.

## Section 6 - ACCIDENTAL RELEASE MEASURES

### MINOR SPILLS

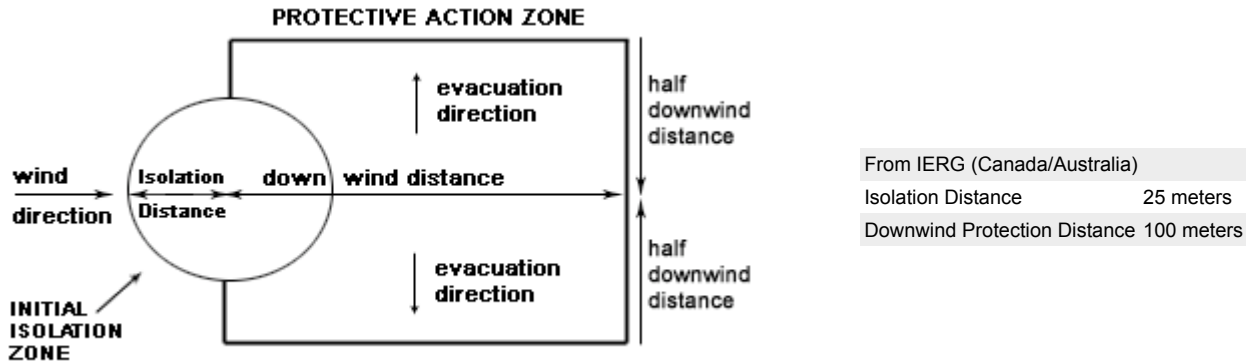
- Clean up all spills immediately.
- No smoking, naked lights, ignition sources.
- Avoid all contact with any organic matter including fuel, solvents, sawdust, paper or cloth and other incompatible materials; as ignition may result.
- Avoid breathing dust or vapors and all contact with skin and eyes.

- Control personal contact by using protective equipment.
- Contain and absorb spill with dry sand, earth, inert material or vermiculite
- DO NOT use sawdust as fire may result.
- Scoop up solid residues and seal in labeled drums for disposal.
- Neutralize/decontaminate area.

#### 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 and protective gloves.
- Prevent, by any means available, spillage from entering drains or water courses.
- No smoking, flames or ignition sources. Increase ventilation.
- Contain spill with sand, earth or other clean, inert materials.
- NEVER use organic absorbents such as sawdust, paper or cloth.
- Use spark-free and explosion-proof equipment.
- Collect any recoverable product into labeled containers for possible recycling.
- Avoid contamination with organic matter to prevent subsequent fire and explosion.
- DO NOT mix fresh with recovered material.
- Collect residues and seal in labeled drums for disposal.
- Wash area and prevent runoff into drains.
- Decontaminate equipment and launder protective clothing before storage and re-use.
- If contamination of drains or waterways occurs advise emergency services.

#### PROTECTIVE ACTIONS FOR SPILL



#### 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 140 is taken from the US DOT emergency response guide book.
- 6 IERG information is derived from CANUTEC - Transport Canada.

#### ACUTE EXPOSURE GUIDELINE LEVELS (AEGL) (in ppm)

AEGL 1: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic nonsensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.

AEGL 2: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.

AEGL 3: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

## Section 7 - HANDLING AND STORAGE

### PROCEDURE FOR HANDLING

- 
- Avoid personal contact and inhalation of dust, mist or vapors.
- Provide adequate ventilation.
- Always wear protective equipment and wash off any spillage from clothing.
- Keep material away from light, heat, flammables or combustibles.
- Keep cool, dry and away from incompatible materials.
- Avoid physical damage to containers.
- DO NOT repack or return unused portions to original containers.
- Withdraw only sufficient amounts for immediate use.
- Contamination can lead to decomposition leading to possible intense heat and fire.
- When handling NEVER smoke, eat or drink.
- Always wash hands with soap and water after handling.
- Use only good occupational work practice.
- Observe manufacturer's storing and handling directions.

Empty containers may contain residual dust which has the potential to accumulate following settling. Such dusts may explode in the presence of an appropriate ignition source.

- Do NOT cut, drill, grind or weld such containers.
- In addition ensure such activity is not performed near full, partially empty or empty containers without appropriate workplace safety authorisation or permit.

### RECOMMENDED STORAGE METHODS

- Glass container.
- DO NOT repack. Use containers supplied by manufacturer only.

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:

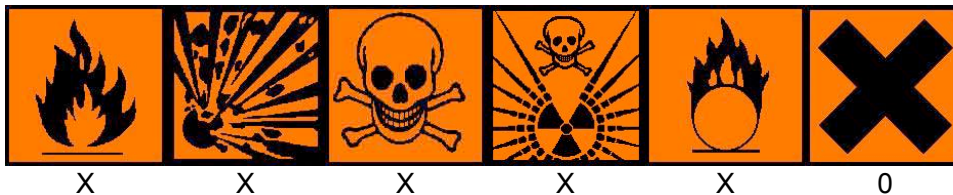
- Removable head packaging and
- cans with friction closures may be used.

- 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.

### STORAGE REQUIREMENTS

• In addition, Goods of Class 5.1, packing group III should be stored in packages and be separated from buildings, tanks, and compounds containing other dangerous goods in tanks, and from property boundaries by a distance of at least 5 metres.

### 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 <sup>3</sup>	STEL ppm	STEL mg/m <sup>3</sup>	Peak ppm	Peak mg/m <sup>3</sup>	TWA F/CC	Notes
US - Oregon Permissible Exposure Limits (Z-3)	tetrabutylammonium perchlorate (Inert or Nuisance Dust: Total dust)		10						(d)
US OSHA Permissible Exposure Levels (PELs) - Table Z3	tetrabutylammonium perchlorate (Inert or Nuisance Dust: (d) Respirable fraction)		5						
US OSHA Permissible Exposure Levels (PELs) - Table Z3	tetrabutylammonium perchlorate (Inert or Nuisance Dust: (d) Total dust)		15						

US - Hawaii Air Contaminant Limits	tetrabutylammonium perchlorate (Particulates not other wise regulated - Total dust)	10	
US - Hawaii Air Contaminant Limits	tetrabutylammonium perchlorate (Particulates not other wise regulated - Respirable fraction)	5	
US - Oregon Permissible Exposure Limits (Z-3)	tetrabutylammonium perchlorate (Inert or Nuisance Dust: Respirable fraction)	5	(d)
US ACGIH Threshold Limit Values (TLV)	tetrabutylammonium perchlorate (Particles (Insoluble or Poorly Soluble) [NOS] Inhalable particles)	10	See Appendix B current TLV/BEI Book
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants	tetrabutylammonium perchlorate (Particulates not otherwise regulated Respirable fraction)	5	
US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants	tetrabutylammonium perchlorate (Particulates not otherwise regulated (PNOR)(f)- Respirable fraction)	5	
US - Michigan Exposure Limits for Air Contaminants	tetrabutylammonium perchlorate (Particulates not otherwise regulated, Respirable dust)	5	
Canada - Prince Edward Island Occupational Exposure Limits	tetrabutylammonium perchlorate (Particles (Insoluble or Poorly Soluble) [NOS] Inhalable particles)	10	See Appendix B current TLV/BEI Book

## MATERIAL DATA

### TETRABUTYLAMMONIUM PERCHLORATE:

• It is the goal of the ACGIH (and other Agencies) to recommend TLVs (or their equivalent) for all substances for which there is evidence of health effects at airborne concentrations encountered in the workplace.

At this time no TLV has been established, even though this material may produce adverse health effects (as evidenced in animal experiments or clinical experience). Airborne concentrations must be maintained as low as is practically possible and occupational exposure must be kept to a minimum.

NOTE: The ACGIH occupational exposure standard for Particles Not Otherwise Specified (P.N.O.S) does NOT apply.

Sensory irritants are chemicals that produce temporary and undesirable side-effects on the eyes, nose or throat. Historically occupational exposure standards for these irritants have been based on observation of workers' responses to various airborne concentrations. Present day expectations require that nearly every individual should be protected against even minor sensory irritation and exposure standards are established using uncertainty factors or safety factors of 5 to 10 or more. On occasion animal no-observable-effect-levels (NOEL) are used to determine these limits where human results are unavailable. An additional approach, typically used by the TLV committee (USA) in determining respiratory standards for this group of chemicals, has been to assign ceiling values (TLV C) to rapidly acting irritants and to assign short-term exposure limits (TLV STELs) when the weight of evidence from irritation, bioaccumulation and other endpoints combine to warrant such a limit. In contrast the MAK Commission (Germany) uses a five-category system based on intensive odour, local irritation, and elimination half-life. However this system is being replaced to be consistent with the European Union (EU) Scientific Committee for Occupational Exposure Limits (SCOEL); this is more closely allied to that of the USA.

OSHA (USA) concluded that exposure to sensory irritants can:

- cause inflammation
- cause increased susceptibility to other irritants and infectious agents
- lead to permanent injury or dysfunction
- permit greater absorption of hazardous substances and
- acclimate the worker to the irritant warning properties of these substances thus increasing the risk of overexposure.

## 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.

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.

- DO NOT wear cotton or cotton-backed gloves.
- DO NOT wear leather gloves.
- Promptly hose all spills off leather shoes or boots or ensure that such footwear is protected with PVC over-shoes.

## OTHER

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

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- Respirators may be necessary when engineering and administrative controls do not adequately prevent exposures.
- The decision to use respiratory protection should be based on professional judgment that takes into account toxicity information, exposure measurement data, and frequency and likelihood of the worker's exposure - ensure users are not subject to high thermal loads which may result in heat stress or distress due to personal protective equipment (powered, positive flow, full face apparatus may be an option).
- Published occupational exposure limits, where they exist, will assist in determining the adequacy of the selected respiratory . These may be government mandated or vendor recommended.
- Certified respirators will be useful for protecting workers from inhalation of particulates when properly selected and fit tested as part of a complete respiratory protection program.
- Use approved positive flow mask if significant quantities of dust becomes airborne.
- Try to avoid creating dust conditions.

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

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- Local exhaust ventilation is required where solids are handled as powders or crystals; even when particulates are relatively large, a certain proportion will be powdered by mutual friction.
- Exhaust ventilation should be designed to prevent accumulation and recirculation of particulates in the workplace.
- If in spite of local exhaust an adverse concentration of the substance in air could occur, respiratory protection should be considered. Such protection might consist of:

(a): particle dust respirators, if necessary, combined with an absorption cartridge;

(b): filter respirators with absorption cartridge or canister of the right type;

(c): fresh-air hoods or masks

- Build-up of electrostatic charge on the dust particle, may be prevented by bonding and grounding.
- Powder handling equipment such as dust collectors, dryers and mills may require additional protection measures such as explosion venting.

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

Type of Contaminant:	Air Speed:
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 4-10 m/s (800-2000 f/min) for extraction of crusher dusts generated 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

Mixes with water.

State	DIVIDED SOLID	Molecular Weight	341.92
Melting Range (°F)	410 approx.	Viscosity	Not Applicable
Boiling Range (°F)	Not available.	Solubility in water (g/L)	Miscible
Flash Point (°F)	Not available	pH (1% solution)	Not available.
Decomposition Temp (°F)	Not Available	pH (as supplied)	Not applicable
Autoignition Temp (°F)	Not available	Vapour Pressure (mmHG)	Negligible
Upper Explosive Limit (%)	Not available	Specific Gravity (water=1)	Not available.
Lower Explosive Limit (%)	Not available	Relative Vapor Density (air=1)	Not applicable
Volatile Component (%vol)	Negligible	Evaporation Rate	Not applicable

### APPEARANCE

White hygroscopic crystalline powder; mixes with water.

## Section 10 - CHEMICAL STABILITY

### CONDITIONS CONTRIBUTING TO INSTABILITY

- 
- Presence of incompatible materials.
- Product is considered stable under normal handling conditions.
- Prolonged exposure to heat.
- Hazardous polymerization will not occur.

### STORAGE INCOMPATIBILITY

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- Quaternary oxidants are effectively complete fuel oxidant systems at the molecular level with the oxidising anion juxtaposed in the crystal lattice with the organic cation. there have been several instances of unheralded and violent decomposition with this type of compound which, taken together, suggests that considerable caution is necessary in the preparation, storage and use of these potentially hazardous salts.
- Dependent on the nature of the quaternary cation, a series of permanganate salts decomposed explosively at 80-90 deg. C ("unsaturated" cations) or passively at 80-100 deg C ("saturated" cations)
- Examination of the thermal instability and mode of decomposition of several salts leads to the conclusion that thermal stability is a matter of concern and that the salts should be held only in small quantity and in cold storage at all times. Extreme care should be taken when transferring from one container to another

NOTE: May contain traces of perchloric acid or may, on contact with acids, produce an anhydrous perchloric acid an extremely reactive and explosive species. Many of the reported explosions involving perchlorate may result its ability to form unstable perchlorate esters or salts of the anhydrous acid.

#### WARNING:

- On the basis of experience with cobalt(III) perchlorate, attention is drawn to the possibility of stable metal perchlorates being converted by unintentional dehydration to unstable (endothermic) lower hydrates capable of explosive decomposition in the absence of impurities. Great care must be taken to avoid dehydration or desolvation of perchlorates.
- Metal perchlorates may be explosively reactive with finely divided aluminium, magnesium and zinc and other metals, calcium and strontium hydrides, glycol (on heating), sulfuric acid (with the formation of unstable perchloric acid), and trifluoromethanesulfonic acid.
- The perchlorate salts of the complexes of divalent cobalt, nickel and particularly iron ([tetramethyl[14]-N8 complexes) are potentially explosive and storage for more than 4 weeks is inadvisable
- Avoid any contamination of this material as it is very reactive and any contamination is potentially hazardous
- Segregate chlorates from organic matter, acids, poisonous gases, flammables, corrosives, aluminium and ammonium salts and any other combustible material.

- Mixtures of chlorates with fibrous and absorbent organic materials such as wood, paper, leather, flour, sawdust, sugar, shellac, may be ignited or caused to explode by static sparks, friction or shock.
- The extreme hazardous nature of mixtures of metal chlorates with phosphorus or sulfur, apart from being powerful explosives, are dangerously sensitive to friction or shock; spontaneous ignition occasionally occurs.
- Mixtures with sucrose, lactose, chromium, sulfur dioxide, sodium amide, zirconium, germanium and titanium explode on heating.
- Forms incompatible sometimes explosive mixtures with thorium dicarbide, strontium hydride, hydrogen iodide, fluorine, cyanoguanidine, cyanides, dinickel trioxide, powdered carbon, aqua regia and ruthenium, nitric acid, manganese dioxide and potassium hydroxide or boron.
- Chlorates should not be allowed to come into contact with ammonium salts, aluminium and other powdered metals, phosphorous, silicon, sulfur, sulfides, sulfuric acid, nitrobenzene, iodides and tartaric acid
- Mixtures with hydrocarbons, metal phosphides (Zn, Ag, Al, Cu, Hg, Mg, etc), metal thiocyanates, metal sulfides, arsenic, carbon, phosphorous, sulfur, ammonium salts, powdered metals, arsenic trioxide, phosphorous, silicon, sulfur, sulfides, sulfites and hyposulfites are easily ignited (by friction impact or heat) and are potentially explosive.
- Metal chlorates in contact with strong acids liberate explosive chlorine dioxide gas. With concentrated sulfuric acid a violent explosion can occur unless effective cooling is used. Mixing potassium chlorate and concentrated sulfuric acid results in an explosion with optimum temperature range being 120-130. Heating a moist mixture of metal chlorate and a dibasic organic acid (tartaric or citric acid) liberates chlorine dioxide diluted with carbon dioxide.
- Fusion of chlorates with metal cyanides may lead to an explosion.
- Chlorates containing 1-2% bromate or sulfur are liable to spontaneous explosion.
- Chlorates releases oxygen, chlorine and chlorine dioxide when heated above 300 deg. C..
- In presence of moisture may release oxygen and ozone
- Intimate mixtures of chlorates, bromates or iodates of barium, cadmium, calcium, magnesium, potassium, sodium or zinc, with finely divided aluminium, arsenic, copper, carbon, phosphorus, sulfur, hydrides of alkali- and alkaline earth-metals; sulfides of antimony, arsenic, copper or tin; metal cyanides, thiocyanates; or impure manganese dioxide may react explosively or violently, either spontaneously (especially in the presence of moisture) or on initiation by heat, impact or friction, sparks or addition of sulfuric acid.

BRETHERRICKS HANDBOOK OF REACTIVE CHEMICAL HAZARDS, 4th Edition.

- Inorganic reducing agents react with oxidizing agents to generate heat and products that may be flammable, combustible, or otherwise reactive. Their reactions with oxidizing agents may be violent.

Avoid storage with reducing agents.

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

## Section 11 - TOXICOLOGICAL INFORMATION

tetrabutylammonium perchlorate

### TOXICITY AND IRRITATION

- unless otherwise specified data extracted from RTECS - Register of Toxic Effects of Chemical Substances.
- Most undiluted cationic surfactants satisfy the criteria for classification as Harmful (Xn) with R22 and as Irritant (Xi) for skin and eyes with R38 and R41.

#### For quaternary ammonium compounds (QACs):

Quaternary ammonium compounds (QACs) are cationic surfactants. They are synthetic organically tetra-substituted ammonium compounds, where the R substituents are alkyl or heterocyclic radicals. A common characteristic of these synthetic compounds is that one of the R's is a long-chain hydrophobic aliphatic residue

The cationic surface active compounds are in general more toxic than the anionic and non-ionic surfactants. The positively-charged cationic portion is the functional part of the molecule and the local irritation effects of QACs appear to result from the quaternary ammonium cation.

Due to their relative ability to solubilise phospholipids and cholesterol in lipid membranes, QACs affect cell permeability which may lead to cell death. Further QACs denature proteins as cationic materials precipitate protein and are accompanied by generalised tissue irritation.

It has been suggested that the experimentally determined decrease in acute toxicity of QACs with chain lengths above C16 is due to decreased water solubility.

In general it appears that QACs with a single long-chain alkyl groups are more toxic and irritating than those with two such substitutions,

The straight chain aliphatic QACs have been shown to release histamine from minced guinea pig lung tissue. However, studies with benzalkonium chloride have shown that the effect on histamine release depends on the concentration of the solution. When cell suspensions (11% mast cells) from rats were exposed to low concentrations, a decrease in histamine release was seen. When exposed to high concentrations the opposite result was obtained.

In addition, QACs may show curare-like properties (specifically benzalkonium and cetylpyridinium derivatives, a muscular paralysis with no involvement of the central nervous system. This is most often associated with lethal doses Parenteral injections in rats, rabbits and dogs have resulted in prompt but transient limb paralysis and sometimes fatal paresis of the respiratory muscles. This effect seems to be transient. From human testing of different QACs the generalised conclusion is obtained that all the compounds investigated to date exhibit similar toxicological properties.

Acute toxicity: Studies in rats have indicated poor intestinal absorption of QACs. Acute toxicity of QACs varies with the compound and, especially, the route of administration. For some substances the LD50 value is several hundreds times lower by the i.p. or i.v. than the oral route, whereas toxicities between the congeners only differ in the range of two to five times.

At least some QACs are significantly more toxic in 50% dimethyl sulfoxide than in plain water when given orally

Probably all common QAC derivatives produce similar toxic reactions, but as tested in laboratory animals the oral mean lethal dose varies with the compound.

Oral toxicity: LD50 values for QACs have been reported within the range of 250-1000 mg/kg for rats, 150-1000 mg/kg for mice, 150-300 mg/kg for guinea pigs and about 500 mg/kg b.w. for rabbits and dogs. The ranges observed reflect differences in the study designs of these rather old experiments as well as differences between the various QACs.

The oral route of administration was characterised by delayed deaths, gastrointestinal lesions and respiratory and central nervous system depression. It was also found that given into a full stomach, the QACs lead to lower mortality and fewer gastrointestinal symptoms. This supports the suggestion of an irritating effect

Dermal toxicity: It has been concluded that the maximum concentration that did not produce irritating effect on intact skin is 0.1%. Irritation became manifest in the 1-10% range. Concentrations below 0.1% have caused irritation in persons with contact dermatitis or broken skin. Although the absorption of QACs through normal skin probably is of less importance than by other routes, studies with excised guinea pig skin have shown that the permeability constants strongly depends on the exposure time and type of skin

Sensitisation: Topical mucosal application of QACs may produce sensitisation. Reports on case stories and patch test have shown that compounds such as benzalkonium chloride, cetalkonium chloride and cetrimide may possibly act as sensitisers. However, in general it is suggested that QACs have a low potential for sensitising man. It is difficult to distinguish between an allergic and an irritative skin reaction due to the inherent skin irritating effect of QACs.

#### **Long term/repeated exposure:**

Inhalation: A group of 196 farmers (with or without respiratory symptoms) were evaluated for the relationship between exposure to QACs (unspecified, exposure levels not given) and respiratory disorders by testing for lung function and bronchial responsiveness to histamine. After histamine provocation statistically significant associations were found between the prevalence of mild bronchial responsiveness (including asthma-like symptoms) and the use of QACs as disinfectant. The association seems even stronger in people without respiratory symptoms.

Genetic toxicity: QACs have been investigated for mutagenicity in microbial test systems. In Ames tests using *Salmonella typhimurium* with and without metabolic activation no signs of mutagenicity has been observed. Negative results were also obtained in *E. coli* reversion and *B. subtilis* rec assays. However, for benzalkonium chloride also positive and equivocal results were seen in the *B. subtilis* rec assays.

No significant acute toxicological data identified in literature search.

## **Section 12 - ECOLOGICAL INFORMATION**

Refer to data for ingredients, which follows:

**TETRABUTYLAMMONIUM PERCHLORATE:**

- Toxic to aquatic organisms.
- 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.

- For quaternary ammonium compounds (QACs):

QACs are white, crystalline powders. Low molecular weight QACs are very soluble in water, but slightly or not at all soluble in solvents such as ether, petrol and benzene. As the molecular weight and chain lengths increases, the solubility in polar solvents (e.g. water) decreases and the solubility in non-polar solvents increases.

Environmental fate

A major part of the QACs is discharged into wastewater and removed in the biological processes of sewage treatment plant. A 90% reduction of the QACs in the water phase of sludge has been reported and alkyl di-/ trimethyl ammonium and alkyl dimethyl benzyl ammonium compounds seem almost completely degraded in sewage sludge.

However, the aerobic and anaerobic biodegradability of QACs is not well investigated. Only sparse data are available concerning stability, solubility and biodegradability. In general, it seems that the biodegradability decreases with increasing numbers of alkyl chains:  $R(\text{CH}_3)_3\text{N}^+ > R_2(\text{CH}_3)_2\text{N}^+ > R_3(\text{CH}_3)\text{N}^+$ . Within each category the biodegradability seems inversely proportional to the alkyl chain length. Heterocyclic QACs are less degradable than the non-cyclic.

Investigations have shown that bioaccumulation of considerable dimensions will probably not take place.

Ecotoxicity:

Quaternary ammonium compounds and their polymers may be highly toxic to fish and other aquatic organisms. The toxicity of the quaternary ammoniums is known to be greatly reduced in the environment because of preferential binding to dissolved organics in surface water.

- Perchlorate poses a human health concern because this contaminant has the same ionic size as iodide, and can compete with iodide for uptake into the thyroid gland, causing changes in thyroid hormone levels and possibly thyroid disorders. Although the long-term effects on humans are currently being debated, public concerns have generated considerable legislation designed to minimise potential damage. The environmental impacts of perchlorate have been less well studied, but the pollutant is clearly being transferred between abiotic and biotic ecosystem components.

Perchlorate consists of four-double covalent bonds between chlorine and oxygen (tetrahedral coordination), making this highly soluble oxyanion very stable and nonreactive in aqueous environments. Perchlorate salts also have a very low volatility. Although a strong oxidizing agent, the perchlorate anion is stable in the environment, due to the high activation energy associated with its abiotic reduction to chlorate ( $\text{ClO}_3^-$ ). Moreover, given its relatively low charge density, perchlorate does not form complexes with metals in the same manner as other anions, and it does not readily sorb to environmental media. This combination of perchlorate solubility, stability, and mobility creates the potential for both localised and area-wide potential effects of ecotoxicological interest. As such, it is a relatively non-reactive and kinetically a very stable contaminant, with very low biodegradation rates under many natural conditions. Biodegradation of perchlorate in the natural environment (e.g., sediments) will not occur unless significant levels of organic carbon are present, oxygen and nitrate are depleted, and perchlorate-degrading anaerobic bacteria are present.

Perchlorate ( $\text{ClO}_4^-$ ) is a highly toxic compound that is stable and persistent in the environment. Once perchlorate gets into the food chain or water supply, it does not break down easily. It has been detected in surface and ground water, soils and food (lettuce, bottled water, milk, meat, kelp, animal feed). It is stable, water soluble and persistent; it is not volatile and does not readily adhere to soil. It is also found in plants because its solubility in water allows it be taken up by their roots. The populations considered to be most sensitive to perchlorate exposure are nursing infants, children, post-menopausal women, and people with hypothyroidism. Perchlorate interferes with thyroid functioning and is especially dangerous to fetuses, babies, and children. It causes thyroid iodine deficiency that in turn limits the gland's ability to produce a hormone essential to neurological development. "On average, children of iodine-deficient mothers have 5-to-13 fewer IQ points compared to children of mothers with iodine-sufficient diets," according to a report issued by the Environment California Research and Policy Center. "Reduced thyroid levels in the first few weeks of life for pre-term and low birth-weight babies are associated with increased risk of neurological disorders, including the need for special education by age nine."

Little is known about how perchlorate affects other species and the environment.

Until perchlorate effects on the human body are better understood a human reference dose of 0.0007 mg/kg per day has been suggested by the US EPA. The human reference dose is the daily exposure level below which EPA believes there would be no serious negative effects to a human over their lifetime. The EPA added that it considers drinking water safe if it contains no more than 24.5 parts per billion (ppb) of perchlorate.

Perchlorate has contaminated ground and surface waters that are currently being used for irrigation in food production. Physical processes

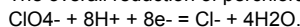
including mixing and dispersion control the distribution of perchlorate in groundwater.

Soil is not expected to naturally contain perchlorate. Perchlorate does not adsorb onto inorganic surfaces, including hydrous ferric oxide, smectite, and manganese oxide. These are characterised by net-negative surface charges at pH of 6.5 to 9.0. The inorganic perchlorate compounds introduced into soils are readily soluble and are not strongly adsorbed by other soil components. In soils, perchlorate is chemically stable and is expected to behave in a manner similar to dissolved minerals. While perchlorate is subject to leaching, its content in the soil is expected to approach steady state equilibrium in irrigated crop production system.

Perchlorate has been shown to be absorbed into crops from irrigation water or other sources. Reports show that raw materials and ingredients used to formulate fertilizers may contain significant amounts of perchlorate. Sodium nitrate imported from Chile is manufactured from Chilean caliche ores that are known to contain considerable amounts of perchlorate. Plants absorb nutrients and pollutants from solutions in the soil. Evidence shows that plants take up perchlorate from soils by processes similar to those of pertechnetate ( $\text{TcO}_4^-$ ) and nitrate. Based on the basic principles of ion transport processes, plants exposed to perchlorate in the growing media are expected to accumulate perchlorate. The extent of the accumulation, however, may be influenced by external factors such as plant species and maturity, nutrient concentrations, and consumptive use of water. perchlorate uptake increased linearly in proportion to the perchlorate concentration in the growth media and the plant biomass. While there is evidence that a portion of the absorbed perchlorate may be reduced inside the plant through biochemical pathways similar to reductive microbial metabolic mechanisms, the majority of the absorbed perchlorate will translocate to and concentrate in the leaf tissue. Since oxygen is always present in the leaf tissue, plant mediated perchlorate reductions are not likely to be efficient or complete. The slow rate of phytodegradation of the perchlorate fraction taken up by plants during the growing season explains the detection of higher perchlorate concentrations in leaves collected later in the growing season (autumn) and in senesced leaves compared to younger, live leaves. This proves that the leaves of senesced plant potentially recycle perchlorate back into the soil on which plant litter collects. To minimise the potential recycling of perchlorate during phytoremediation, it is recommended that senesced leaves be collected and composted or phytoremediation be designed to enhance rapid rhizodegradation (rhizoremediation)

The fate of perchlorate ( $\text{ClO}_4^-$ ) in streambed sediments is becoming a concern due to the increasing number of groundwater and surface water contamination sites. Results indicated that the spatial and temporal  $\text{ClO}_4^-$  penetration into sediments could be affected by numerous factors, such as temperature, microbial degradation,  $\text{ClO}_4^-$  surface water concentration, and sediment physico-geological properties. In general, maximum  $\text{ClO}_4^-$  penetration into sediments at the studied sites was 30 cm below the sediment-water surface. The vertical sequential depletion of electron acceptors in sediments suggested that microbial reduction was responsible for  $\text{ClO}_4^-$  depletion in stream sediments. Biodegradation of  $\text{ClO}_4^-$  occurred over a seasonally variable active depth zone of 1-10 cm. Results implied that there was a rapid natural attenuation potential of perchlorate in near-surface sediments. Perchlorate may be rapidly attenuated in saturated near-surface sediments.

The overall reduction of perchlorate to chloride is given by the following half reaction:



This reaction has relevance to natural systems such as wetlands and other microbially-active environments with plentiful and diverse electron donors. Perchlorate is reduced to intermediate compounds (chlorate [ $\text{Cl(V)}$ ] and chlorite [ $\text{Cl(III)}$ ]) and eventually to chloride in anaerobic environments by serving as a terminal electron acceptor during oxidation of acetate and other forms of reactive organic carbon. Perchlorate reduction is both thermodynamically and microbially enhanced under denitrifying conditions. Perchlorate has been shown to serve as a terminal electron acceptor for energy and growth. Reductase enzymes catalyse the reduction of perchlorate to chlorate and then to chlorite ( $\text{ClO}_2^-$ ). A fairly unique enzyme, a dismutase, then facilitates the disproportionation of  $\text{ClO}_2^-$  to  $\text{Cl}^-$  and  $\text{O}_2$ . There are numerous strains of micro-organisms capable of reducing both chlorate and perchlorate under anoxic conditions. The chlorite dismutase enzyme is present in all dissimilatory perchlorate- and chlorate reducing bacteria. Under anaerobic conditions, perchlorate and chlorate- are first converted to chlorite ( $\text{ClO}_2^-$ ) by the enzyme chlorate reductase, which is present in perchlorate- and chlorate-reducing bacteria. In the second step, chlorite is disproportionated to chloride ( $\text{Cl}^-$ ) and molecular oxygen ( $\text{O}_2$ ) by the non-respiratory enzyme chlorite dismutase, which catalyses the reaction. The presence of chlorite dismutase is a prerequisite for the growth of perchlorate- and chlorate reducing bacteria as chlorite is toxic due to its high reactivity.

Perchlorate is not likely to come out of solution given its low vapor pressure. Droplet size during showering would likely preclude significant inhalation of perchlorate-contaminated water as an aerosol.

In perchlorate-contaminated lakes and streams, perchlorate is detected infrequently in fish heads, filets, and whole bodies, but may be detected more often depending on species and seasonal trends, and always at concentrations higher in the fish than in the water. Perchlorates may perturb thyroid-hormone concentration in fish; this may affect growth and neurological development. Data from fish indicates that perchlorate can also disrupt sexual development. Certain have been so dramatic that female fish have been mistaken for males. Several females displayed male-courtship behavior and produced sperm. This is suggestive of the fact that perchlorate may act as an androgen (male sex hormone). The concentration of perchlorate used in these studies were at least a 1000 times the US EPA limit (24.5 parts per billion in natural bodies of water).

- DO NOT discharge into sewer or waterways.

## 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. 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.

FOR DISPOSAL OF SMALL QUANTITIES:

- Cautiously acidify a 3% solution or a suspension of the material to pH 2 with sulfuric acid.
- Gradually add a 50% excess of aqueous sodium bisulfite with stirring at room temperature. (Other reducers such as thiosulfate or ferrous salts may substitute; do NOT use carbon, sulfur or other strong reducing agents). An increase in temperature indicates reaction is taking place. If no reaction is observed on the addition of about 10% of the sodium bisulfite solution, initiate it by cautiously adding more acid.
- If manganese, chromium or molybdenum are present adjust the pH of the solution to 7 and treat with sulfide to precipitate for burial as a hazardous waste. Destroy excess sulfide, neutralize and flush the solution down the drain (subject to State and Local Regulation).

[Sigma/Aldrich].

- 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:	5.1
Identification Numbers:	UN1479	PG:	III
Label Codes:	5.1	Special provisions:	62, IB8, IP3, T1, TP33
Packaging: Exceptions:	152	Packaging: Non-bulk:	213
Packaging: Exceptions:	152	Quantity limitations: Passenger aircraft/rail:	25 kg
Quantity Limitations: Cargo aircraft only:	100 kg	Vessel stowage: Location:	B
Vessel stowage: Other:	56, 58, 106, 138		

Hazardous materials descriptions and proper shipping names:

Oxidizing solid, n.o.s.

### Air Transport IATA:

ICAO/IATA Class:	5.1	ICAO/IATA Subrisk:	None
UN/ID Number:	1479	Packing Group:	III
Special provisions:	A3		

Shipping Name: OXIDIZING SOLID, N.O.S. \*(CONTAINS TETRABUTYLAMMONIUM PERCHLORATE)

### Maritime Transport IMDG:

IMDG Class:	5.1	IMDG Subrisk:	None
UN Number:	1479	Packing Group:	III
EMS Number:	F-A, S-Q	Special provisions:	223 274 900
Limited Quantities:	5 kg		

Shipping Name: OXIDIZING SOLID, N.O.S.(contains tetrabutylammonium perchlorate)

## Section 15 - REGULATORY INFORMATION

**tetrabutylammonium perchlorate (CAS: 1923-70-2) is found on the following regulatory lists;**

"Canada Domestic Substances List (DSL)"; "US Toxic Substances Control Act (TSCA) - Inventory"

## Section 16 - OTHER INFORMATION

### LIMITED EVIDENCE

- Cumulative effects may result following exposure\*.
- May produce discomfort of the respiratory system\*.
- May possibly be harmful to the fetus/ embryo\*.

\* (limited evidence).

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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](http://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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