PRELIMINARY ANALYSIS LETTER ITEM #1:
Reagent Volumes and MSDS

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REAGENT LIST FOR PIÑON RIDGE MILL

1,000 ton per day ore processing

Reagent	Reference Usage Amount	Units	Reference Source	Annual Usage Amount (tpy)[4]
Sulfuric Acid	400	lb/ton ore	Process Design Criteria MM-2600-DC-001	70,000
Kerosene [1]	0.21	gal/ton ore	Scaled usage based off of data from White Mesa Mill	250
Alamine [1]	0.05	lb/ton ore	Scaled usage based off of data from White Mesa Mill	9
Isodecanol [1]	0.02	lb/ton ore	Scaled usage based off of data from White Mesa Mill	4
Ammonia	488.2	lb/hr	Process Flow Diagram Sheet 800-PF-001	2,050
Ammonium Sulfate [2]	1,798	lb/hr	Process Flow Diagram Sheet 800-PF-001	7,552
Sodium Hydroxide [3]	50	lb/hr	Process Flow Diagram Sheet 800-PF-001	210
Sodium Carbonate [2]	712.9	lb/hr	Process Flow Diagram Sheet 800-PF-001	2,994
Flocculant [2]	43.7	lb/hr	Process Flow Diagram Sheet 800-PF-001	184
Sodium Chlorate [3]	1,950	lb/hr	Process Flow Diagram Sheet 800-PF-001	8,189
Hydrogen Peroxide	59	lb/hr	Process Flow Diagram Sheet 800-PF-001	248
Diatomaceous Earth [2]	958	lb/day	Email from Bob Monok	168

1. Kerosene, Isodecanol, and Alamine are mixed to make the organic solution, approximately 96% Kerosene, 3% Isodecanol, 1% Alamine in mixture. (6/17/2009 email from Bob Monok)
2. Reagent received dry and then mixed with water on-site.
3. Liquid reagent diluted with water on-site.
4. Working days per year: 350

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Material Safety Data Sheet
Kerosene

MSDS Number: M1002
Effective Date: 8/12/2004

Section 1 - Chemical Product and Company Identification

MSDS Name: Kerosene
Synonyms: Kerosine, Coal Oil, Fuel Oil #1, Turbine Fuel
Company Identification:
VEE GEE Scientific, Inc.
13600 NE 126th Pl Ste A
Kirkland, WA 98034
For information in North America, call: 425-823-4518

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
8008-20-6	Kerosene	90-100%	232-366-4

Hazard Symbols: XN
Risk Phrases: 65

Section 3 - Hazards Identification

1. The major effect of exposure to this product is headache, drowsiness, irritation of the eyes and nose, and lungs. Target organs include the respiratory system, nervous system, and mucous membranes.
2. NIOSH recommends that whole diesel engine exhaust be regarded as a potential occupational carcinogen. Follow OSHA and NSHA rules where diesel engine exhaust fumes may be generated.
3. A life time skin painting study by the American Petroleum Institute has shown that similar naphtha products with a boiling range of 350-700 degrees F usually produce skin tumors and/ or skin cancers in laboratory mice. Only a weak to moderate response occurred. The effect to humans has not been determined. Contact dermatitis (skin irritation) may occur with prolonged or repeated contact.
4. IARC has listed kerosene as probably carcinogenic to humans based on sufficient evidence in experimental animals and limited evidence in humans.

Hazards of Combustion Products: Carbon monoxide and carbon dioxide can be found in the combustion products of this product and other forms of hydrocarbon combustion. Carbon monoxide in moderate concentrations can cause symptoms of headache, nausea, vomiting, increased cardiac output, and confusion. Exposure to higher concentrations of carbon monoxide can cause loss of consciousness, heart damage, brain damage, and/or death. Exposure to high concentrations of carbon dioxide can cause simple asphyxiation by displacing available oxygen. Combustion of this and other similar materials should only be carried out in well ventilated areas. The National Kerosene Heater Association has released preliminary test results that indicate no increased emissions of carbon monoxide or nitrogen dioxide resulted from using red-dyed kerosene in "new generation" heaters.
Medical Condition Generally Aggravated By Exposure: Medical conditions which have the same symptoms and effects as those outlined under the health hazard information section can be aggraved by exposure to this product.

Routes Of Exposure

Inhalation: Irritation of the upper respiratory tract and eyes, with possible euphoria, dizziness, headache, discoordination, ringing in the ears, convulsions, coma, and respiratory arrest.
Skin Contact: Defatting of the skin may occur with continued and prolonged contact. Irritation and burning sensation may occur on exposure to the liquid or mists, as well as the possibility of blisters. Hair loss can occur upon chronic exposure.
Skin Absorption: Not significant.
Eye Contact: Severe burning sensation with temporary irritation and swelling of lids.
Ingestion: Irritation of the mucous membranes of throat, esophagus and stomach which may result in nausea and vomiting; central nervous system depression may occur, if absorbed (see inhalation symptoms above). If aspirated, chemical pneumonitis may occur with potentially fatal results.
Carcinogenicity Statement: Kerosene is not listed as carcinogenic by NTP, OSHA, and ACGIH. IARC has listed kerosene as a probable human carcinogen (2A).

Section 4 - First Aid Measures

Eyes: Immediately flush eyes with large amount of water for at least 15 minutes holding lids apart to ensure flushing of the entire eye surface. SEEK MEDICAL ATTENTION.
Skin: Wash contaminated areas with plenty of soap and water. A soothing ointment may be applied to irritated skin after thoroughly cleansing. Remove contaminated clothing and footwear. SEEK MEDICAL ATTENTION.
Inhalation: Get person out of contaminated area to fresh air. If breathing has stopped resuscitate and administer oxygen if readily available. SEEK MEDICAL ATTENTION IMMEDIATELY.
Ingestion: Never give anything by mouth to an unconscious person. If swallowed, do not induce vomiting. If vomiting occurs spontaneously, keep airway clear. SEEK MEDICAL ATTENTION IMMEDIATELY.
Note to Physician: Do not induce vomiting, use gastric lavage only. Aspiration of liquid into the lungs could result in chemical pneumonitis. Use of adrenaline is not advised. Treat symptomatically.

Section 5 - Fire Fighting Measures

Flash Point: 100°F PM (minimum)
Autoignition Temperature: 410°F
Flammable Limits In Air: UEL: 5% - LEL: 0.7%
Extinguishing Media: Use dry chemical, carbon dioxide, foam or water spray. Water may be ineffective in fighting fires of liquids with low flash points, but water should be used to keep fire exposed containers cool. If a leak or spill has not ignited, use water spray to disperse the vapors and to protect persons attempting to stop a leak.
Special Fire Fighting Procedures: Pressure-demand, self contained, breathing apparatus should be provided for fire fighters in buildings or confined areas where product is stored.
Unusual Fire And Explosion Hazard: Clothing, rags, or similar organic material contaminated with the product and stored in a closed space may undergo spontaneous combustion. Vapor accumulation is possible and flashback can occur with explosive force if vapors are ignited.

Section 6 - Accidental Release Measures

If material is spilled, steps should be taken to contain liquid and prevent discharges to streams or sewer systems and control or stop the loss of volatile materials to the atmosphere. Spills or releases should be reported, if required to the appropriate local, state and federal regulatory agencies.

Small Spills: Remove ignition sources. Absorb spilled material with non-combustible materials such as cat litter, dirt, sand, or petroleum sorbent pads/ pillows. Do not use combustible materials like rags, wood chips, or saw dust. Remove contaminated materials to an appropriate disposal container.

Large Spills: Remove ignition sources. Dike spill area with sand or dirt to contain material and cover sewers/drains. Remain upwind and keep unnecessary people away. Contact trained emergency response team for cleanup. Remove liquid using grounded suction pumps, isolate hazard area and deny entry.

Section 7 - Handling and Storage

Store only in approved containers. Protect containers against physical damage. Outside or detached storage is preferred. Separate from oxidizing materials. Store in cool, well ventilated area of non-combustible construction away from possible sources of ignition. Keep away from incompatible materials and follow OSHA 29 CFR 1910.106 and NFPA 30 for storage requirements.

Product Use: This product is intended for use as a fuel in engines and heaters designed for kerosene or diesel fuels, and for use in engineered processes. Use in other applications may result in higher exposures and require additional controls, such as local exhaust ventilation and personal protective equipment.

Section 8 - Exposure Controls, Personal Protection

Ventilation Requirements: Work in well ventilated areas using good engineering practices to process, transfer and store. Special ventilation in not required unless product is sprayed or heated. High volume use may require engineering controls.

Specific Personal Protective Equipment

Respiratory: Respiratory protection is not required unless product is sprayed or heated. Use NIOSH approved respiratory protection following manufacture's recommendations where spray, mists, or vapors may be generated. Supplied air respiratory protection is required for IDLH areas. See 29 CFR 1910.134 for OSHA Respirator Protection regulations.
Eye: Face shield and goggles or chemical goggles should be worn where mist or spray may be generated, and where splashing occurs. Shower and eyewash facilities should be accessible.
Gloves: Impermeable protective gloves such as nitrile gloves should be worn during routine handling of this product. Barrier creams may also be appropriate where tactile sensitivity is required.
Other Clothing and Equipment: Clothing contaminated with this product should be removed and laundered before reuse. Items which can not be laundered should be discarded. Allow contaminated items to air dry or hang in a well ventilated area. Spontaneous combustion or fire may result from contaminated materials being placed together before drying.

Exposure Monitoring

Biological: No applicable procedure, breath analysis for hydrocarbons has been suggested.
Personal/Area: Monitor for kerosene using both active and passive monitors employing charcoal adsorption follow by gas chromatography. An average molecular weight of 170 has been suggested as the average value to convert the determined weight of hydrocarbons to ppm. Direct reading colorimetric tubes are available to evaluate short term exposure.

Section 9 - Physical and Chemical Properties

Appearance and Odor: Colorless to pale straw, or red oily liquid with characteristic odor.
Viscosity: Specification dependent, 1.0-1.9 cSt @ 40°C for K1, 8.0 cSt max @ -4°C for Jet-A.
Boiling Range @ 760 mm Hg: 304-574°F (151-301°C)
Vapor Density (Air=1): 4.5
Evaporation Rate (BuAc=1): N/A
Specific Gravity (H2O=1): 0.80-0.81
Bulk Density At 60°F: 6.67 lbs./gal.
Solubility in H2O % by WT.: Insoluble
Freezing Point: 0°F (-18°C)
Vapor Pressure: 0.5 mmHg @ 20°C
% Volatiles By Vol.: N/A
API Gravity: Specification dependent
pH: NA

Section 10 - Stability and Reactivity

Conditions Contributing to Instability: Under normal conditions, the material is stable. Avoid sources of ignition such as flames, hot surfaces, sparks, and electrical equipment.
Incompatibility: Avoid contact with strong oxidizers such as chlorine, fluorine, nitrogen tetraoxide, concentrated oxygen, and sodium hypochlorite or other hypochlorites.
Hazardous Decomposition Products: Thermal decomposition products may include carbon monoxide, carbon dioxide, oxides of sulfur and nitrogen, and other toxic gases.
Hazardous Polymerization: Material is not known to polymerize.

Section 11 - Toxilogical Information

RTECS#:
CAS# 8008-20-6: OA5500000

LD50/LC50:
CAS# 8008-20-6:
Draize test, rabbit, skin: 500 mg Severe;
Draize test, rabbit, skin: 100%/24H Moderate;
Oral, rabbit: LD50 = 2835 mg/kg

Carcinogenicity:
CAS# 8008-20-6:
ACGIH: A3 - Animal Carcinogen (as total hydrocarbon vapor).
Epidemiology: Ingestion of kerosene has been known to produce rapid death by gross aspiration and occlusion of the respiratory system. Even when death does not occur promptly, there is abundant evidence that the pneumonia commonly seen in children who swallow kerosene usually results from aspiration. The aspiration usually occurs at the moment of ingestion or as the result of vomiting within the first hour.
Teratogenicity: No information available.
Reproductive Effects: No information available.
Neurotoxicity: No information available.
Mutagenicity: No information available.

Section 12 - Ecological Information

Ecotoxicity: No data available. Bluegill (fresh water) TLm=2990ppm/24H
Environmental: Biological Oxygen Demand (BOD): 53%, 5 days.
Physical: No information available.
Other: None.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series: None listed.

Section 14 - Transport Information

	US DOT	Canada TDG
Shipping Name	Kerosene	Kerosene
Hazard Class	3	3
UN Number	UN1223	UN1223
Packing Group	III	NA

Section 15 - Regulatory Information

US FEDERAL

TSCA: CAS# 8008-20-6 is listed on the TSCA inventory.
Health & Safety Reporting List: None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules: None of the chemicals in this product are under a Chemical Test Rule.
Section 12b: None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule: None of the chemicals in this material have a SNUR under TSCA.

SARA

CERCLA Hazardous Substances and corresponding RQs: None of the chemicals in this material have an RQ.
SARA Section 302 Extremely Hazardous Substances: None of the chemicals in this product have a TPQ.
SARA Codes: CAS # 8008-20-6: acute, flammable.
Section 313: No chemicals are reportable under Section 313.
Clean Air Act: This material does not contain any hazardous air pollutants. This material does not contain any Class 1 Ozone depletors. This material does not contain any Class 2 Ozone depletors.
Clean Water Act: None of the chemicals in this product are listed as Hazardous Substances under the CWA. None of the chemicals in this product are listed as Priority Pollutants under the CWA. None of the chemicals in this product are listed as Toxic Pollutants under the CWA.
OSHA: None of the chemicals in this product are considered highly hazardous by OSHA.
STATE: CAS# 8008-20-6 can be found on the following state right to know lists: New Jersey, Pennsylvania, Massachusetts.
California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives
Hazard Symbols: XN
Risk Phrases: R 65 Harmful: may cause lung damage if swallowed.
Safety Phrases:
S 23 Do not inhale gas/fumes/vapour/spray.
S 24 Avoid contact with skin.
S 62 If swallowed, do not induce vomiting, seek medical advice immediately and show this container or label.

WGK (Water Danger/Protection)

CAS# 8008-20-6: No information available.
Canada - DSL/NDSL
CAS# 8008-20-6 is listed on Canada's DSL List.
Canada - WHMIS
This product has a WHMIS classification of B3, D2B.
Canadian Ingredient Disclosure List
Exposure Limits

Section 16 - Additional Information

MSDS Creation Date: 08/12/2004

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall VEE GEE Scientific be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if VEE GEE Scientific has been advised of the possibility of such damages.

Airgas

SECTION 1: CHEMICAL PRODUCT & COMPANY IDENTIFICATION

CHEMICAL NAME: Anhydrous Ammonia
TRADE NAMES / SYNONYMS: Ammonia

DISTRIBUTOR:
Airgas Specialty Products
6340 Sugarloaf Parkway, 300
Duluth, GA 30097 USA

EMERGENCY TELEPHONE NUMBERS:
Transportation (CHEMTREC): 1-800-424-9300
Transportation, Canada (CANUTEC): 1-613-996-6666
Environmental/Health/Safety (24-hr): 1-800-528-4963
Customer Service (Toll Free): 1-800-295-2225

SECTION 2: COMPOSITION / INFORMATION ON INGREDIENTS

CHEMICAL	FORMULA	% BY WEIGHT		CAS	OSHA PEL	NIOSH REL / ACGIH TLV		IDLH
		C-grade	P-grade		25 ppm (California only)			
Ammonia	NH_3	99.5	99.995	7664-41-7	50 ppm (TWA)	25 ppm (TWA)	35 ppm (STEL)	300ppm
Water	H_2O	0.4	33 ppm	7732-18-5	None	None	None	
Oil	----	0.1	2 ppm	----------	None	None	None	

SECTION 3: HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: 1. Colorless gas or compressed liquid with a pungent, suffocating odor **2.** Liquid ammonia reacts violently with water. Vapor cloud is produced. **3.** Avoid contact with liquid and vapor. **4.** Stay upwind and use water spray to absorb vapor. **5.** Not flammable under conditions likely to be encountered outdoors. **6.** Stop discharge if possible.

POTENTIAL HEALTH EFFECT

ROUTES OF ENTRY: Inhalation, Skin Contact, Eye Contact, Ingestion. **TARGET ORGANS:** Eyes, skin and respiratory system. **EYE CONTACT:** Exposure to liquid or high concentrations of vapor can cause painful, instant and possibly irreversible damage to tissue such as conjunctiva, cornea and lens. **SKIN CONTACT:** Prolonged contact with high concentrations can cause painful tissue damage, frostbite and serious chemical burns. **INHALATION:** Depending on exposure concentration and duration, effects can vary from none or only mild irritation, to obstruction of breathing from laryngeal and bronchial spasm, to edema and severe damage to mucous membranes of the respiratory tract with possible fatal results. Latent edema and residual reduction in pulmonary function may occur. **INGESTION:** Tissue damage, chemical burns, nausea and vomiting can occur. Ammonia is a gas under normal atmospheric conditions and ingestion is unlikely. **CARCINOGENICITY: NTP?** No **IARC?** No **OSHA?** No

SECTION 4: FIRST AID MEASURES

EYE CONTACT: Flush with large amounts of water for at least 15 minutes then immediately seek medical aid.
SKIN CONTACT: Immediately flush with large quantities of water for at least 15 minutes while removing clothing. If clothing has frozen to skin, thaw with water before removal. Seek immediate medical aid.
INHALATION: Remove from exposure. If breathing has stopped or is difficult, administer artificial respiration or oxygen as needed. Seek immediate medical aid.
INGESTION: Do not induce vomiting. Have victim drink large quantities of water if conscious. Immediately seek medical aid. Never give anything by mouth to an unconscious person.

SECTION 5: FIRE FIGHTING MEASURES

FLASH POINT(method used): Not Applicable **FLAMMABLE LIMITS:** 16-25% in air (for labeling purposes, not DOT flammable gas). **EXTINGUISHING MEDIA:** Stop flow of gas or liquid. Ammonia will burn in the range of 16-25% in air with a constant source of ignition. **SPECIAL FIRE FIGHTING PROCEDURES:** Move containers from fire zone if possible; if not, use water to cool fire-exposed containers. Use water spray to control vapors. Do not put water directly on liquid ammonia. Personnel must be equipped with appropriate protective clothing and respiratory protection.

NFPA HAZARD CLASSIFICATION: Health: 3 **Flammability:** 1 **Reactivity:** 0 (least-0 —— 4-highest)

SECTION 6: ACCIDENTAL RELEASE MEASURES

In US, federal regulations require that a release of 100 lb. or more of ammonia must be reported immediately to the National Response Center at (800) 424-8802, the SERC and the LEPC. In California, ALL releases must be reported to CUPA, state and local agencies. Additional state and local regulations may apply. **SUGGESTED LOCAL ACTION:** Stop leak if feasible. Avoid breathing ammonia. Evacuate personnel not equipped with protective clothing and equipment. Use copious amounts of water spray or fog to absorb ammonia vapor. DO NOT put water on liquid ammonia. Contain run-off to prevent ammonia from entering a stream, lake, sewer, or ditch. Any release of this material, during the course of loading, transporting, unloading or temporary storage, must be reported to U.S. DOT as required by 49 CFR 171.15 and 171.16.

SECTION 7: HANDLING AND STORAGE

Refer to the ANSI K61.1 standard for storage and handling information. Protect containers from physical damage and temperatures exceeding 120°F. Use only approved storage systems. Zinc, copper, silver, cadmium, and their alloys must not be used in ammonia systems since they can be rapidly corroded by it. Avoid hydrostatic pressure, which can cause equipment rupture, by adhering to proper filling procedures and the use of hydrostatic pressure relief valves where appropriate.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

RESPIRATORY PROTECTION: Respiratory protection approved by NIOSH / MSHA for ammonia must be used when exposure limits are exceeded. Whether chemical canister respirator or self-contained breathing apparatus is sufficient for effective respiratory protection depends on the type and magnitude of exposure.

SKIN PROTECTION: Rubber gloves and rubber or other types of approved protective clothing should be used to prevent skin contact. A face shield should be used for increased protection from contact with liquid or vapor.

EYE PROTECTION: Chemical splash goggles, approved for use with ammonia, must be worn to prevent eye contact with liquid or vapor. A face shield should be used for increased protection from contact with liquid.

VENTILATION: Local positive pressure and/or exhaust ventilation should be used to reduce vapor concentrations in confined spaces. Ammonia vapor, being lighter than air, can be expected to dissipate to the upper atmosphere. Ammonia concentrations may also be reduced by the use of an appropriate absorbent or reactant material.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

BOILING POINT: -28.1°F
SOLUBILITY IN WATER: High
MELTING POINT: -107.9°F
PERCENT VOLATILE BY VOLUME: 100%
VAPOR PRESSURE: 4802.9 mm Hg @ 60°F or 107.6 psia.
SPECIFIC GRAVITY: 0.62 @ 60°F (water=1)
VAPOR DENSITY: 0.60 @ 32°F (Air=1)
pH: Approx. 11.6 for 1 N Sol'n. in water
APPEARANCE: Colorless, pungent gas

SECTION 10: STABILITY AND REACTIVITY

STABILITY: Material generally considered stable. Heating above ambient temperature causes rapid increase of vapor pressure.

INCOMPATIBILITY (materials to avoid): Ammonia can react violently with strong acids. Under certain conditions, ammonia reacts with bromine, chlorine, fluorine or iodine to form compounds, which explode spontaneously. Reactions of ammonia with gold, silver or mercury to form explosive fulminate-like compounds has been reported.

HAZARDOUS DECOMPOSITION PRODUCTS: Hydrogen on heating to over 850°F. The decomposition temperature may be lowered to 575°F by contact with certain metals such as iron or nickel.

HAZARDOUS POLYMERIZATION: Will not occur **CONDITIONS TO AVOID:** Not applicable

SECTION 11: TOXICOLOGICAL INFORMATION

Ammonia is a strong alkali and readily damages all body tissues. Ammonia is not a cumulative metabolic poison. Carcinogenicity, Reproductive, Mutagenicity, Teratogenicy Effects: No information is available and no adverse effects are anticipated. Synergistic Materials: None known.

SECTION 12: ECOLOGICAL INFORMATION

AQUATIC TOXICITY: 2.0-2.5 ppm/1-4 days/ goldfish and yellow perch/LC; 60-80 ppm/3 days/crayfish/LC_{100}; 8.2ppm/96hr/fathead minnow/TLm
WATERFOWL TOXICITY: 120 ppm
BIOCHEMICAL OXYGEN DEMAND: Not pertinent
FOOD CHAIN CONCENTRATION POTENTIAL: None

SECTION 13: DISPOSAL CONSIDERATIONS

Recover ammonia if feasible. Otherwise, let ammonia evaporate if appropriate. Only personnel experienced in ammonia spills should add water to liquid ammonia. Dispose of diluted ammonia as a fertilizer or in an industrial process. For Hazardous Waste Regulations call (800) 424-9346, the RCRA Hotline.

SECTION 14: TRANSPORT INFORMATION

	DOMESTIC SHIPMENTS	INTERNATIONAL SHIPMENTS	CANADIAN TDG ACT
Proper shipping name:	Ammonia, Anhydrous	Ammonia, Anhydrous	Ammonia, Anhydrous
Shipping Class:	DOT 2.2 (nonflammable gas)	2.3 (poison gas)	2.4 (9.2)
Identification Number:	UN1005	UN1005	UN1005
Packing Group:	None	None	None

SECTION 15: REGULATORY INFORMATION

NOTICE: This product is subject to the reporting requirements of SARA (1986, Section 313 of Title III) and 40 CFR Part 370. Be sure to verify and comply with state and local regulations.

CERCLA/SUPERFUND, 40 CFR 117.302: Unpermitted releases of 100 lb. or more of ammonia in any 24-hour period must be reported immediately to the NRC at 1-800-424-8802, the SERC, and the LEPC. Written follow-up is required to SERC & LEPC.

OSHA HAZARD COMMUNICATION RULE, 20 CFR 1910.1200: Ammonia is considered a hazardous chemical.

TOXIC SUBSTANCE CONTROL ACT: This material is listed in the TSCA Inventory.

EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW ACT (SARA, TITLE III): Section 302 Extremely Hazardous Substance: Yes; Section 311/312 Hazardous Categories: Immediate (Acute) Health Hazards; Section 313 Toxic Chemical: Yes.

WHMIS: One percent (1%) **CALIFORNIA PROPOSITION 65:** Reproductive: No Carcinogen: No

OSHA PROCESS SAFETY MANAGEMENT, 29 CFR 1910.119: This product is subject to the Process Safety Management requirements of 29 CFR 1910.119 if maintained on-site in quantities of 10,000 lb. or greater.

EPA CHEMICAL ACCIDENTAL RELEASE PREVENTION, 40 CFR PART 68: This product is subject to the Risk Management Plan requirements of 40 CFR Part 68 if maintained on-site in quantities of 10,000 lb. or greater.

DRINKING WATER: Maximum use dosage in potable water is 5mg/l.

SECTION 16: OTHER INFORMATION

REASON FOR REVISION: 1. Addition of new Toll Free Customer Service Number in Section 1.
2. Revised LEL and UEL from 16-25% to 15-28%. 3. Company name change from LaRoche Industries to Airgas Specialty Products.
4. Canadian transportation emergency information added. 5. California PEL limits added. 6. LEL and UEL Revised: 16-25%.

MSDS PREPARED BY: Airgas Specialty Products

This information is taken from sources or based upon data believed to be reliable, however, Airgas Specialty Products makes no warranty as to the absolute correctness or sufficiency of any of the foregoing or that additional or other measures may not be required under particular conditions.

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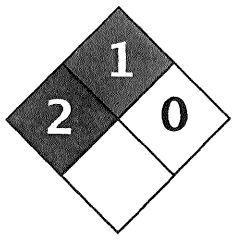
Chemicals & Laboratory Equipment



Health	2
Fire	1
Reactivity	0
Personal Protection	E

Material Safety Data Sheet
Ammonium sulfate MSDS

Section 1: Chemical Product and Company Identification

Product Name: Ammonium sulfate

Catalog Codes: SLA2851, SLA2011, SLA1168, SLA2674

CAS#: 7783-20-2

RTECS: BS4500000

TSCA: TSCA 8(b) inventory: Ammonium sulfate

CI#: Not available.

Synonym: Sulfluric Acid, Diammonium Salt

Chemical Name: Ammonium Sulfate

Chemical Formula: (NH4)2SO4

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Ammonium sulfate	7783-20-2	100

Toxicological Data on Ingredients: Ammonium sulfate: ORAL (LD50): Acute: 2840 mg/kg [Rat]. 640 mg/kg [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects: Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
Repeated or prolonged exposure is not known to aggravate medical condition.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: CLOSED CUP: Higher than 93.3°C (200°F).

Flammable Limits: Not available.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances:
Flammable in presence of oxidizing materials.
Slightly flammable to flammable in presence of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.
Explosive in presence of oxidizing materials.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards:
A mixture of ammonium sulfate and potassium chlorate decomposes with incandescence when heated.
When a little ammonium sulfate is added to fused potassium nitrite, a vigorous reaction occurs attended by flame.
Non combustible. This substance itself does not burn, but may decompose upon heating to produce corrosive and/or toxic fumes.

Special Remarks on Explosion Hazards:
If accidently mixed with oxidizers like potassium chlorate, potassium nitrate or potassium nitrite, there is an explosion hazard during fire.
A mixture of ammonium sulfate and ammonium nitrate can easily be exploded by potassium or sodium-potassium alloy.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Do not ingest. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Crystals solid.)

Odor: Odorless.

Taste: Not available.

Molecular Weight: 132.14 g/mole

Color: brownish gray to white

pH (1% soln/water): Not available.

Boiling Point: Not available.

Melting Point: 280°C (536°F)

Critical Temperature: Not available.

Specific Gravity: 1.77 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility:
Soluble in cold water.
Insoluble in acetone.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Excess heat, incompatible materials.

Incompatibility with various substances:
Highly reactive with oxidizing agents.
Reactive with alkalis.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Incompatible with the following:
Potassium + ammonium nitrate, potassium chlorate, potassium nitrate, potassium nitrite, sodium hypochlorite, sodium/potassium alloy + ammonium nitrate. Substance should not contact either zinc or copper bearing materials.
Reacts with alkali to release ammonia.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals: Acute oral toxicity (LD50): 640 mg/kg [Mouse].

Chronic Effects on Humans: Not available.

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Dose/Conc:
LDL [Domestic animal - Goat, Sheep) - Route: Oral; Dose: 3500 mg/kg

Special Remarks on Chronic Effects on Humans:

It may be a possible mutagen. It has been tested for mutagenicity, but so far tests have been inconclusive or test information has not been made available.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: Causes skin irritation.
Eyes: Causes eye irritation.
Inhalation: May cause respiratory tract irritation.
Ingestion: When ingested, its osmolarity can draw water from the body into the bowel, acting as a laxative. However, if enough is absorbed systemically it may produce Ammonia poisoning. Symptoms may include gastrointestinal (digestive) tract irritation with nausea, vomiting, hypermotility, diarrhea. May also affect eyes (Mydriasis), behavior/central nervous system (somnolence, tremor, convulsions, muscle contraction or spasticity), and respiratory system (respiratory stimulation, dyspnea). Also, with ingestion of large doses of Ammonium Sulfate arises the possibility of sufficient absorption to produce diuresis, an excessive discharge of urine, and kidney damage (renal tubular disorder, abnormal renal function).
Chronic Potential Health Effects:
One Russian occupational standard study discussed chronic exposure effects which may include cardiac contraction, neurotoxicity, and hypertension. This has not been confirmed in other ammonium sulfate exposed workers.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:
Rhode Island RTK hazardous substances: Ammonium sulfate
Pennsylvania RTK: Ammonium sulfate
Florida: Ammonium sulfate
Massachusetts RTK: Ammonium sulfate
New Jersey: Ammonium sulfate
TSCA 8(b) inventory: Ammonium sulfate

Other Regulations: EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): Not controlled under WHMIS (Canada).

DSCL (EEC):
R16- Explosive when mixed with
oxidizing substances.
R36/38- Irritating to eyes and skin.
S24/25- Avoid contact with skin and eyes.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 1

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an
approved/certified respirator or
equivalent.
Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:14 PM

Last Updated: 11/06/2008 12:00 PM

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MSDS Number: **A6190** * * * * * *Effective Date:* ***08/02/07*** * * * * * *Supercedes:* ***12/14/04***

MSDS Material Safety Data Sheet

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. And Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

J.T.Baker®

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

Ammonium Sulfate, 38% (w/w) Solution

---

1. Product Identification

Synonyms: Sulfuric Acid, Diammonium Salt; Diammonium Sulfate
CAS No.: 7783-20-2
Molecular Weight: 132.14
Chemical Formula: (NH4)2SO4
Product Codes: 0791

---

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Ammonium Sulfate	7783-20-2	38 - 40%	Yes
Water	7732-18-5	60 - 62%	No

---

3. Hazards Identification

Emergency Overview

WARNING! CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. MAY BE HARMFUL IF SWALLOWED.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 1 - Slight
Flammability Rating: 0 - None
Reactivity Rating: 1 - Slight
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES; LAB COAT; PROPER GLOVES
Storage Color Code: Green (General Storage)

Potential Health Effects

Inhalation:
Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath.
Ingestion:
Causes irritation to the gastrointestinal tract. Symptoms may include nausea, vomiting and diarrhea. It presents little toxicity unless large amounts are ingested, in which case, vomiting and diarrhea are likely.
Skin Contact:
Causes irritation to skin. Symptoms include redness, itching, and pain.
Eye Contact:
Causes irritation, redness, and pain.
Chronic Exposure:
No information found.
Aggravation of Pre-existing Conditions:
No information found.

---

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Ingestion:
Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention.
Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.

Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

---

5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard. Flammable ammonia gas may be released in a fire.
Explosion:
May explode if mixed with oxidizers, such as potassium nitrate, potassium nitrite, and potassium chlorate.
Fire Extinguishing Media:
Water spray may be used to keep fire exposed containers cool. Use any means suitable for extinguishing surrounding fire.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

---

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Contain and recover liquid when possible. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer!

---

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from incompatible substances. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
None established.
Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures as low as possible. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):

For conditions of use where exposure to the substance is apparent, consult an industrial hygienist. For emergencies, or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:

Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties

Appearance:

Colorless liquid.

Odor:

Slight odor of ammonia.

Solubility:

Complete (100%)

Specific Gravity:

No information found.

pH:

5.5 (0.1M aqueous solution)

% Volatiles by volume @ 21C (70F):

0

Boiling Point:

No information found.

Melting Point:

No information found.

Vapor Density (Air=1):

Not applicable.

Vapor Pressure (mm Hg):

Not applicable.

Evaporation Rate (BuAc=1):

No information found.

---

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
May emit ammonia, oxides of sulfur, oxides of nitrogen, and oxides of carbon.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong oxidizing agents, Sodium hypochlorite, potassium plus ammonium nitrate, potassium chlorate, potassium nitrite, and sodium-potassium powder plus ammonium nitrate, and other strong oxidizers.
Conditions to Avoid:
Heat, incompatibles.

---

11. Toxicological Information

Oral rat LD50: 2840 mg/kg
Investigated as a mutagen.

```
  --------\Cancer Lists\-----------------------------------------------------
-
                                          ---NTP Carcinogen---
  Ingredient                              Known    Anticipated    IARC
Category
  -------------------------------------   -----    -----------    ------------
-
  Ammonium Sulfate (7783-20-2)             No          No            None
  Water (7732-18-5)                        No          No            None
```

---

12. Ecological Information

Environmental Fate:
No information found.
Environmental Toxicity:
No information found.

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13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

```
  --------\Chemical Inventory Status - Part 1\-------------------------------
--
  Ingredient                                        TSCA  EC   Japan
Australia
  ----------------------------------------------  ----  ---  -----  --------
-
  Ammonium Sulfate (7783-20-2)                     Yes  Yes   Yes      Yes
  Water (7732-18-5)                                Yes  Yes   Yes      Yes

  --------\Chemical Inventory Status - Part 2\-------------------------------
--
                                                          --Canada--
  Ingredient                                        Korea  DSL   NDSL  Phil.
  ----------------------------------------------  -----  ---   ----  -----
  Ammonium Sulfate (7783-20-2)                     Yes   Yes   No     Yes
  Water (7732-18-5)                                Yes   Yes   No     Yes

  --------\Federal, State & International Regulations - Part 1\--------------
--
                                                -SARA 302-    ------SARA 313----
--
  Ingredient                                    RQ    TPQ     List  Chemical
Catg.
  ----------------------------------------  ---   -----   ----  ------------
--
  Ammonium Sulfate (7783-20-2)              No    No      No         No
  Water (7732-18-5)                         No    No      No         No

  --------\Federal, State & International Regulations - Part 2\--------------
--
                                                            -RCRA-    -TSCA-
  Ingredient                                    CERCLA     261.33     8(d)
  ----------------------------------------  ------     ------    ------
  Ammonium Sulfate (7783-20-2)              No         No         No
  Water (7732-18-5)                         No         No         No


Chemical Weapons Convention:  No     TSCA 12(b):  No     CDTA:  No
SARA 311/312:  Acute: Yes      Chronic: No   Fire: No  Pressure: No
Reactivity: No          (Mixture / Liquid)
```

Australian Hazchem Code: None allocated.

Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

NFPA Ratings: Health: **2** Flammability: **0** Reactivity: **0**
Label Hazard Warning:
WARNING! CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. MAY BE HARMFUL IF SWALLOWED.
Label Precautions:
Avoid contact with eyes, skin and clothing.
Wash thoroughly after handling.
Avoid breathing vapor.
Keep container closed.
Use only with adequate ventilation.
Label First Aid:
In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. In all cases, get medical attention.
Product Use:
Laboratory Reagent.
Revision Information:
No Changes.
Disclaimer:
****
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****

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

MATERIAL SAFETY DATA SHEET

Sodium Hydroxide 50% Solution

MSDS Ref. No.: 1310-73-2-3
Date Approved: 01/26/2004
Revision No.: 4

This document has been prepared to meet the requirements of the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200; the Canada's Workplace Hazardous Materials Information System (WHMIS) and, the EC Directive, 2001/58/EC.

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME:	Sodium Hydroxide 50% Solution
SYNONYMS:	Caustic Soda Solution; Lye Solution; Sodium Hydrate Solution, White Caustic Solution
GENERAL USE:	pH Control
	This chemical is certified to ANSI/NSF Standard 60, Drinking Water Chemicals-Health Effects (as packaged in the original, unopened container). The maximum dosage level for this chemical is 200 mg/L

MANUFACTURER

FMC Wyoming Corporation
Alkali Chemicals Division
1735 Market Street
Philadelphia, PA 19103
(215) 299-6000 (General Information)

EMERGENCY TELEPHONE NUMBERS

(800) 424-9300 (CHEMTREC - U.S.)
(303) 595-9048 (Medical - Call Collect)

(307) 872-2452 (Plant - Green River, WY)

2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

- Water white liquid with no appreciable odor.
- Solution is corrosive to body tissues and metallic materials.
- Product may react violently with acids.

POTENTIAL HEALTH EFFECTS: Solution is corrosive and severely irritating to the eyes and skin.

MEDICAL CONDITIONS AGGRAVATED: Skin and lung disorders may be affected adversely by this material; an individual's specific medical condition and circumstances of exposure determine the likelihood of an adverse effect.

3. COMPOSITION / INFORMATION ON INGREDIENTS

Chemical Name	CAS#	Wt.%	EC No.	EC Class
Sodium Hydroxide	1310-73-2	50	215-185-5	C R35 /34; Xi R36/38
Water	7732-18-5	50	231-791-2	Not classified as hazardous

4. FIRST AID MEASURES

EYES: Immediately flush with water for at least 15 minutes, lifting the upper and lower eyelids intermittently. See a medical doctor or ophthalmologist immediately.

SKIN: Immediately flush with plenty of water while removing contaminated clothing and/or shoes, and thoroughly wash with soap and water. See a medical doctor immediately.

INGESTION: Rinse mouth with water. Dilute by giving 1 or 2 glasses of water. Do not induce vomiting. Never give anything by mouth to an unconscious person. See a medical doctor immediately.

INHALATION: Remove to fresh air. If breathing difficulty or discomfort occurs and persists, contact a medical doctor.

NOTES TO MEDICAL DOCTOR: Sodium hydroxide at this concentration is corrosive. Major burns to all surfaces may result. Prolonged dilution with water is required. Neutralization of eye burns is absolutely contraindicated; for skin, 2% acetic acid has been recommended, but washing with water is effective. Ingestion requires milk or water dilution, consideration of esphagoscopy and management for possible esophageal stricture.

5. FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA: Not applicable

FIRE / EXPLOSION HAZARDS: Non-combustible

FIRE FIGHTING PROCEDURES: Not applicable

FLAMMABLE LIMITS: Not applicable

HAZARDOUS COMBUSTION PRODUCTS: None

SENSITIVITY TO IMPACT: Not Sensitive

SENSITIVITY TO STATIC DISCHARGE: Not Sensitive

6. ACCIDENTAL RELEASE MEASURES

RELEASE NOTES: Wear personal protective equipment as recommended in Section 8, "Exposure Controls/Personal Protection" below.

Contain spill using absorbent material and place in an approved container.

Dispose of according to the method outlined in Section 13, "Disposal Considerations" below.

7. HANDLING AND STORAGE

HANDLING: During handling of liquid, prevent contact with skin and eyes by using adequate personal protective equipment (see Section 8, "Exposure Controls/Personal Protection" below). If the release of airborne material is likely, exhaust ventilation and/or respiratory protection may also be necessary.

STORAGE: Store in closed containers away from sources of heat.

COMMENTS: Use only in systems, processes and procedures in which effective ventilation has been provided to meet established exposure limits.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE LIMITS

Chemical Name	ACGIH	OSHA	Supplier
Sodium Hydroxide	2 mg/m^3 (STEL) (Ceiling)	2 mg/m^3 (TWA) 2 mg/m^3 (PEL) (ceiling)	

ENGINEERING CONTROLS: Adequate engineering controls and/or personal protective equipment must be used to prevent contact with skin and eyes. Engineering controls and/or respirators may be necessary when the generation of airborne mists or fogs are possible.

PERSONAL PROTECTIVE EQUIPMENT

EYES AND FACE: Chemical goggles (and face shield if necessary) should be worn to prevent contact.

RESPIRATORY: When exposure above the established standard is likely, a respiratory protection program that complies with OSHA General Industry Standard 1910.134 should be implemented. Wear full face-piece respirators approved by MSHA / NIOSH if mists are expected.

PROTECTIVE CLOTHING: Rubber or vinyl apron. Rubber boots or rubber overshoes.

GLOVES: Impervious rubber or vinyl gloves with gauntlets. Thoroughly wash the outside of gloves with soap and water prior to removal. Inspect regularly for leaks.

COMMENTS:

The information noted above provides general guidance for handling this product. Specific work environments and material handling practices will dictate the selection and use of personal protection equipment (PPE).

---

9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR:	No appreciable odor
APPEARANCE:	Water white liquid
AUTOIGNITION TEMPERATURE:	Not applicable
BOILING POINT:	145 °C (293 °F)
COEFFICIENT OF OIL / WATER:	Not applicable
EVAPORATION RATE:	(butyl acetate = 1) Not available
FLASH POINT:	Non-combustible
FREEZING POINT:	4.4°C (40°F)
ODOR THRESHOLD:	Not applicable
OXIDIZING PROPERTIES:	Not available
PERCENT VOLATILE:	Not applicable
pH:	(as is) 13.7
SOLUBILITY IN WATER:	Infinite
SPECIFIC GRAVITY:	1.53 @ 15.5°C (60°F) (water = 1)
VAPOR DENSITY:	Not applicable
VAPOR PRESSURE:	6.33 mm Hg @ 40 °C (104 °F)

COMMENTS:

pH (1% solution): 13.0

10. STABILITY AND REACTIVITY

CONDITIONS TO AVOID:	Contact with acids, flammable liquids, organic halogen compounds, nitro compounds, and amphoteric metals, such as aluminum, magnesium and zinc.
STABILITY:	Slightly reactive
POLYMERIZATION:	Will not occur
INCOMPATIBLE MATERIALS:	Acids, flammable liquids, organic halogen compounds, nitro compounds, and amphoteric metals, such as aluminum, magnesium and zinc.
HAZARDOUS DECOMPOSITION PRODUCTS:	None

11. TOXICOLOGICAL INFORMATION

EYE EFFECTS: Severely irritating, corrosive (rabbit) [RTECS 1986, NIOSH 1975]

SKIN EFFECTS: Severely irritating, corrosive (rabbit) [RTECS 1986, PB 234-899 1974]

DERMAL LD_{50}: Corrosive

ORAL LD_{50}: 400 mg/kg (rabbit) LDLo [PB 234-899 1974]

INHALATION LC_{50}: Corrosive

TARGET ORGANS: Skin, eyes, mucous membranes

ACUTE EFFECTS FROM OVEREXPOSURE: Sodium hydroxide is corrosive and may produce severe eye, skin and respiratory tract irritation and upper gastrointestinal tract damage. Ingestion of concentrated solutions has caused death in animals and humans. [Gosselin, Smith & Hodge, 1984; PB 234-899 1974]

CHRONIC EFFECTS FROM OVEREXPOSURE: Sodium hydroxide may produce inflammation of the eyes, skin, and mucous membranes. Esophageal carcinoma at the site of a chronic lye stricture has been reported. [Gosselin , Smith & Hodge 1984]

CARCINOGENICITY:

NTP:	Not listed
IARC:	Not listed
OSHA:	Not listed
OTHER:	Not Listed (ACGIH)

12. ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION: Bluegill sunfish: 48-hour LC_{50} = 99 mg/L
Mosquito fish: 96-hour LC_{50} = 125 mg/L
Brown shrimp (Crangon crangon): 48-hour LC_{50} = 30 - 100 mg/L

The damaging effects are mostly a consequence of the increase in pH. The upper pH limit tolerated by most freshwater fish is 8.4; the pH must generally be greater than 9 before the aqueous environment becomes lethal for fully developed fish. Freshwater algae are destroyed above pH 8.5. Concentrations of 20 to 100 mg/L have been reported to kill salmon, trout, carp and crayfish. [Ref. , Environment Canada, Environmental Protection Service, Sodium Hydroxide Environmental and Technical Information for Problem Spills. June 1984]

CHEMICAL FATE INFORMATION: The pH effect of sodium hydroxide in water is naturally reduced by the absorption of atmospheric carbon dioxide. This reduction is also effected by dilution with water and by the natural acidity of a given water body. There is no degradation of sodium hydroxide in waters, only loss by absorption or through chemical neutralization.

13. DISPOSAL CONSIDERATIONS

DISPOSAL METHOD: Dispose of in accordance with all local, state and federal environmental rules and regulations. Check the pH of the waste to be disposed, if it is greater than 12.5 it must be handled as a RCRA hazardous waste.

14. TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

PROPER SHIPPING NAME:	Sodium Hydroxide Solution
PRIMARY HAZARD CLASS / DIVISION:	8 (Corrosive)
UN/NA NUMBER:	UN 1824
PACKING GROUP:	II

LABEL(S):	Corrosive
PLACARD(S):	Corrosive
MARKING(S):	Sodium Hydroxide Solution
ADDITIONAL INFORMATION:	Hazardous Substance/RQ = 1000 lbs. (454 kg) 49 STCC Number: 4935240

INTERNATIONAL MARITIME DANGEROUS GOODS (IMDG)

PROPER SHIPPING NAME:	Sodium Hydroxide Solution

INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO) / INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA)

PROPER SHIPPING NAME:	Sodium Hydroxide Solution

OTHER INFORMATION:

Cool containers with water if exposed to fire or excessive heat conditions.

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15. REGULATORY INFORMATION

UNITED STATES

SARA TITLE III (SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT)

SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355, APPENDIX A):
Not listed

SECTION 311 HAZARD CATEGORIES (40 CFR 370):
Immediate (Acute) Health Hazard

SECTION 312 THRESHOLD PLANNING QUANTITY (40 CFR 370):
The Threshold Planning Quantity (TPQ) for this product, if treated as a mixture, is 10,000 lbs; however, this product contains the following ingredients with a TPQ of less than 10,000 lbs.:
None

SECTION 313 REPORTABLE INGREDIENTS (40 CFR 372):
Not listed

CERCLA (COMPREHENSIVE ENVIRONMENTAL RESPONSE COMPENSATION AND LIABILITY ACT)

CERCLA DESIGNATION & REPORTABLE QUANTITIES (RQ) (40 CFR 302.4):
Listed

Chemical Name	RQ	
Sodium Hydroxide	1,000 lb	Category C

TSCA (TOXIC SUBSTANCE CONTROL ACT)

TSCA INVENTORY STATUS (40 CFR 710):
Listed

U.S. STATES

U.S. State Regulation:
New Jersey - Special Health Hazard
Massachusetts - Substance List

CANADA

WHMIS (WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM):

Product Identification Number:	Not available
Hazard Classification / Division:	Class D, Div. 2, Subdiv. B (Toxic), E (Corrosive)
Ingredient Disclosure List:	Listed

EU EINECS NUMBERS:

sodium hydroxide 011-002-00-6

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16. OTHER INFORMATION

HAZARD, RISK AND SAFETY PHRASE DESCRIPTIONS:

Sodium hydroxide:

EC Symbols:	C	(Corrosive)
	Xi	(Irritant)
EC Risk Phrases:	R35/34	(Causes severe burns / causes burns)
	R36/38	(Irritating to eyes and skin.)
EC Safety Phrases:	S1/2	(Keep locked up and out of reach of children.)
	S26	(In case of contact with eyes, rinse immediately with plenty of water and seek medical advice)
	S37	(Wear suitable gloves.)
	S39	(Wear eye/face protection.)
	S45	(In case of accident or if you feel unwell, seek medical advice immediately - show the label where possible.)

HMIS

Health	3
Flammability	0
Physical Hazard	1
Personal Protection (PPE)	J

Protection = J (Safety goggles, gloves, apron & combination dust & vapor respirator)

HMIS = Hazardous Materials Identification System

Degree of Hazard Code:
4 = Severe
3 = Serious
2 = Moderate
1 = Slight
0 = Minimal

NFPA

Health	3
Flammability	0
Reactivity	1
Special	None

No special requirements

NFPA = National Fire Protection Association

Degree of Hazard Code:
4 = Extreme
3 = High
2 = Moderate
1 = Slight
0 = Insignificant

REVISION SUMMARY:
New Format, as well as text changes and/or updates to one or more Sections of this MSDS.

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OFI TESTING EQUIPMENT, INC.
MATERIAL SAFETY DATA SHEET

SECTION I - PRODUCT AND COMPANY IDENTIFICATION

Chemical Name:	SODIUM HYDROXIDE SOLUTION
Trade Name:	SODIUM HYDROXIDE SOLUTION 15%
OFI Part No.	260-09
Chemical Family:	SODIUM HYDROXIDE
Formula:	NaOH : H_2O
Manufacturer:	OFI Testing Equipment, Inc. 1006 West 34th Street Houston, TX 77018 U.S.A. (713) 880-9885
In Case of Emergency Spills, Leaks, Fire, Exposure or Accident	In the USA, call INFOTRAC at 1-800-535-5053 day or night Outside the USA, call collect, (352) 323-3500

SECTION II - COMPOSITION/INFORMATION ON INGREDIENTS

CAS #:	CHEMICAL NAME	
1310-73-2	Sodium Hydroxide	15%

SECTION III - HAZARD IDENTIFICATION

Emergency Overview:	Poison! Danger! Corrosive. May be fatal if swallowed. Harmful if inhaled. Causes burns to any area of contact. Reacts with water, acids and other materials.
Inhalation:	Severe Irritant. Effects from Inhalation of Mists vary from Mild Irritation to Serious Damage of the Upper Respiratory Tract, Depending on Severity of Exposure. Symptoms may Include Sneezing, Sore Throat or Runny Nose. Severe Pneumonitis may Occur.
Ingestion:	CORROSIVE! Swallowing may Cause Burns of the Mouth, Throat and Stomach. Severe Scaring of Tissue and Death may Result. Symptoms may Include Bleeding, Vomiting, Diarrhea, Fall in Blood Pressure. Damage may Appear Days after Exposure.
Skin:	CORROSIVE! Contact with Skin can Cause Irritation or Severe Burns and Scarring with Greater Exposures.
Eye Contact:	CORROSIVE! Causes Irritation to Eyes, and with Greater Exposures, Severe Buns with Possibly Blindness Resulting.
Chronic Exposure:	Persons with Pre-Existing Skin Disorders or Eye Problems or Impaired Respiratory Function may be More Susceptible to the Effects of the Substance.
Aggravated by Exposure:	Persons with Pre-Existing Skin Disorders or Eye Problems or Impaired Respiratory Function may be More Susceptible to the Effects of the Substance.

SECTION IV - FIRST AID MEASURES

Inhalation:	Remove to Fresh Air. Get Medical Attention for any Breathing Difficulty
Ingestion:	If Swallowed - Do Not Induce Vomiting! Give Large Quantities of Water. Never Give Anything by Mouth to an Unconscious Person. Get Medical Attention Immediately.
Skin:	Immediately Flush Skin with Plenty of Water for at Least 15 Minutes while Removing Contaminated Clothing and Shoes. Call Physician Immediately. Wash Clothing before Reuse.
Eyes:	Immediately Flush Eyes with Gentle but Large Stream of Water for at Least 15 Minutes, Lifting Lower and Upper Eyelids Occasionally. Get Medical Attention Immediately.
Note to Physician:	Perform Endoscopy in All Cases of Suspected Sodium Hydroxide Ingestion.

SECTION V - FIRE FIGHTING MEASURES

Fire:	Not Considered to be a Fire Hazard.
Explosion:	Not Considered to be an Explosion Hazard.
Fire Extinguishing Media:	Use any means Suitable for Extinguishing Surrounding Fire. Adding Water to Caustic Solution Generates Large Amounts of Heat.
Special Information:	Use Protective Clothing and Breathing Equipment Appropriate for the Surrounding Fire.

SECTION VI - ACCIDENTAL RELEASE MEASURES

Ventilate area of Leak or Spill. Keep Unnecessary and Unprotected People away from the area of Spill. Wear Appropriate Personal Protective Equipment as Specified in Section 8. Contain and Recover Liquid when Possible. Residues from Spills can be Diluted with Water, Neutralized with Dilute Acid such as Acetic, Hydrochloric or Sulfuric. Absorb Neutralized Caustic Residue on Clay, Vermiculite or other Inert Substance and Package in Suitable Container for Disposal. US Regulations (CERCLA) Require Reporting Spills and Releases to Soil, Water and Air in Excess of Reportable Quantities. Do Not Flush to Sewer!

SECTION VII - HANDLING AND STORAGE

Keep in a Tightly closed Container. Protect from Physical Damage. Store in a Cool, Dry, Ventilated Area away from Sources of Heat, Moisture and Incompatibilities. Separate from Acids and Alkalis. Containers of this Material may be Hazardous when Empty since they Retain Product Residues (Vapors, Liquid). Protect from Freezing.

SECTION VIII – EXPOSURE CONTROL/ PERSONAL PROTECTION

Ventilation System:	A System of Local and/or General Exhaust is Recommended to Keep Employee Exposures Below the Airborne Exposure Limits. Local Exhaust Ventilation is Generally Preferred Because it can Control the Emissions of the Contaminant at its Source, Preventing Dispersion of it into the General Work Area.
Airborne Exposure Limits:	OSHA Permissible Exposure (PEL) 2 mg/m^3 (Ceiling)-ACGIH (TLV) 2 mg/m^3 (Ceiling)
Personal Respirators: (NIOSH APPROVED)	If the Exposure Limit is Exceeded, a Half-Face Dust/Mist Respirator May be Worn for up to Ten Times the Exposure Limit or the Maximum use Concentration Specified by the Appropriate Regulatory Agency or Respirator Supplier, Whichever is Lowest. A Full-Face piece Dust/Mist Respirator May be Worn up to 50 times the Exposure Limit or the Maximum use Concentration Specified by the Appropriate Regulatory Agency or Respirator Supplier, Whichever is Lowest.
Skin Protection:	Wear Impervious Protective Clothing, Including Boots, Apron, Gloves, Lab Coat or Coveralls, as Appropriate, to Prevent Skin Contact.
Eye Protection:	Use Chemical Safety Goggles and/or Full Face Shield where Splashing is Possible. Maintain Eye Wash Fountain and Quick-Drench Facilities in Work Area.

SECTION IX - PHYSICAL AND CHEMICAL PROPERTIES

Appearance / Odor:	Clear, Colorless Solution / Odorless
Solubility:	Completely Miscible with Water
Specific Gravity:	approx. 1.22
pH:	14
% Volatiles by Vol.:	No Information Found
Melting Point:	24 °F (6 °C)
Boiling Point:	230 °F (110 °C)
Vapor Density (Air=1):	No Information Found
Vapor Pressure (mmHg):	No Information Found

SECTION X -STABILITY AND REACTIVITY

General Reactivity: Stable Under Ordinary Conditions of Use and Storage.
Hazardous Decomposition: No Hazardous Decomposition Products.
Incompatibilities: Acids, Aluminum, Tin and Zinc Metals
Hazardous Polymerization: Will Not Occur.

SECTION XI - TOXICOLOGICAL INFORMATION

Carcinogenic References: NTP Carcinogen - Known: No, IARC Category- None

SECTION XII - ECOLOGICAL INFORMATION

Environmental Fate: No information found
Environmental Toxicity: No information found

SECTION XIII -DISPOSAL CONSIDERATIONS

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

SECTION XIV -TRANSPORT INFORMATION

Shipping Name: SODIUM HYDROXIDE SOLUTION
Hazard Class: 8
Identification No.: UN1824, Packing Group II

SECTION XV - REGULATORY INFORMATION

Chemical Inventory Status – Part 1:

Ingredient	TSCA	EC	Japan	Australia
Sodium Hydroxide (1310-73-2)	Yes	Yes	Yes	Yes

Chemical Inventory Status – Part 2:

Ingredient	Korea	--Canada– DSL	NDSL	Phil.
Sodium Hydroxide (1310-73-2)	Yes	Yes	No	Yes

Federal, State & International Regulations – Part 1:

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Sodium Hydroxide (1310-73-2)	No	No	No	No

Federal, State & International Regulations – Part 2:

Ingredient	CERCLA	-RCRA- 261.33	-TSCA 8(d)
Sodium Hydroxide (1310-73-2)	1000	No	No

Chemical Weapons Convention: No
TSCA 12 (b): No
CDTA: No
SARA 311/312: Acute: Yes Chronic: No Fire: No Pressure: No Reactivity: No (Pure/Liquid)
Australian Hazchem Code: 2R
Poison Schedule: S5

SECTION XVI - OTHER INFORMATION

NFPA Rating: HEALTH-3, FLAMMABILITY-0, REACTIVITY-1

Disclaimer: The information contained herein is based upon data believed to be reliable and reflects our best professional judgment. Although reasonable care has been taken in the preparation of this document, we extend no warranties and make no representations as to the accuracy or completeness of the information contained therein and assume no responsibility regarding the suitability of this information for the user's intended purpose or for the consequence of its use. Each individual should make a determination as to the suitability of the information for his/her particular purpose(s).

National Chemicals Incorporated
PO Box 32 ◥ 105 Liberty Street ◥ Winona, MN 55987 ◥ Phone: 800-533-0027 or 507-454-5640 ◥ Fax: 507-454-5641

FOR CHEMICAL EMERGENCY
Involving Shipping and Handling Spills, Leak, Fire, Exposure or Accident
Call CHEMTREC 1-800-424-9300

Complies with OSHA's Hazard Communication Standard 29 CFR 1910.1200

Section 1 - Product Identification

PRODUCT NAME: Sodium Carbonate/Soda Ash

GENERAL USE: Glass manufacture, detergent manufacture, sodium chemicals and carbonate chemicals manufacture, pulp and paper, brine treatment, water hardness removal, pH adjustment in water or wastewater, flue gas desulfurization, coal treatment, ion exchange resin regeneration.

Section 2 - Hazardous Identification

EMERGENCY OVERVIEW: White, odorless, granular solid. Product is non-combustible. Reacts with acid to release carbon dioxide gas and heat. Irritating to the eyes and continuous contact may irritate the skin. Not expected to be toxic to the environment, nor to aquatic organisms.

POTENTIAL HEALTH EFFECTS: Direct contact with the product causes irritation of the eyes and continuous contact may cause skin irritation (red, dry, cracked skin). Excessive levels of airborne dust may irritate the mucous membranes and upper respiratory tract.

Section 3 - Composition/Information on Ingredients

CHEMICAL NAME (COMMON NAME)	CAS NO.	WT. %	EC NO.	EC CLASS
Sodium Carbonate Anhydrous	497-19-8	99.8%	207-838-8	R36; S2-22-26

Section 4 - First Aid Measures

EYES: Immediately flush with water for at least 15 minutes, lifting the upper and lower eyelids intermittently. See a medical doctor or ophthalmologist as necessary.

SKIN: Wash with plenty of soap and water. Get medical attention if irritation occurs and persists.

INGESTION: Rinse mouth with water. Dilute by giving 1 or 2 glasses of water. Do not induce vomiting. Never give anything by mouth to an unconscious person. See a medical doctor immediately.

INHALATION: Remove to fresh air. If breathing difficultly or discomfort occurs and persists, obtain medical attention.

Notes to Medical Doctor: While internal toxicity is low, irritant effects of high concentrations may produce corneal opacities and vesicular skin reactions in humans with abraded skin only. Treatment is symptomatic and supportive.

Section 5 - Fire Fighting Measures

EXTINGUISHING MEDIA: Water, water fog, carbon dioxide (CO_2), dry chemical

FIRE/EXPLOSION HAZARDS: not applicable

FIRE FIGHTING PROCEDURES: Wear full protective clothing and self-contained breathing apparatus.

FLAMMABLE LIMITS: not applicable

HAZARDOUS COMBUSTION PRODUCTS: Fumes of sodium oxide.

SENSITIVITY TO IMPACT: none

SENSITIVITY TO STATIC DISCHARGE: none

Section 9 - Accidental Release Measures

PERSONAL PRECAUTIONS: Refer to Section 8 Exposure Controls/Personal Protection.

CONTAINMENT: Prevent large quantities of this product from contacting vegetation or waterways; large spills could kill vegetation and fish.

CLEAN UP: This product, if spilled, can be recovered and re-used if contamination does not present a problem. Vacuum or sweep up the material. If the spilled product is unusable due to contamination, consult state or federal environmental agencies for acceptable disposal procedures and locations. See Section 13 Disposal Considerations.

NOTIFICATION REQUIREMENTS: Federal regulations do not require notification for spills of this product. State and local regulations may contain different requirements; consult local authorities.

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Section 7 - Handling and Storage

HANDLING: Use air conveying/mechanical systems for bulk transfer to storage. For manual handling or bulk transfer use mechanical ventilation to remove airborne dust from rail car, ship or truck. Use approved respiratory protection when ventilation systems are not available. Selection of respirators is based on the dust cloud generation. Keep material out of lakes, streams, ponds and sewer drains.

STORAGE: Store in cool, dry area, away from acids.

Section 8 - Exposure Controls / Personal Protection

ENGINEERING CONTROLS: Where possible, provide general mechanical and/or local exhaust ventilation to prevent release of airborne dust into work environment.

PERSONAL PROTECTIVE EQUIPMENT

EYES AND FACE: Appropriate eye and face protection equipment (ANSI Z87 approved) should be selected for the particular use intended for this material. Safety glasses with side shields are recommended.

RESPIRATORY: Whenever dust is in the worker's breathing zone cannot be controlled with ventilation or other engineering means, workers should wear respirators or dust masks approved by NIOSHA/MSHA, EU CEN or comparable certification organization to protect them against airborne dust.

PROTECTIVE CLOTHING: Dry product is generally non-irritating to intact skin. However, this product can be irritating where skin has been damaged and can create skin irritation after long exposures when moisture is present. Under such conditions, gloves and long-sleeved clothing are recommended to minimize skin contact.

ADDITIONAL EXPOSURES GUIDELINES: Federal guidelines treat the ingredients in this product as a nuisance dust, as no product-specific guidelines have been issued for exposure. As with all nuisance dusts, worker breathing zone concentrations should be measured by validated sampling and analytical methods. The following limits (OSHA and MSHA) apply to this material:

Particulates not otherwise regulated: OSHA (PEL/TWA): 15 mg/m3 (total dust); 5mg/m3 (resp fraction)
MSHA (PEL/TWA): 10 mg/m3 (total dust)

The information noted above provides general guidance for handling this product. Specific work environments and material handling practices will dictate the selection and use of personal protection equipment (PPE).

Section 9 - Physical and Chemical Properties

ODOR:	Odorless
APPEARANCE:	White, granular solid
AUTO-IGNITION TEMPERATURE:	not applicable
BOILING POINT:	Decomposes
COEFFICIENT OF OIL/WATER:	not applicable
DENSITY/WEIGHT PER VOLUME:	(g/mL) Dense Grades = 0.86 - 1.12; Light Grades = 0.70 - 0.90
EVAPORATION RATE:	not applicable
FLASH POINT:	Non-combustible
FREEZING POINT:	851° C (1564° F)
ODOR THRESHOLD:	not applicable
OXIDIZING PROPERTIES:	not applicable
PERCENT VOLATILE:	not applicable
EVAPORATION RATE:	not applicable
pH:	11.4 (1% solution)
SOLUBILITY IN WATER:	33.2% maximum
VAPOR DENSITY:	not applicable
VAPOR PRESSURE:	not applicable

Section 10 - Stability and Reactivity

CONDITIONS TO AVOID: Contact with acids except under controlled conditions.

STABILITY: Stable

POLYMERIZATION: Will not occur

INCOMPATIBLE MATERIALS: Reacts with acids with release of large volumes of carbon dioxide gas and heat.

HAZARDOUS DECOMPOSITION PRODUCTS: Heated to decomposition, it emits fumes of sodium oxide.

MATERIALS TO AVOID: Aluminum powder, acids, fluorine, molten lithium

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Section 11 - Toxicological Information

EYE EFFECTS: Severe irritant (rabbit) (Toxicology 23:281 (1982)).

SKIN EFFECTS: Non-irritating to intact skin. Minor irritation may occur on abraded skin. (Toxicol. Appl. Pharmacol. 31:481 (1975))

DERMAL LD50: No data available for the product.

ORAL LD50: Harmful if swallowed.

INHALATION LC50: 2.3mg/1 (2h) (rat) (Environ, Res. 31:138 (1983)).

SENSITIZATION: 0.25% sodium carbonate: Non-sensitizing (human) (Toxicol. Appl. Pharmacol. 31:481 (1975)).

TARGET ORGANS: Eyes.

ACUTE EFFECTS FROM OVEREXPOSURE: May cause severe irritation of the eyes, including corneal opacities. Dusts and mists may be irritating to the skin, mucous membranes and upper respiratory tract. No significant acute toxicological effects expected.

CHRONIC EFFECTS FROM OVEREXPOSURE: No data available for the product.

EYES: Immediately flush with cool, running water for at least 15 minutes.

SKIN: Immediately wash skin and clothing with soap and water.

INHALATION: Remove to fresh air. If breathing is difficult, get medical attention.

INGESTION: Rinse mouth at once; give vinegar or juice of lemon, orange or grapefruit. Do not induce vomiting.

CARCINOGENICITY:

NTP: not listed

IARC: not listed

OSHA: not listed

OTHER: (ACGIH) not listed

Section 12 - Ecological Information

ECOTOXICOLOGICAL INFORMATION: 96-hour LC50 = 265-565 mg/L (daphnia magnia) (low toxicity)
96-hour LC50 = 300-320 mg/L (bluegill sunfish) (low toxicity)

CHEMICAL FATE INFORMATION: Biodegradability does not apply to inorganic substances. No significant toxicity to aquatic organisms is expected.

Section 13 - Disposal Method

DISPOSAL METHOD: When this product is discarded or disposed of, as purchased, it is neither a characteristic nor a listed hazardous waste according to US Federal RCRA regulations (40 CFR 261). As a non-hazardous waste the material may be disposed of in a landfill in accordance with government regulations; check local or state regulations for applicable requirements prior to disposal. Any processing, usage, alteration, chemical additions to, or contamination of, the product may alter the disposal requirements. Under Federal regulations, it is the generator's responsibility to determine if a waste is a hazardous waste.

Section 14 - Transportation Information

US DEPARTMENT OF TRANSPORTATION (DOT)

PROPER SHIPPING NAME: not regulated

PRIMARY HAZARD CLASS/DIVISION: not applicable

UN/NA NUMBER: none

LABEL(S): not applicable

PLACARD(S): not applicable

MARKING(S): not applicable

ADDITIONAL INFORMATION: Hazardous Substance/RQ: not applicable 49 STCC Number: not applicable

INTERNATIONAL MARITIME DANGEROUS GOODS (IMDG)

ADDITIONAL INFORMATION: not regulated

ADR - EUROPEAN AGREEMENT CONCERNING THE INTERNATIONAL CARRIAGE OF DANGEROUS GOODS BY ROAD

ADDITIONAL INFORMATION: not regulated

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Section 15 - Regulatory Information

UNITED STATES

SARA TITLE III (SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT)

SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355, APPENDIX A): not listed

SECTION 311 HAZARD CATEGORIES (40 CFR 370): Immediate (Acute) Health Hazard

SECTION 312 THRESHOLD PLANNING QUANTITY (40 CFR 370): The Threshold Planning Quantity (TPQ) for this product, if treated as a mixture, is 10,000 lb; however, this product contains the following ingredients with a TPQ of less than 10,000 lb: None

SECTION 313 HAZARD REPORTABLE INGREDIENTS (40 CFR 370): not listed

CERCLA (COMPREHENSIVE ENVIRONMENTAL RESPONSE COMPENSATION AND LIABILITY ACT)

CERCLA DESIGNATION AND REPORTABLE QUANTITIES (RQ) (40 CFR 302.4): not listed

TSCA (TOXIC SUBSTANCE CONTROL ACT)

TSCA INVENTORY STATUS (40 CFR 710): listed

RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)

RCRA IDENTIFICATION OF HAZARDOUS WASTE (40 CFR 261): Waste Number: Refer to Section 13 Disposal Methods for RCRA status.

CANADA

WHMIS (WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM)

PRODUCT IDENTIFICATION NUMBER: not applicable

HAZARD CLASSIFICATION / DIVISION: D.2.B, E

INGREDIENT DISCLOSURE LIST: listed

DOMESTIC SUBSTANCE LIST: listed

E NUMBERS: E500

EU EINECS NUMBERS: 011-005-00-2

INTERNATIONAL LISTINGS

AUSTRALIA (AICS): listed

CHINA: listed

JAPAN (ENCS): (1)-164

KOREA: KE-31380

PHILIPPINES (PICCS): listed

INTERNATIONAL LISTINGS

AUSTRALIA (AICS): listed

HAZARD, RISK AND SAFETY PHRASE DESCRIPTIONS

SODIUM CARBONATE:

EC Symbols: Xi (irritant)

EC Risk Phrases: R36 (Irritating to eyes)

EC Safety Phrases: S2 (Keep out of reach of children)
S22 (Do not breathe dust)
S26 (In case of contact with eyes, rinse immediately with plenty of water and seek medical advice)

FOR CHEMICAL EMERGENCY

Involving Shipping and Handling Spills, Leak, Fire, Exposure or Accident

Call CHEMTREC 1-800-424-9300

The information and recommendations in this Material Safety Data Sheet are based upon data believed to be correct and does not relate to its use in combination with any other material or process. Since use conditions vary, we assume no liability for failure to follow product use direction and safety precautions. As data, standards and regulations change; NO WARRANTY, EXPRESS OR IMPLIED, IS MADE AS TO THE COMPLETENESS OR CONTINUING ACCURACY OF THIS INFORMATION.

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FLINN SCIENTIFIC INC.

"Your Safer Source for Science Supplies"

Material Safety Data Sheet (MSDS)

MSDS #: 719.00
Revision Date: November 25, 2002

Section 1 — Chemical Product and Company Identification

Sodium Carbonate Solution

Flinn Scientific, Inc. P.O. Box 219 Batavia, IL 60510 (800) 452-1261

CHEMTREC Emergency Phone Number: (800) 424-9300

Section 2 — Composition, Information on Ingredients

Sodium Carbonate (497-19-8) 1-20%, and Water (7732-18-5) 80-99%

CAS#: None Established

Section 3 — Hazards Identification

Colorless, odorless solution.
Irritating to body tissues.

FLINN AT-A-GLANCE
Health-0
Flammability-0
Reactivity-0
Exposure-1
Storage-0

0 is low hazard, 3 is high hazard

Section 4 — First Aid Measures

Call a physician, seek medical attention for further treatment, observation and support after first aid.
Inhalation: Remove to fresh air at once. If breathing has stopped give artificial respiration immediately.
Eye: Immediately flush with fresh water for 15 minutes.
External: Wash continuously with fresh water for 15 minutes.
Internal: Give no more than 1-2 cups of water for dilution. Do not induce vomiting. Call a physician or poison control at once.

Section 5 — Fire Fighting Measures

Non combustible liquid.

NFPA CODE
None Established

Section 6 — Accidental Release Measures

Restrict unprotected personnel from area and ventilate area. Contain spill with sand or absorbent material; deposit in sealed bag or container. See Sections 8 and 13 for further information.

Section 7 — Handling and Storage

Flinn Suggested Chemical Storage Pattern: Inorganic #4. Store with hydroxides, oxides, silicates and carbonates.

Section 8 — Exposure Controls , Personal Protection

Avoid contact with eyes, skin and clothing. Wear chemical splash goggles, chemical-resistant gloves and chemical-resistant apron. Use exhaust ventilation to keep airborne concentrations low.

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Section 9 — Physical and Chemical Properties

Colorless, odorless solution.

Section 10 — Stability and Reactivity

Shelf Life: Good.

Section 11 — Toxicological Information

Acute effects: Irritant
Chronic effects: N.A.
Target organs: N.A.

ORL-RAT LD50: 4090 mg/kg as sodium carbonate
IHL-RAT LC50: N.A.
SKN-RBT LD50: N.A.

N.A. = Not available, not all health aspects of this substance have been fully investigated.

Section 12 — Ecological Information

Data not yet available.

Section 13 — Disposal Considerations

Please consult with state and local regulations.
Flinn Suggested Disposal Method #26b is one option.

Section 14 — Transport Information

Shipping Name: Not regulated
Hazard Class: N/A
UN Number: N/A

N/A = Not applicable

Section 15 — Regulatory Information

Not listed.

Section 16 — Other Information

Consult your copy of the Flinn Scientific Catalog/Reference Manual for additional information about laboratory chemicals. This Material Safety Data Sheet (MSDS) is for guidance and is based upon information and tests believed to be reliable. Flinn Scientific Inc. makes no guarantee of the accuracy or completeness of the data and shall not be liable for any damages relating thereto. The data is offered solely for your consideration, investigation, and verification. Flinn Scientific Inc. assumes no legal responsibility for use or reliance upon this data.

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Material Safety Data Sheet
Sulfuric acid 90-98%

ACC# 22350

Section 1 - Chemical Product and Company Identification

MSDS Name: Sulfuric acid 90-98%
Catalog Numbers: AC124640000, AC124640010, AC124640011, AC124640025, AC124640026, AC124645000, AC124645001, AC133610000, AC133610010, AC133610011, AC133610025, AC133610026, AC133610051, AC302070000, AC302070010, AC302070011, AC302070025, AC302070026, AC388270000, AC424520000, AC424520025, AC424520026, AC424525000, AC424525001, S71211, S71211MF, S71211SC, S71826, S79200, S79200MF, S79200SCMF, S80213, S80213-1, S93391, A298-212, A300-212, A300-225LB, A300-500, A300-500LC, A300-612GAL, A300-700LB, A300C-212, A300C-212002, A300C-212003, A300C-212LC, A300C212004, A300C212005, A300C212006, A300C212007, A300C212008, A300C212009, A300C212010, A300J-500, A300P-500, A300S-212, A300S-212LC, A300S-500, A300SI-212, A468-1, A468-2, A468-250, A468-500, A484-212, A510-212, A510-500, A510SK-212, NC9008405, NC9825433, S71211SCMF, SA174-212, SA174-4, SA176-4, SA196-500
Synonyms: Hydrogen sulfate; Oil of vitriol; Vitriol brown oil; Mattling acid; Battery acid; Sulphuric acid; Electrolyte acid; Dihydrogen sulfate; Spirit of sulfur; Chamber acid.
Company Identification:
Fisher Scientific
1 Reagent Lane
Fair Lawn, NJ 07410
For information, call: 201-796-7100
Emergency Number: 201-796-7100
For CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call: 703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
7664-93-9	Sulfuric acid	90-98	231-639-5

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: clear colorless to yellow liquid.
Danger! Causes eye and skin burns. Causes digestive and respiratory tract burns. May be fatal if mist inhaled. Strong inorganic acid mists containing sulfuric acid may cause cancer. Concentrated sulfuric acid reacts violently with water and many other substances under certain conditions. May cause lung damage. Hygroscopic (absorbs moisture from the air). Corrosive to metal.
Target Organs: Lungs, teeth, eyes, skin, mucous membranes.

Potential Health Effects
Eye: Causes severe eye burns. May cause irreversible eye injury. May cause blindness. May cause permanent corneal opacification. The severity of injury depends on the concentration of the

solution and the duration of exposure.
Skin: Causes skin burns. The severity of injury depends on the concentration of the solution and the duration of exposure.
Ingestion: May cause severe and permanent damage to the digestive tract. Causes gastrointestinal tract burns.
Inhalation: May cause irritation of the respiratory tract with burning pain in the nose and throat, coughing, wheezing, shortness of breath and pulmonary edema. Causes chemical burns to the respiratory tract. Inhalation may be fatal as a result of spasm, inflammation, edema of the larynx and bronchi, chemical pneumonitis and pulmonary edema. Because its vapor pressure is negligible, it exists in the air only as a mist or spray. Exposure may impair lung function and cause mucostasis (reduced mucous clearance).
Chronic: Prolonged or repeated skin contact may cause dermatitis. Prolonged or repeated inhalation may cause nosebleeds, nasal congestion, erosion of the teeth, perforation of the nasal septum, chest pain and bronchitis. Prolonged or repeated eye contact may cause conjunctivitis. Effects may be delayed. Workers chronically exposed to sulfuric acid mists may show various lesions of the skin, tracheobronchitis, stomatitis, conjunctivitis, or gastritis. Occupational exposure to strong inorganic acid mists containing sulfuric acid is carcinogenic to humans.

Section 4 - First Aid Measures

Eyes: In case of contact, immediately flush eyes with plenty of water for a t least 15 minutes. Get medical aid immediately.
Skin: In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid immediately. Wash clothing before reuse.
Ingestion: If swallowed, do NOT induce vomiting. Get medical aid immediately. If victim is fully conscious, give a cupful of water. Never give anything by mouth to an unconscious person.
Inhalation: POISON material. If inhaled, get medical aid immediately. Remove victim to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
Notes to Physician: Monitor arterial blood gases, chest x-ray, and pulmonary function tests if respiratory tract irritation or respiratory depression is evident. Treat dermal irritation or burns with standard topical therapy. Effects may be delayed. Do NOT use sodium bicarbonate in an attempt to neutralize the acid.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Use water spray to keep fire-exposed containers cool. Substance is noncombustible. Contact with water can cause violent liberation of heat and splattering of the material. Contact with metals may evolve flammable hydrogen gas. Runoff from fire control or dilution water may cause pollution. Approach fire from upwind to avoid hazardous vapors and toxic decomposition products. Strong dehydrating agent, which may cause ignition of finely divided materials on contact. Oxides of sulfur may be produced in fire.
Extinguishing Media: Use extinguishing media most appropriate for the surrounding fire. Do NOT get water inside containers. If water is used, care should be taken, since it can generate heat and cause spattering if applied directly to sulfuric acid.
Flash Point: Not applicable.
Autoignition Temperature: Not available.
Explosion Limits, Lower: Not available.
Upper: Not available.

NFPA Rating: (estimated) Health: 3; Flammability: 0; Instability: 2; Special Hazard: -W-

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Avoid runoff into storm sewers and ditches which lead to waterways. Clean up spills immediately, observing precautions in the Protective Equipment section. Carefully scoop up and place into appropriate disposal container. Provide ventilation. Do not get water inside containers. Cover with dry earth, dry sand, or other non-combustible material followed with plastic sheet to minimize spreading and contact with water.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Do not allow water to get into the container because of violent reaction. Do not get in eyes, on skin, or on clothing. Keep container tightly closed. Discard contaminated shoes. Use only with adequate ventilation. Do not breathe spray or mist. Do not use with metal spatula or other metal items. Inform laundry personnel of contaminant's hazards.
Storage: Do not store near combustible materials. Keep container closed when not in use. Store in a cool, dry, well-ventilated area away from incompatible substances. Do not store near alkaline substances. Store protected from moisture. Ideally, sulfuric acid should be stored in isolation from all other chemicals in an approved acid or corrosives safety cabinet.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits. Use a corrosion-resistant ventilation system.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Sulfuric acid	0.2 mg/m3 TWA (thoracic fraction)	1 mg/m3 TWA 15 mg/m3 IDLH	1 mg/m3 TWA

OSHA Vacated PELs: Sulfuric acid: 1 mg/m3 TWA
Personal Protective Equipment
Eyes: Wear chemical splash goggles and face shield.
Skin: Wear neoprene gloves, apron, and/or clothing. Viton gloves are recommended.
Clothing: Wear appropriate protective clothing to prevent skin exposure.
Respirators: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Section 9 - Physical and Chemical Properties

Physical State: Liquid
Appearance: oily - clear colorless to yellow
Odor: odorless
pH: 0.3 (1N solution)
Vapor Pressure: < 0.001 mm Hg @ 20 deg C
Vapor Density: 3.38 (air=1)
Evaporation Rate: Slower than ether.
Viscosity: 21 mPas @ 25 C
Boiling Point: 290 - 338 deg C
Freezing/Melting Point:10 deg C
Decomposition Temperature:340 deg C
Solubility: Soluble with much heat
Specific Gravity/Density:1.84
Molecular Formula:H_2SO_4
Molecular Weight:98.07

Section 10 - Stability and Reactivity

Chemical Stability: Sulfuric acid reacts vigorously, violently or explosively with many organic and inorganic chemicals and with water.
Conditions to Avoid: Excess heat, exposure to moist air or water, Note: Use great caution in mixing with water due to heat evolution that causes explosive spattering. Always add the acid to water, never the reverse..
Incompatibilities with Other Materials: Metals, oxidizing agents, reducing agents, bases, acrylonitrile, chlorates, finely powdered metals, nitrates, perchlorates, permanganates, epichlorohydrin, aniline, carbides, fulminates, picrates, organic materials, flammable liquids.
Hazardous Decomposition Products: Oxides of sulfur.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 7664-93-9: WS5600000
LD50/LC50:
CAS# 7664-93-9:
Draize test, rabbit, eye: 250 ug Severe;
Inhalation, mouse: LC50 = 320 mg/m3/2H;
Inhalation, mouse: LC50 = 320 mg/m3;
Inhalation, rat: LC50 = 510 mg/m3/2H;
Inhalation, rat: LC50 = 510 mg/m3;
Oral, rat: LD50 = 2140 mg/kg;
.

Carcinogenicity:
CAS# 7664-93-9:

- **ACGIH:** A2 - Suspected Human Carcinogen (contained in strong inorganic acid mists)
- **California:** carcinogen, initial date 3/14/03 (listed as Strong inorganic acid mists containing sulfuric acid).
- **NTP:** Known carcinogen (listed as Strong inorganic acid mists containing s).

- **IARC:** Group 1 carcinogen

Epidemiology: Workers exposed to industrial sulfuric acid mist showed a statistical increase in laryngeal cancer. This suggests a possible relationship between carcinogenesis and inhalation of sulfuric acid mist.
Teratogenicity: Sulfuric acid was not teratogenic in mice and rabbits, but was slightly embryotoxic in rabbits (a minor, rare skeletal variation). The animals were exposed to 5 and 20 mg/m3 for 7 hr/day throughout pregnancy. Slight maternal toxicity was present at the highest dose in both species.
Reproductive Effects: No information found
Mutagenicity: There are no mutagenicity studies specifically of sulfuric acid. However, there are established effects of reduced pH in mutagenicity testing, as would be caused by sulfuric acid. These effects are an artifact of low pH and are not necessarily due to biological effects of sulfuric acid itself.
Neurotoxicity: No information found
Other Studies:

Section 12 - Ecological Information

Ecotoxicity: Fish: Bluegill/Sunfish: 49 mg/L; 48Hr; TLm (tap water @ 20C)
Fish: Bluegill/Sunfish: 24.5 ppm; 48Hr; TLm (fresh water)

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series: None listed.

Section 14 - Transport Information

	US DOT	Canada TDG
Shipping Name:	SULFURIC ACID	SULFURIC ACID
Hazard Class:	8	8
UN Number:	UN1830	UN1830
Packing Group:	II	II

Section 15 - Regulatory Information

US FEDERAL

TSCA
CAS# 7664-93-9 is listed on the TSCA inventory.
Health & Safety Reporting List

None of the chemicals are on the Health & Safety Reporting List.

Chemical Test Rules

None of the chemicals in this product are under a Chemical Test Rule.

Section 12b

None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

CERCLA Hazardous Substances and corresponding RQs

CAS# 7664-93-9: 1000 lb final RQ; 454 kg final RQ

SARA Section 302 Extremely Hazardous Substances

CAS# 7664-93-9: 1000 lb TPQ

SARA Codes

CAS # 7664-93-9: immediate, delayed, reactive.

Section 313

This material contains Sulfuric acid (CAS# 7664-93-9, 90-98%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.

Clean Air Act:

This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

CAS# 7664-93-9 is listed as a Hazardous Substance under the CWA.
None of the chemicals in this product are listed as Priority Pollutants under the CWA.
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

CAS# 7664-93-9 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.

California Prop 65

The following statement(s) is(are) made in order to comply with the California Safe Drinking Water Act:

WARNING: This product contains Sulfuric acid, listed as `Strong inorganic acid mists contain', a chemical known to the state of California to cause cancer.
California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols:

C

Risk Phrases:

R 35 Causes severe burns.

Safety Phrases:

S 26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S 30 Never add water to this product.
S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

WGK (Water Danger/Protection)

CAS# 7664-93-9: 2

Canada - DSL/NDSL

CAS# 7664-93-9 is listed on Canada's DSL List.

Canada - WHMIS

This product has a WHMIS classification of D2A, D1A, E.

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.

Canadian Ingredient Disclosure List

CAS# 7664-93-9 is listed on the Canadian Ingredient Disclosure List.

Section 16 - Additional Information

MSDS Creation Date: 4/22/1999
Revision #14 Date: 6/07/2006

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

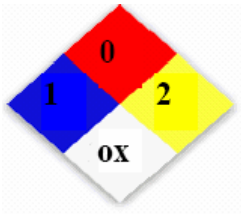
MATERIAL SAFETY DATA SHEET

Sodium Chlorate Solution

For more detailed information on the hazards of this product, contact Chemical Safety and Health Department or Medical Services Department at the address below. Technical Information Bulletin may also be available.

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT IDENTIFICATION



Brand Name..... Sodium chlorate solution
Chemical Name ..... Sodium chlorate solution
Common Name..... Sodium chlorate solution
Formula ..... $NaClO_3$
Molecular Weight..... 106.44 (Sodium Chlorate)
Product Use ..... Non-selective herbicide; defoliant. Also used to
..... generate ClO_2 for pulp bleaching.
Canadian PIN 2428

MANUFACTURER

Tronox
One Leadership Square, Suite 300
211 N. Robinson Ave.
Oklahoma City, OK 73102 US

EMERGENCY TELEPHONE NUMBER

1-866-775-5009 (24 hours)

2. COMPOSITION/INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS NUMBER	WEIGHT %
Sodium Chlorate	7775-09-9	43.7
Water	7732-18-5	56.3

See Section 15 for OSHA Regulatory Status.

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

Odorless, colorless-to-green or yellow liquid. Harmful if swallowed. May be irritating to the respiratory system if mists or fumes are inhaled, or to eyes or skin in case of contact.

DANGER! Strong oxidizer – Contact with other materials such as paper, wood, hydrocarbons, petroleum products, vegetation, and clothing may cause a fire or explosion. Can produce shock-sensitive mixtures. Thermally unstable at elevated temperatures.

In case of a spill, wear full protective equipment (See Section 8).

Will not burn in a fire, but may cause combustible materials to ignite; it will accelerate the burning of other materials and increase the fire hazard. In case of a fire, **use water only**.

POTENTIAL HEALTH EFFECTS

PRIMARY ROUTE(S) OF ENTRY

Inhalation (breathing); eye and skin contact; ingestion (swallowing).

SYMPTOMS OF EXPOSURE

Inhalation: Irritation or burning in the respiratory tract; coughing and sneezing.

Eye Contact: Itching or mild irritation

Skin Contact: Itching or mild irritation; prolonged and repeated contact may cause dermatitis

Ingestion: The primary target organ in humans is blood; effects include hemolysis and methemoglobinemia-carboxyhemoglobinemia. Ingesting large quantities can cause abdominal pain, nausea, and diarrhea, possibly with dark blood, cyanosis (blue lips, tongue, mucous membranes, with slate gray skin color), possibly progressing to headache, difficulty in breathing, dizziness, seizures, or coma. Large doses can cause kidney or liver damage, and may be fatal.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE

Breathing or respiratory disorders, digestive tract, kidney and blood disorders could be aggravated by exposure to this chemical.

REPORTED AS CARCINOGEN OR POTENTIAL CARCINOGEN

X Not Applicable
_ National Toxicology Program (NTP)
_ OSHA
_ International Agency for Research on Cancer (IARC)

4. FIRST AID MEASURES

Inhalation: Remove from area to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get immediate medical attention.

Eye contact: Immediately rinse eyes with water. Remove any contact lenses, and continue flushing eyes with running water for at least 15 minutes. Hold eyelids apart to ensure rinsing of the entire surface of the eyes and lids with water. Get immediate medical attention.

Skin Contact: Wash affected areas with plenty of water, and soap if available, for several minutes. Remove and wash contaminated clothing before it dries. Seek medical attention if irritation develops or persists. Soak leather shoes in water and discard as flammable, hazardous articles.

Ingestion: Immediately give 3-4 glasses of water, and induce vomiting. Give fluids until vomitus is clear. Do not induce vomiting or give anything by mouth to an unconscious or convulsing person. Get immediate medical attention.

NOTE TO PHYSICIAN

Chemical of exposure is sodium chlorate, a strong oxidizer and methemoglobin former. Cyanosis, resistant to oxygen therapy, may be noted within several hours following inhalation or ingestion. Large doses can affect the kidneys, liver, and central nervous system, and may be fatal (see Section 11 for toxicological data).

5. FIRE FIGHTING MEASURES

Flash Point and Method N/A

GENERAL HAZARD

This product is not flammable, but may cause combustible materials to ignite; it will accelerate the burning of these materials and increase the fire hazard. Thermally unstable under fire conditions; may undergo a violent decomposition.

EXTINGUISHING MEDIA

Use water only. For large fires, use flooding quantities of water as fog or spray applied from a distance. For a massive fire in a storage area use an unmanned hose holder or monitor nozzles; if this is impossible, withdraw from the area and let the fire burn.

SPECIAL FIREFIGHTING INSTRUCTIONS

Keep unnecessary people away; isolate hazard area and deny entry. DO NOT attempt to fight a large fire unless you are a trained fire fighter. Approach fire from upwind to avoid hazardous vapors and toxic decomposition products. Cool fire-exposed containers with water spray until well after fire is out. Extinguish fire using agent suitable for surrounding fire.

FIREFIGHTING EQUIPMENT

Wear a NIOSH-approved, positive-pressure self-contained breathing apparatus and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

ON LAND

Small Spills: Take up with sand, vermiculite, or other noncombustible absorbent material and place in metal containers for later disposal.

Large Spills: Dike flow of spilled material using soil or sandbags. Prevent liquid from entering sewers or waterways. Remove bulk of liquid with, for example, a vacuum truck for recovery or disposal. Then flush area with water. If permitted, flush washings to a waste treatment plant; otherwise transfer to a licensed waste disposal contractor.

Dispose of as a hazardous waste under federal, state and local regulations.

IN WATER

Small pools of contaminant may be absorbed in a non-reactive absorbent and disposed of as outlined above. Spills in large bodies of water should be dispersed.

7. HANDLING AND STORAGE

HANDLING

Wear appropriate protective equipment (See Section 8). Avoid breathing mists. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

Clothing, vegetation, hydrocarbons, petroleum products, and other organic materials contaminated with sodium

chlorate or its solutions are dangerously flammable. Keep from contact with clothing and other combustible materials. Remove and wash contaminated clothing promptly. Do not wear leather shoes, gloves or belts. Wear rubber boots and apron to avoid contact with clothing. Always have a water filled jump tank or deluge shower in immediate work area. If your clothing catches fire, **do not** use a fire blanket. Use the jump tank or deluge shower.

Clean up all spills promptly. Do not allow liquid to dry. The oxidizing power of the dry chemical is much greater.

STORAGE

Store in a dry, well-ventilated area, preferably outdoors. Isolate from incompatible materials (See Section 10). Do not store with reducing agents, ammonia, or amines. Store in the original tightly closed container.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS

Provide local exhaust and general ventilation system. Do not allow solution to dry and solid to accumulate on pipes, structural members, or walkways.

PERSONAL PROTECTION

Respirator: In operations where exposure limits are exceeded, use a NIOSH-approved respirator that has been selected by a technically qualified person for the specific work conditions. If respirators are used, OSHA requires compliance with its respiratory protection program (29 CFR 1910.134).

Eye Protection: Wear safety glasses with side shield (or goggles).

Gloves: Use gloves that will not allow the product to penetrate.

Clothing: Wear easily washable clothing; keep pants over rubber boots or shoes. Wash clothing after each shift. If clothing becomes contaminated, keep wet until washed. Do **not** wear leather shoes, gloves or belts. If leather is inadvertently contaminated, do not reuse; soak in water and discard as hazardous, flammable article.

Other: Eye wash, safety shower or jump tank.

EXPOSURE CONTROLS

COMPONENT	OSHA PEL		ACGIH TLV	
	TWA	STEL	TWA	STEL
Sodium chlorate	N/E	N/E	N/E	N/E

9. PHYSICAL AND CHEMICAL PROPERTIES

State ..... Liquid
Color ..... Colorless to green or yellow
Odor ..... None
Vapor Pressure..... N/A
Melting Point °C..... N/A
Boiling Point °C 110 (50%)

Bulk Density, lb/cu. Ft..... N/A
Weight Per Gallon 11.7 (50%)
Specific Gravity @ 20 °C ... 1.4 (50%)
Water Solubility @ 20 °C ... Miscible
pH..... 5-9

10. STABILITY AND REACTIVITY

REACTIVITY

Normally stable unless contaminated.

INCOMPATIBILITIES

DANGER! Strong oxidizer - contact with other materials may cause fire or explosive mixtures. May react violently with strong reducing agents. **Do not mix** with charcoal, shellac, sugar, starch, sulfur and sulfur compounds, ammonia, ammonium compounds, amines, acids, phosphorus, metal powders, sawdust, explosives, and other flammable or oxidizable materials including clothing. Can become shock or friction sensitive when mixed with some of these materials.

HAZARDOUS DECOMPOSITION PRODUCTS

If subjected to intense heat, may release toxic and hazardous fumes of sodium oxide, chlorine, and chlorine dioxide.

CONDITIONS TO AVOID

High temperatures; reducing agents.

11. TOXICOLOGICAL INFORMATION

Acute Effects on Humans
Humans appear to be more susceptible than animals to acute effects of exposure to sodium chlorate (see data below). Doses of 100 grams or more are invariably fatal to humans. In a study of 14 cases of poisoning by sodium chlorate, the lowest fatal dose reported occurred in a 46-year old woman who ingested 15 grams (estimated to be 280 mg/kg body weight). In another reported case, however, an 18-year old male survived a dose of 100 grams (estimated to be 1.14 g/kg of body weight) (HSDB, 1998).

The U.S. Environmental Protection Agency (USEPA) reviewed two studies conducted with adult male volunteers that reported the acute No Observable Adverse Effect Level (NOAEL) to be 0.034 mg chlorate ion/kg-day, and the sub-acute NOAEL to be 0.036 mg chlorate ion/kg-day (EPA, 1994).

RTECS FO0525000

LD_{Lo} (human)	214 mg/kg – unreported route
LD_{Lo} (child)	185 mg/kg – unreported route
Oral TD_{Lo} (woman)	800 mg/kg
Oral LD_{50} (rat)	1200 mg/kg
Oral LD_{50} (mouse)	8350 mg/kg
Oral LD_{50} (rabbit)	7200 mg/kg
Oral LD_{Lo} (cat)	1350 mg/kg
Oral LD_{Lo} (dog)	700 mg/kg
Inhalation LC_{50} (rat)	>28 g/m3/1 hr
Intraperitoneal LD_{50} (mouse)	596 mg/kg
Dermal LD_{50} (rabbit)	>10 g/kg
Dermal (rabbit)	500 mg/24 hr – mild irritation
Eye (rabbit)	10 mg – mild irritation

Mutation effects were observed in bacteria and insects.

Potential Chronic Effects
In sub-chronic oral studies, the NOAEL for sodium chlorate was found to be: 9 mg/kg-day for Green monkeys dosed via drinking water for 30-60 days (Bercz, et al., 1982); 38-53 mg/kg-day for rats dosed via drinking water for three months (McCauley, et al., 1995); 100 mg/kg-day for rates dosed by gavage for three months (Barrett, 1987a); and 360 mg/kg-day for beagle dogs dosed by gavage for three months (Barrett, 1987b).

In a one-year study on rats dosed via drinking water, no NOAEL was determined; however, the Lowest Observable Adverse Effect Level was 1.8 mg/kg-day (Abdel-Rahmann, et al., 1985).

In a study with pregnant rats, sodium chlorate did not appear to affect either dams or fetuses. The NOAEL appeared to be 1000 mg/kg-day (Schroeder, 1987). No studies of reproductive toxicity of sodium chlorate are available.

Four studies (Wyngaarden, et al., 1952, Greer, et al., 1966, Eskandari, et al., 1997, Van Sande, et al., 2003) indicate that chlorate inhibits iodide uptake by the thyroid. Rats and mice fed drinking water containing sodium chlorate in concentrations up to 2g/L demonstrated decreased T4 levels after 4 days and a concentrationdependent increase in thyroid follicular cell hyperplasia after 90 days (Hooth, et al., 2001). Chlorine dioxide is converted to chlorate and chlorite in vivo. Human volunteers had no detectable thyroid hormone changes after drinking 500 ml of water containing 5 mg/L sodium chlorate each day for 12 weeks (Lubbers, et al., 1982).

Perchlorate is produced during the electrolytic production of chlorates and is present in the finished product in an expected range of approximately 17-22 ppm. Perchlorate can potentially inhibit iodide uptake by the thyroid and result in a decrease in thyroid hormone (Wyngaarden, et al., 1952, Greer, et al., 1966, Eskandari, et al., 1997, Van Sande, et al., 2003). The health effects of perchlorate are being studied by USEPA through the preparation of a toxicity assessment that is currently under review, which is expected to lead to the establishment of a maximum contaminant level for perchlorate in drinking water by 2007.

Sodium dichromate, a source of hexavalent chromium, is necessary to the electrolytic production of chlorates and sodium dichromate is present in the finished product in the range of 1-3 ppm. The State of California has determined in accordance with the Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65) that hexavalent chromium poses a significant risk of cancer when in excess of 0.001 microgram (one one-billionth of a gram) per day could be inhaled.

12. ECOLOGICAL INFORMATION

Sodium chlorate acts as a non-selective contact herbicide, acting as a desiccant; it is a semi-permanent soil sterilant.

Sodium chlorate was found to be weakly toxic to aquatic organisms. (Matida, 1976)

13. DISPOSAL CONSIDERATIONS

RCRA Waste Code:.....D001

Sodium chlorate, including spill cleanups, is prohibited from land disposal without prior treatment. Dispose in accordance with applicable federal, state, and local regulations.

14. TRANSPORT INFORMATION

DOT Proper Shipping Name .....Sodium chlorate, aqueous solution
DOT Hazard Class.....5.1
DOT I.D. Number……..UN 2428
DOT Packing Group……..II
Label(s)……..Oxidizer
ERG – Guide No. ……..140

TDG Shipping Name.....Sodium chlorate, aqueous solution
TDG Classification.....5.1
Product Identification Number……..UN 2428
Packing Group…….……..II
Label(s)……..Oxidizer

IMDG Proper Shipping Name.....Sodium chlorate, aqueous solution
IMDG Hazard Class 5.1
IMDG I.D. Number…….……..UN 2428
Packing Group…….……..II
Label(s)……..Oxidizer

IATA Proper Shipping Name.....Sodium chlorate, aqueous solution
IATA Hazard Class 5.1
IATA I.D. Number……..……..UN 2428
Packing Group…….……..II
Label(s)……..Oxidizer

15. REGULATORY INFORMATION

OSHA HAZARD COMMUNICATION STANDARD (29 CFR 1910.1200)

X Hazardous _ Non-Hazardous

SAFE DRINKING WATER ACT - MAXIMUM CONTAMINANT LEVELS GOAL

In July, 1994 EPA concluded that existing data are inadequate for developing a maximum contaminant level goal for chlorate. (Federal Register, **59**, No. 145, pp 38691-4, 1994)

CERCLA/SUPERFUND (40 CFR 117, 302)

Chemical Name	RQ (lbs)/(kg)
N/A	

SARA EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355)

Chemical Name	TPQ (lbs)	RQ (lbs)
N/A		

SARA HAZARD CATEGORIES (40 CFR 370)

X Acute X Chronic X Fire _ Pressure _ Reactive _ None

SARA TOXIC CHEMICALS (40 CFR 372)

Chemical Name	CAS Number	%
N/A		

WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (CPR Section (33))

This product has been classified according to the hazard criteria of the Controlled Products Regulations, and the MSDS contains all required information.

X Controlled Product; Classification: C _ Not a Controlled Product

INVENTORY STATUS

This chemical is listed on the US TSCA Chemical Substance Inventory and the Canadian Domestic Substances List.

TOXIC SUBSTANCES CONTROL ACT

No specific regulations apply.

STATE REGULATIONS

California Proposition 65 ..... WARNING: This product contains a chemical known to the State of California to cause cancer. (See Section 16)
Florida Hazardous Substance List .... Present
Massachusetts Right to Know List ..... Present
New Jersey Right to Know List..... Substance No. 1688
Pennsylvania Right to Know List..... Present

16. OTHER INFORMATION

Sodium dichromate, a source of hexavalent chromium, is a necessary material in the electrolytic production of chlorates. It serves both as a pH buffer in the process and to inhibit cathodic reduction of the product. Subsequent treatment removes >99.9% of the hexavalent chromium from the product, however a small but measurable amount remains; KM Sodium chlorate solution contains 0.4-1.3 parts-per-million of hexavalent chromium.

The State of California has determined in accordance with the Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65) that hexavalent chromium poses a significant risk of cancer when an excess of 0.001 microgram (one one-billionth of a gram) per day could be inhaled.

Use this product in accordance with the instructions contained in this Material Safety Data Sheet. The recommendations for safe handling and personal protective equipment, if followed, will minimize exposure to this product and the hexavalent chromium contained therein.

ABBREVIATIONS

C - Ceiling limit
ERG - Emergency Response Guidebook
LOAEL - Lowest Observable Adverse Effect Level
LC_{50} - The concentration of a substance in air that will kill 50% of test animals within a certain exposure period.
LD_{Lo} - The lowest dose of a substance that will kill a test animal.
LD_{50} - The dose that causes death in 50% of test animals.
N/A - Not applicable
N/D - Not determined
N/E - Not established
N/K - Not known
NOAEL - No Observable Adverse Effect Level
PIN – Product Identification Number
RQ - Reportable Quantity
TD_{Lo} - The lowest dose of a substance that causes a specific toxic effect.
TPQ - Threshold Planning Quantity

PREPARATION INFORMATION

Prepared by..... ..... Safety and Health Department
MSDS No. B-5011
Date Revised:... ..... February 28, 2006 Replaces: September 17, 2003
Date of Issue: .. .. March 2006

REVISION INFORMATION

Section 1: Updated company name, address, telephone and product name
Section 14: IMDG/IATA added
Section 15: WHMIS classification changed

MATERIAL SAFETY DATA SHEET

Hydrogen Peroxide (40 to 60%)

MSDS Ref. No.: 7722-84-1-4
Date Approved: 02/02/2004
Revision No.: 7

This document has been prepared to meet the requirements of the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200; the Canada's Workplace Hazardous Materials Information System (WHMIS) and, the EC Directive, 2001/58/EC.

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: Hydrogen Peroxide (40 to 60%)

ALTERNATE PRODUCT NAME(S): Durox® Reg. & LR 50%, Oxypure® 50%, Semiconductor Reg & Seg 50%, Standard 50%, Technical 50%, Chlorate Grade 50%, Super D® 50%

GENERAL USE: Durox® 50% Reg. and LR - meets the Food Chemical Codex requirements for aseptic packaging and other food related applications.

Oxypure® 50% - certified by NSF to meet NSF/ANSI Standard 60 requirements for drinking water treatment.

Standard 50% - most suitable for industrial bleaching, processing, pollution abatement and general oxidation reactions.

Semiconductor Reg. & Seg. 50% - conforms to ACS and Semi Specs., for wafer etching and cleaning, and applications requiring low residues.

Super D® 50% - meets US Pharmacopoeia specifications for 3% topical solutions when diluted with proper quality water. While manufactured to the USP standards or purity and to FMC's demanding ISO 9002 quality standards, FMC does not claim that its Hydrogen Peroxide is manufactured in accordance with all pharmaceutical cGMP conditions.

Technical 50% - essentially free of inorganic metals, suitable for chemical synthesis.

Chlorate Grade 50% - specially formulated for use in chlorate manufacture or processing.

SynergOx™ - combination of a proprietary catalyst and 50% hydrogen peroxide, at the point of use, for environmental applications.

MANUFACTURER

FMC CORPORATION
Hydrogen Peroxide Division
1735 Market Street
Philadelphia, PA 19103
(215) 299-6000 (General Information)

FMC of Canada Ltd.
Hydrogen Peroxide Division
PG Pulp Mill Road
Prince George, BC V2N2S6
(250) 561-4200 (General Information)

EMERGENCY TELEPHONE NUMBERS

(800) 424-9300 (CHEMTREC - U.S.)
(613) 996-6666 (CANUTEC)
(303) 595-9048 (Medical - U.S. - Call Collect)

(281) 474-8750 (Plant: Pasadena, TX, US - Call Collect)
(250) 561-4221 (Plant: Prince George, BC, Canada - Call Collect)

2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

- Clear, colorless, odorless liquid
- Oxidizer.
- Contact with combustibles may cause fire.
- Decomposes yielding oxygen that supports combustion of organic matters and can cause overpressure if confined.
- Corrosive to eyes, nose, throat, lungs and gastrointestinal tract.

POTENTIAL HEALTH EFFECTS: Corrosive to eyes, skin, nose, throat and lungs. May cause irreversible tissue damage to the eyes including blindness.

3. COMPOSITION / INFORMATION ON INGREDIENTS

Chemical Name	CAS#	Wt.%	EC No.	EC Class
Hydrogen Peroxide	7722-84-1	40 - 60	231-765-0	C, R34
Water	7732-18-5	40 - 60	231-791-2	Not classified as hazardous

4. FIRST AID MEASURES

EYES: Immediately flush with water for at least 15 minutes, lifting the upper and lower eyelids intermittently. See a medical doctor or ophthalmologist immediately.

SKIN: Immediately flush with plenty of water while removing contaminated clothing and/or shoes, and thoroughly wash with soap and water. See a medical doctor immediately.

INGESTION: Rinse mouth with water. Dilute by giving 1 or 2 glasses of water. Do not induce vomiting. Never give anything by mouth to an unconscious person. See a medical doctor immediately.

INHALATION: Remove to fresh air. If breathing difficulty or discomfort occurs and persists, contact a medical doctor.

NOTES TO MEDICAL DOCTOR: Hydrogen peroxide at these concentrations is a strong oxidant. Direct contact with the eye is likely to cause corneal damage especially if not washed immediately. Careful ophthalmologic evaluation is recommended and the possibility of local corticosteroid therapy should be considered. Because of the likelihood of corrosive effects on the gastrointestinal tract after ingestion, and the unlikelihood of systemic effects, attempts at evacuating the stomach via emesis induction or gastric lavage should be avoided. There is a remote possibility, however, that a nasogastric or orogastric tube may be required for the reduction of severe distension due to gas formation.

5. FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA: Flood with water.

FIRE / EXPLOSION HAZARDS: Product is non-combustible. On decomposition releases oxygen which may intensify fire.

FIRE FIGHTING PROCEDURES: Any tank or container surrounded by fire should be flooded with water for cooling. Wear full protective clothing and self-contained breathing apparatus.

FLAMMABLE LIMITS: Non-combustible

SENSITIVITY TO IMPACT: No data available

SENSITIVITY TO STATIC DISCHARGE: No data available

6. ACCIDENTAL RELEASE MEASURES

RELEASE NOTES: Dilute with a large volume of water and hold in a pond or diked area until hydrogen peroxide decomposes. Hydrogen peroxide may be decomposed by adding sodium metabisulfite or sodium sulfite after diluting to about 5%. Dispose according to methods outlined for waste disposal.

Combustible materials exposed to hydrogen peroxide should be immediately submerged in or rinsed with large amounts of water to ensure that all hydrogen peroxide is removed. Residual hydrogen peroxide that is allowed to dry (upon evaporation hydrogen peroxide can concentrate) on organic materials such as paper, fabrics, cotton, leather, wood or other combustibles can cause the material to ignite and result in a fire.

7. HANDLING AND STORAGE

HANDLING: Wear chemical splash-type monogoggles and full-face shield, impervious clothing, such as rubber, PVC, etc., and rubber or neoprene gloves and shoes. Avoid cotton, wool and leather. Avoid excessive heat and contamination. Contamination may cause decomposition and generation of oxygen gas which could result in high pressures and possible container rupture. Hydrogen peroxide should be stored only in vented containers and transferred only in a prescribed manner (see FMC Technical Bulletins). Never return unused hydrogen peroxide to original container, empty drums should be triple rinsed with water before discarding. Utensils used for handling hydrogen peroxide should only be made of glass, stainless steel, aluminum or plastic.

STORAGE: Store drums in cool areas out of direct sunlight and away from combustibles. For bulk storage refer to FMC Technical Bulletins.

COMMENTS: VENTILATION: Provide mechanical general and/or local exhaust ventilation to prevent release of vapor or mist into the work environment.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE LIMITS

Chemical Name	ACGIH	OSHA	Supplier
Hydrogen Peroxide	1 ppm (TWA)	1 ppm (PEL)	

ENGINEERING CONTROLS: Ventilation should be provided to minimize the release of hydrogen peroxide vapors and mists into the work environment. Spills should be minimized or confined immediately to prevent release into the work area. Remove contaminated clothing immediately and wash before reuse.

PERSONAL PROTECTIVE EQUIPMENT

EYES AND FACE: Use chemical splash-type monogoggles and a full-face shield made of polycarbonate, acetate, polycarbonate/acetate, PETG or thermoplastic.

RESPIRATORY: If concentrations in excess of 10 ppm are expected, use NIOSH/DHHS approved self-contained breathing apparatus (SCBA), or other approved atmospheric-supplied respirator (ASR) equipment (e.g., a full-face airline respirator (ALR)). DO NOT use any form of air-purifying respirator (APR) or filtering facepiece (AKA dust mask), especially those containing oxidizable sorbants such as activated carbon.

PROTECTIVE CLOTHING: For body protection wear impervious clothing such as an approved splash protective suit made of SBR Rubber, PVC (PVC Outershell w/Polyester Substrate), Gore-Tex (Polyester trilaminate w/Gore-Tex), or a specialized HAZMAT Splash or Protective Suite (Level A, B, or C). For foot protection, wear approved boots made of NBR, PVC, Polyurethane, or neoprene. Overboots made of Latex or PVC, as well as firefighter boots or specialized HAZMAT boots are also permitted. DO NOT wear any form of boot or overboots made of nylon or nylon blends. DO NOT use cotton, wool or leather, as these materials react RAPIDLY with higher concentrations of hydrogen peroxide. Completely submerge hydrogen peroxide contaminated clothing or other materials in water prior to drying. Residual hydrogen peroxide, if allowed to dry on materials such as paper, fabrics, cotton, leather, wood or other combustibles can cause the material to ignite and result in a fire.

GLOVES: For hand protection, wear approved gloves made of nitrile, PVC, or neoprene. DO NOT use cotton, wool or leather for these materials react RAPIDLY with higher concentrations of hydrogen peroxide. Thoroughly rinse the outside of gloves with water prior to removal. Inspect regularly for leaks.

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9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR:	Odorless
APPEARANCE:	Clear, colorless liquid
AUTOIGNITION TEMPERATURE:	Non-combustible
BOILING POINT:	110°C (229°F) (40%); 114°C (237°F) (50%)
COEFFICIENT OF OIL / WATER:	Not available
DENSITY / WEIGHT PER VOLUME:	Not available
EVAPORATION RATE:	Above 1 (Butyl Acetate = 1)
FLASH POINT:	Non-combustible
FREEZING POINT:	-41.4°C (-42.5°F) (40%); -52°C (-62°F) (50%)
ODOR THRESHOLD:	Not available
OXIDIZING PROPERTIES:	Strong oxidizer
PERCENT VOLATILE:	100%
pH:	(as is) 1.0 to 3.0
SOLUBILITY IN WATER:	(in H_2O % by wt) 100%

SPECIFIC GRAVITY:	(H_20 = 1) 1.15 @ 20°C/4°C (40%); 1.19 @ 20°C/4°C (50%)
VAPOR DENSITY:	Not available (Air = 1)
VAPOR PRESSURE:	22 mmHg @ 30°C (40%); 18.3 mmHg @ 30°C (50%)

COMMENTS:
pH (1% solution) : 5.0 - 6.0

10. STABILITY AND REACTIVITY

CONDITIONS TO AVOID:	Excessive heat or contamination could cause product to become unstable.
STABILITY:	Stable (heat and contamination could cause decomposition)
POLYMERIZATION:	Will not occur
INCOMPATIBLE MATERIALS:	Reducing agents, wood, paper and other combustibles, iron and other heavy metals, copper alloys and caustic.
HAZARDOUS DECOMPOSITION PRODUCTS:	Oxygen which supports combustion.

COMMENTS: Materials to Avoid : Dirt, organics, cyanides and combustibles such as wood, paper, oils, etc.

11. TOXICOLOGICAL INFORMATION

EYE EFFECTS: 70% hydrogen peroxide: Severe irritant (corrosive) (rabbit) [FMC Study Number: ICG/T-79.027]

SKIN EFFECTS: 50% hydrogen peroxide: Severe irritant (corrosive) (rabbit) [FMC Study Number: I89-1079]

DERMAL LD_{50}: 70% hydrogen peroxide: > 6.5 g/kg (rabbit) [FMC Study Number: ICG/T-79.027]

ORAL LD_{50}: 50% hydrogen peroxide: > 225 mg/kg (rat) [FMC Study Number: I86-914]

INHALATION LC_{50}: 50% hydrogen peroxide: > 0.17 mg/l (rat) [FMC Study Number: I89-1080]

TARGET ORGANS: Eye, skin, nose, throat, lungs

ACUTE EFFECTS FROM OVEREXPOSURE: Severe irritant/corrosive to eyes, skin and gastrointestinal tract. May cause irreversible tissue damage to the eyes including blindness. Inhalation of mist or vapors may be severely irritating to nose, throat and lungs.

CHRONIC EFFECTS FROM OVEREXPOSURE: The International Agency for Research on Cancer (IARC) has concluded that there is inadequate evidence for carcinogenicity of hydrogen peroxide in humans, but limited evidence in experimental animals (Group 3 - not classifiable as to its carcinogenicity to humans). The American Conference of Governmental Industrial Hygienists (ACGIH) has concluded that hydrogen peroxide is a 'Confirmed Animal Carcinogen with Unknown Relevance to Humans' (A3).

CARCINOGENICITY:

Chemical Name	IARC	NTP	OSHA	Other
Hydrogen Peroxide	Listed	Not listed	Not listed	(ACGIH) Listed (A3, Animal Carcinogen)

12. ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION: Channel catfish 96-hour LC_{50} = 37.4 mg/L
Fathead minnow 96-hour LC_{50} = 16.4 mg/L
Daphnia magna 24-hour EC_{50} = 7.7 mg/L
Daphnia pulex 48-hour LC_{50} = 2.4 mg/L
Freshwater snail 96-hour LC_{50} = 17.7 mg/L
For more information refer to ECETOC "Joint Assessment of Commodity Chemicals No. 22, Hydrogen Peroxide." ISSN-0773-6339, January 1993

CHEMICAL FATE INFORMATION: Hydrogen peroxide in the aquatic environment is subject to various reduction or oxidation processes and decomposes into water and oxygen. Hydrogen peroxide half-life in freshwater ranged from 8 hours to 20 days, in air from 10-20 hrs. and in soils from minutes to hours depending upon microbiological activity and metal contaminants.

13. DISPOSAL CONSIDERATIONS

DISPOSAL METHOD: An acceptable method of disposal is to dilute with a large amount of water and allow the hydrogen peroxide to decompose followed by discharge into a suitable treatment system in accordance with all regulatory agencies. The appropriate regulatory agencies should be contacted prior to disposal.

14. TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

PROPER SHIPPING NAME:	Hydrogen peroxide, aqueous solutions with more than 40% but not more than 60% hydrogen peroxide.
PRIMARY HAZARD CLASS / DIVISION:	5.1 (Oxidizer)
UN/NA NUMBER:	UN 2014
PACKING GROUP:	II
LABEL(S):	Oxidizer, Corrosive
PLACARD(S):	5.1 (Oxidizer)
ADDITIONAL INFORMATION:	DOT Marking: Hydrogen Peroxide, aqueous solution with more than 40%, but not more than 60% Hydrogen Peroxide, UN 2014 Hazardous Substance/RQ: Not applicable 49 STCC Number: 4918775 DOT Spec: stainless steel/high purity aluminum cargo tanks and rail cars. UN Spec: HDPE drums. Contact FMC for specific details.

INTERNATIONAL MARITIME DANGEROUS GOODS (IMDG)

PROPER SHIPPING NAME:	Hydrogen peroxide, aqueous solutions with not less than 20%, but not more than 60% hydrogen peroxide.

INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO) / INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA)

PROPER SHIPPING NAME:	Hydrogen peroxide (40 - 60%) is forbidden on Passenger and Cargo Aircraft, as well as Cargo Only Aircraft.

OTHER INFORMATION:

Protect from physical damage. Keep drums in upright position. Drums should not be stacked in transit. Do not store drum on wooden pallets.

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15. REGULATORY INFORMATION

UNITED STATES

SARA TITLE III (SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT)

SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355, APPENDIX A):

Hydrogen Peroxide > 52%, RQ: 1000 lbs. Planning Threshold: 10,000 lbs.

SECTION 311 HAZARD CATEGORIES (40 CFR 370):
Fire Hazard, Immediate (Acute) Health Hazard

SECTION 312 THRESHOLD PLANNING QUANTITY (40 CFR 370):
The Threshold Planning Quantity (TPQ) for this product, if treated as a mixture, is 10,000 lbs; however, this product contains the following ingredients with a TPQ of less than 10,000 lbs.: None, (conc. <52%) (hydrogen peroxide, 1000 lbs. when conc is >52%)

SECTION 313 REPORTABLE INGREDIENTS (40 CFR 372):
Not listed

CERCLA (COMPREHENSIVE ENVIRONMENTAL RESPONSE COMPENSATION AND LIABILITY ACT)

CERCLA DESIGNATION & REPORTABLE QUANTITIES (RQ) (40 CFR 302.4):
Unlisted (Hydrogen Peroxide); RQ = 100 lbs.; Ignitability, Corrosivity

TSCA (TOXIC SUBSTANCE CONTROL ACT)

TSCA INVENTORY STATUS (40 CFR 710):
Listed

RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)
RCRA IDENTIFICATION OF HAZARDOUS WASTE (40 CFR 261):
Waste Number: D001, D002

CANADA

WHMIS (WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM):

Product Identification Number:	2014
Hazard Classification / Division:	Class C (Oxidizer), Class D, Div. 2, Subdiv. B (Toxic), Class E (Corrosive)
Ingredient Disclosure List:	Listed

EU EINECS NUMBERS:

008-003-00-9 (hydrogen peroxide)

INTERNATIONAL LISTINGS

Hydrogen peroxide:
China: Listed
Japan (ENCS): (1)-419
Korea: KE-20204
Philippines (PICCS): Listed

16. OTHER INFORMATION

HAZARD, RISK AND SAFETY PHRASE DESCRIPTIONS:

Hydrogen Peroxide:

EC Symbols:	C	(Corrosive)
EC Risk Phrases:	R34	(Causes burns)
EC Safety Phrases:	S1/2	(Keep locked up and out of reach of children.)
	S3	(Keep in a cool place.)
	S28	(After contact with skin, wash immediately with plenty of water and soap.)
	S36/39	(Wear suitable protective clothing. Wear eye / face protection.)
	S45	(In case of accident or if you feel unwell, seek medical advice immediately - show the label where possible.)

HMIS

Health	3
Flammability	0
Physical Hazard	1
Personal Protection (PPE)	H

Protection = H (Safety goggles, gloves, apron, the use of a supplied air or SCBA respirator is required in lieu of a vapor cartridge respirator)

HMIS = Hazardous Materials Identification System

Degree of Hazard Code:
4 = Severe
3 = Serious
2 = Moderate
1 = Slight
0 = Minimal

NFPA

Health	3
Flammability	0
Reactivity	1
Special	OX

SPECIAL = OX (Oxidizer)

NFPA = National Fire Protection Association

Degree of Hazard Code:
4 = Extreme
3 = High
2 = Moderate

1 = Slight
0 = Insignificant

REVISION SUMMARY:
Changes in information are as follows:
New Format, as well as text changes and/or updates to one or more Sections of this MSDS.

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NOTE: NFPA Reactivity is 3 - when greater than 52%

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Material Safety Data Sheet

SECTION I - Material Identity
SECTION II - Manufacturer's Information
SECTION III - Physical/Chemical Characteristics
SECTION IV - Fire and Explosion Hazard Data
SECTION V - Reactivity Data
SECTION VI - Health Hazard Data
SECTION VII - Precautions for Safe Handling and Use
SECTION VIII - Control Measures
SECTION IX - Label Data
SECTION X - Transportation Data
SECTION XI - Site Specific/Reporting Information
SECTION XII - Ingredients/Identity Information

SECTION I - Material Identity

Item Name	
Part Number/Trade Name	ALAMINE 336
National Stock Number	6850PALAMINE336
CAGE Code	0JS01
Part Number Indicator	A
MSDS Number	194079
HAZ Code	B

SECTION II - Manufacturer's Information

Manufacturer Name	COGNIS CORP
Street	5051 ESTECREEK DRIVE
City	CINCINNATI
State	OH
Country	US
Zip Code	45232
Emergency Phone	800-424-9300 CHEMTREC
Information Phone	800-543-7370 FAX 513-482-5515

MSDS Preparer's Information

Date MSDS Prepared/Revised	31MAR00
Active Indicator	Y

Alternate Vendors

SECTION III - Physical/Chemical Characteristics

Appearance/Odor	PALE YELLOW LIQUID WITH AMMONIA ODOR
Boiling Point	ND
Melting Point	ND
Vapor Pressure	ND
Vapor Density	ND
Specific Gravity	0.8
Evaporation Rate	ND
Solubility in Water	NEGKLIGIBLE (<0.1%)
Chemical pH	0.0
Container Type	R
Container Pressure Code	1
Temperature Code	4
Product State Code	L

SECTION IV - Fire and Explosion Hazard Data

Flash Point	335
Flash Point Method	COC
Lower Explosion Limit	ND
Upper Explosion Limit	ND
Extinguishing Media	CARBON DIOXIDE, DRY CHEMICAL, FOAM, WATER SPRAY
Special Fire Fighting Procedures	USE WATER ONLY AS A BLANKET
Unusual Fire/Explosion Hazards	WATER MAY SPREAD FIRE (PRODUCT FLOATS ON WATER)

SECTION V - Reactivity Data

Stability	YES
Stability Conditions to Avoid	NORMALLY STABLE - WATER MAY SPREAD FIRE - PRODUCT FLOATS ON WATER
Materials to Avoid	NONE KNOWN
Hazardous Decomposition Products	NONE KNOWN
Hazardous Polymerization	NO
Polymerization Conditions to Avoid	WILL NOT OCCUR

SECTION VI - Health Hazard Data

Route of Entry: Skin	YES
Route of Entry: Ingestion	YES
Route of Entry: Inhalation	YES
Health Hazards - Acute and Chronic	WARNING!! MAY BE HARMFUL TO AQUATIC LIFE. CAUSES SKIN AND EYE IRRITATION. MAY BE HARMFUL IF SWALLOWED. PALE YELLOW LIQUID
Carcinogenity: NTP	NO
Carcinogenity: IARC	NO
Carcinogenity: OSHA	NO
Explanation of Carcinogenity	NO CARCINOGENICITY IS KNOWN
Symptoms of Overexposure	[SKIN] CAUSES SKIN IRRITATION. [EYE] CAUSES EYE IRRITATION [INHAL] MAYBE HARMFUL IF INHALED IN LARGE AMOUNTS OR FOR PROLONGED PERIODS. [INGEST] MAYBE HARMFUL IF SWALLOWED
Medical Cond. Aggrevated by Exposure	NONE KNOWN
Emergency/First Aid Procedures	[SKIN] IMMEDIATELY FLUSH WITH WATER FOR AT LEAST 15 MIN WHILE REMOVING CONTAMINATED CLOTHING AND SHOES. GET MED ATTEN. [EYE] IMMEDIATELY FLUSH WITH WATER FOR AT LEAST 15 MIN. GET MED ATTEN. [INHAL] MOVE TO FRESH AIR. IF THERE ARE ADVERSE REACTIONS, CALL A PHYSIICAN. [INGEST] IMMEDIATELY DRINK A LARGE QUANTITY OF MILD OR WATER AND CALL A PHYSICIAN

SECTION VII - Precautions for Safe Handling and Use

Steps if Material Released/Spilled	USING ADEQUATE PROTECTIVE EQUIPMENT. ADD DRY MATERIAL TO ABSORB SPILL IF LARGE SPILL, FIRST DIKE TO CONTAIN. PICK UP AND CONTAINERIZE FLUSH AREA WITH DILUTE (5%) ACETIC ACID. COLLECT FOR DISPOSAL
Neutralizing Agent	5% ACETIC ACID
Waste Disposal Method	THIS PRODUCT, IF DISPOSED AS SHIPPED, IS NOT A HAZARDOUS WASTE AS SPECIFIED IN 40CFR261. DISPOSE OF IN ACCORDANCE TO ALL APPLICABLE FEDERAL, STATE AND LOCAL REGULATIONS
Handling and Storage Precautions	KEEP CONTAINER TIGHTLY CLOSED WHEN NOT IN USE. STORE IN A DRY LOCATION
Other Precautions	NR

SECTION VIII - Control Measures

Respiratory Protection	NOT APPLICABLE WITH LOCAL EXHAUST
Ventilation	LOCAL EXHAUST
Protective Gloves	RUBBER OR PLASTIC GLOVES
Eye Protection	SAFETY GLASSES WITH SIDE SHIELDS
Other Protective Equipment	NR
Work Hygenic Practices	NR

SECTION IX - Label Data

Protect Eye	NO
Protect Skin	NO
Protect Respiratory	NO
Chronic Indicator	UNKNOWN
Contact Code	UNKNOWN
Fire Code	UNKNOWN
Health Code	UNKNOWN
React Code	UNKNOWN

SECTION X - Transportation Data

SECTION XI - Site Specific/Reporting Information

Volatile Organic Compounds (P/G)	0
Volatile Organic Compounds (G/L)	0

SECTION XII - Ingredients/Identity Information

Ingredient #	01
Ingredient Name	AMINES, TRI-C8-C10-ALKYL
CAS Number	68814959
Proprietary	NO
Percent	100

MATERIAL SAFETY DATA SHEET

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

PRODUCT

Product Name: **Exxal 13**
Product Description: Alcohol
Product Code:
Intended Use: Chemical feedstock

COMPANY IDENTIFICATION

Supplier: **EXXONMOBIL CHEMICAL COMPANY**
P.O. BOX 3272
HOUSTON, TX. 77253-3272 USA

24 Hour Health Emergency	(800) 726-2015
Transportation Emergency Phone	(800) 424-9300 or (703) 527-3887 CHEMTREC
Product Technical Information	(281) 870-6000/Health & Medical (281) 870-6884
Supplier General Contact	(281) 870-6000

SECTION 2 COMPOSITION / INFORMATION ON INGREDIENTS

Reportable Hazardous Substance(s) or Complex Substance(s)

Name	CAS#	Concentration*
ALCOHOLS C11-C14-ISO-, C13-RICH	68526-86-3	100%

* All concentrations are percent by weight unless material is a gas. Gas concentrations are in percent by volume.

SECTION 3 HAZARDS IDENTIFICATION

This material is considered to be hazardous according to regulatory guidelines (see (M)SDS Section 15).

POTENTIAL HEALTH EFFECTS

Irritating to eyes. Low order of toxicity. Excessive exposure may result in eye, skin, or respiratory irritation.

Target Organs: Eye |

ENVIRONMENTAL HAZARDS

Very toxic to aquatic organisms.

NFPA Hazard ID:	Health: 2	Flammability: 1	Reactivity: 0
HMIS Hazard ID:	Health: 2	Flammability: 1	Reactivity: 0

NOTE: This material should not be used for any other purpose than the intended use in Section 1 without expert advice. Health studies have shown that chemical exposure may cause potential human health risks which may vary from person to person.

SECTION 4 FIRST AID MEASURES

INHALATION

Remove from further exposure. For those providing assistance, avoid exposure to yourself or others. Use adequate respiratory protection. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek immediate medical assistance. If breathing has stopped, assist ventilation with a mechanical device or use mouth-to-mouth resuscitation.

SKIN CONTACT

Wash contact areas with soap and water. Remove contaminated clothing. Launder contaminated clothing before reuse.

EYE CONTACT

Flush thoroughly with water for at least 15 minutes. Get medical assistance.

INGESTION

First aid is normally not required. Seek medical attention if discomfort occurs.

SECTION 5 FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA

Appropriate Extinguishing Media: Use water fog, foam, dry chemical or carbon dioxide (CO_2) to extinguish flames.

Inappropriate Extinguishing Media: Straight Streams of Water

FIRE FIGHTING

Fire Fighting Instructions: Evacuate area. Prevent runoff from fire control or dilution from entering streams, sewers, or drinking water supply. Firefighters should use standard protective equipment and in enclosed spaces, self-contained breathing apparatus (SCBA). Use water spray to cool fire exposed surfaces and to protect personnel.

Unusual Fire Hazards: Hazardous material. Firefighters should consider protective equipment indicated in Section 8.

Hazardous Combustion Products: Smoke, Fume, Incomplete combustion products, Oxides of carbon

FLAMMABILITY PROPERTIES

Flash Point [Method]: 122C (252F) [ASTM D-93]
Flammable Limits (Approximate volume % in air): LEL: N/D UEL: N/D
Autoignition Temperature: 260°C (500°F)

SECTION 6 ACCIDENTAL RELEASE MEASURES

NOTIFICATION PROCEDURES

In the event of a spill or accidental release, notify relevant authorities in accordance with all applicable regulations. US regulations require reporting releases of this material to the environment which exceed the

applicable reportable quantity or oil spills which could reach any waterway including intermittent dry creeks. The National Response Center can be reached at (800)424-8802.

PROTECTIVE MEASURES

Avoid contact with spilled material. Warn or evacuate occupants in surrounding and downwind areas if required due to toxicity or flammability of the material. See Section 5 for fire fighting information. See the Hazard Identification Section for Significant Hazards. See Section 4 for First Aid Advice. See Section 8 for Personal Protective Equipment.

SPILL MANAGEMENT

Land Spill: Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). Stop leak if you can do it without risk. Do not touch or walk through spilled material. Small Spills: Absorb with earth, sand or other non-combustible material and transfer to containers for later disposal. Recover by pumping or with suitable absorbent.

Water Spill: Stop leak if you can do it without risk. Confine the spill immediately with booms. Warn other shipping. Remove from the surface by skimming or with suitable absorbents. Seek advice of a specialist

Water spill and land spill recommendations are based on the most likely spill scenario for this material; however, geographic conditions, wind, temperature, (and in the case of a water spill) wave and current direction and speed may greatly influence the appropriate action to be taken. For this reason, local experts should be consulted. Note: Local regulations may prescribe or limit action to be taken.

ENVIRONMENTAL PRECAUTIONS

Large Spills: Dike far ahead of liquid spill for later recovery and disposal. Prevent entry into waterways, sewers, basements or confined areas.

SECTION 7 HANDLING AND STORAGE

HANDLING

Avoid contact with skin. Avoid contact with eyes. Flammable levels of hydrogen may build up in the headspace during shipping. As a precautionary measure, truck, rail and ISO container shipments may have been purged with nitrogen before loading. Nitrogen is a simple asphyxiant and containers should be opened in a well ventilated area. For marine shipments, procedures for closed gauging and sampling should be employed. Use proper bonding and/or grounding procedures. Prevent small spills and leakage to avoid slip hazard. DO NOT handle, store or open near an open flame, sources of heat or sources of ignition. Protect material from direct sunlight.

Loading/Unloading Temperature: [Ambient]

Transport Temperature: [Ambient]
Transport Pressure: 101 kPa (15 psia) [Ambient]

Static Accumulator: This material is not a static accumulator.

STORAGE

Do not store in open or unlabelled containers. Keep container closed. Handle containers with care. Open slowly in order to control possible pressure release. Store in a cool, well-ventilated area. Storage containers should be grounded and bonded.
Storage Temperature: [Ambient]
Storage Pressure: 101 kPa (15 psia) [Ambient]

Suitable Containers/Packing: Tank Trucks; Tank Cars; Drums
Suitable Materials and Coatings: Carbon Steel; Stainless Steel; Aluminum; Polypropylene; PTFE; Polyethylene
Unsuitable Materials and Coatings: Natural Rubber; Butyl Rubber; Vinyls

SECTION 8 EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE LIMIT VALUES

Exposure limits/standards (Note: Exposure limits are not additive)

Source	Form	Limit / Standard			Note	Source
ALCOHOLS C11-C14-ISO-, C13-RICH		TWA	50 ppm		N/A	ExxonMobil

NOTE: Limits/standards shown for guidance only. Follow applicable regulations.

ENGINEERING CONTROLS

The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Control measures to consider:
Adequate ventilation should be provided so that exposure limits are not exceeded.

PERSONAL PROTECTION

Personal protective equipment selections vary based on potential exposure conditions such as applications, handling practices, concentration and ventilation. Information on the selection of protective equipment for use with this material, as provided below, is based upon intended, normal usage.

Respiratory Protection: If engineering controls do not maintain airborne contaminant concentrations at a level which is adequate to protect worker health, an approved respirator may be appropriate. Respirator selection, use, and maintenance must be in accordance with regulatory requirements, if applicable. Types of respirators to be considered for this material include:
Half-face filter respirator

For high airborne concentrations, use an approved supplied-air respirator, operated in positive pressure mode. Supplied air respirators with an escape bottle may be appropriate when oxygen levels are inadequate, gas/vapor warning properties are poor, or if air purifying filter capacity/rating may be exceeded.

Hand Protection: Any specific glove information provided is based on published literature and glove manufacturer data. Glove suitability and breakthrough time will differ depending on the specific use conditions. Contact the glove manufacturer for specific advice on glove selection and breakthrough times for your use conditions. Inspect and replace worn or damaged gloves. The types of gloves to be considered for this material include:
Chemical resistant gloves are recommended.

Eye Protection: Chemical goggles are recommended.

Skin and Body Protection: Any specific clothing information provided is based on published literature or manufacturer data. The types of clothing to be considered for this material include:
Chemical / oil resistant clothing if contact with material is likely.

Specific Hygiene Measures: Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practice good housekeeping.

ENVIRONMENTAL CONTROLS
See Sections 6, 7, 12, 13.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Typical physical and chemical properties are given below. Consult the Supplier in Section 1 for additional data.

GENERAL INFORMATION
Physical State: Liquid
Form: Clear
Color: Colorless
Odor: Alcohol
Odor Threshold: N/D

IMPORTANT HEALTH, SAFETY, AND ENVIRONMENTAL INFORMATION
Relative Density (at 20 C): 0.85
Density (at 20 °C): 850 kg/m³ (7.09 lbs/gal, 0.85 kg/dm³)
Flash Point [Method]: 122C (252F) [ASTM D-93]
Flammable Limits (Approximate volume % in air): LEL: N/D UEL: N/D
Autoignition Temperature: 260°C (500°F)
Boiling Point / Range: 250C (482F) - 270C (518F)
Vapor Density (Air = 1): > 1 at 101 kPa
Vapor Pressure: < 0.001 kPa (0.01 mm Hg) at 20 C | 0.003 kPa (0.02 mm Hg) at 50C | 0.2 kPa (1.5 mm Hg) at 100C
Evaporation Rate (n-butyl acetate = 1): < 0.01
pH: N/A
Log Pow (n-Octanol/Water Partition Coefficient): N/D
Solubility in Water: Negligible
Viscosity: 16.6 cSt (16.6 mm2/sec) at 40 C | 47 cSt (47 mm2/sec) at 20C
Oxidizing Properties: See Sections 3, 15, 16.

OTHER INFORMATION
Freezing Point: <-40°C (-40°F)
Melting Point: N/A
Molecular Weight: 200
Hygroscopic: No
Coefficient of Thermal Expansion: 0.0008 V/VDEGC

SECTION 10 STABILITY AND REACTIVITY

STABILITY: Material is stable under normal conditions.

CONDITIONS TO AVOID: Excessive heat. High energy sources of ignition.

MATERIALS TO AVOID: Strong oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS: Material does not decompose at ambient temperatures.

HAZARDOUS POLYMERIZATION: Will not occur.

SECTION 11 TOXICOLOGICAL INFORMATION

ACUTE TOXICITY

Route of Exposure	Conclusion / Remarks
Inhalation	
Toxicity: Data available.	Minimally Toxic. Based on test data for the material.
Irritation: Data available.	Negligible hazard at ambient/normal handling temperatures. Based on test data for the material.
Ingestion	
Toxicity: Data available.	Minimally Toxic. Based on test data for the material.
Skin	
Toxicity: Data available.	Minimally Toxic. Based on test data for the material.
Irritation: Data available.	Mildly irritating to skin with prolonged exposure. Based on test data for the material.
Eye	
Irritation: Data available.	Moderately irritating to the eyes. Based on test data for the material.

CHRONIC/OTHER EFFECTS

For the product itself:

Vapor concentrations above recommended exposure levels are irritating to the eyes and the respiratory tract, may cause headaches and dizziness, are anesthetic and may have other central nervous system effects.

Additional information is available by request.

The following ingredients are cited on the lists below: None.

--REGULATORY LISTS SEARCHED--

1 = NTP CARC	3 = IARC 1	5 = IARC 2B
2 = NTP SUS	4 = IARC 2A	6 = OSHA CARC

SECTION 12 ECOLOGICAL INFORMATION

The information given is based on data available for the material, the components of the material, and similar materials.

ECOTOXICITY

Material -- Expected to be very toxic to aquatic organisms.

Material -- Not expected to demonstrate chronic toxicity to aquatic organisms.

MOBILITY

Material -- Expected to partition to sediment and wastewater solids. Minimally volatile.

PERSISTENCE AND DEGRADABILITY

Biodegradation:

Material -- Expected to be inherently biodegradable

Hydrolysis:

Material -- Transformation due to hydrolysis not expected to be significant.

Photolysis:

Material -- Transformation due to photolysis not expected to be significant.

Atmospheric Oxidation:

Material -- Expected to degrade rapidly in air

BIOACCUMULATION POTENTIAL

Material -- Potential to bioaccumulate is low.

SECTION 13 DISPOSAL CONSIDERATIONS

Disposal recommendations based on material as supplied. Disposal must be in accordance with current applicable laws and regulations, and material characteristics at time of disposal.

DISPOSAL RECOMMENDATIONS

Suitable routes of disposal are supervised incineration, preferentially with energy recovery, or appropriate recycling methods in accordance with applicable regulations and material characteristics at the time of disposal.

REGULATORY DISPOSAL INFORMATION

RCRA Information: The unused product, in our opinion, is not specifically listed by the EPA as a hazardous waste (40 CFR, Part 261D), nor is it formulated to contain materials which are listed as hazardous wastes. It does not exhibit the hazardous characteristics of ignitability, corrositivity or reactivity and is not formulated with contaminants as determined by the Toxicity Characteristic Leaching Procedure (TCLP). However, used product may be regulated.

Empty Container Warning Empty Container Warning (where applicable): Empty containers may contain residue and can be dangerous. Do not attempt to refill or clean containers without proper instructions. Empty drums should be completely drained and safely stored until appropriately reconditioned or disposed. Empty containers should be taken for recycling, recovery, or disposal through suitably qualified or licensed contractor and in accordance with governmental regulations. DO NOT PRESSURISE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND, OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION. THEY MAY EXPLODE AND CAUSE INJURY OR DEATH.

SECTION 14 TRANSPORT INFORMATION

LAND (DOT)

Proper Shipping Name: ENVIRONMENTALLY HAZARDOUS SUBSTANCES, LIQUID, N.O.S. (Tridecyl alcohol)
Hazard Class & Division: 9
ID Number: 3082

Packing Group: III
Marine Pollutant: MP: 100 %weight PP: 0 %weight
ERG Number: 171
Label(s): 9
Transport Document Name: UN3082, ENVIRONMENTALLY HAZARDOUS SUBSTANCES, LIQUID, N.O.S. (Tridecyl alcohol), 9, PG III, MARINE POLLUTANT

LAND (TDG)
Proper Shipping Name: ENVIRONMENTALLY HAZARDOUS SUBSTANCES, LIQUID, N.O.S. (Tridecyl Alcohol)
Hazard Class & Division: 9
UN Number: 3082
Packing Group: III
Marine Pollutant: MP: 100 %weight PP: 0 %weight
Special Provisions: 16

SEA (IMDG)
Proper Shipping Name: ENVIRONMENTALLY HAZARDOUS SUBSTANCES, LIQUID, N.O.S. (Tridecyl Alcohol)
Hazard Class & Division: 9
EMS Number: F-A, S-F
UN Number: 3082
Packing Group: III
Marine Pollutant: MP: 100 %weight PP: 0 %weight
Label(s): 9
Transport Document Name: UN3082, ENVIRONMENTALLY HAZARDOUS SUBSTANCES, LIQUID, N.O.S. (Tridecyl Alcohol), 9, PG III, MARINE POLLUTANT

AIR (IATA)
Proper Shipping Name: ENVIRONMENTALLY HAZARDOUS SUBSTANCES, LIQUID, N.O.S. (Tridecyl alcohol)
Hazard Class & Division: 9
UN Number: 3082
Packing Group: III
Label(s): 9
Transport Document Name: UN3082, ENVIRONMENTALLY HAZARDOUS SUBSTANCES, LIQUID, N.O.S. (Tridecyl alcohol), 9, PG III

SECTION 15 REGULATORY INFORMATION

OSHA HAZARD COMMUNICATION STANDARD: When used for its intended purpose, this material is classified as hazardous in accordance with OSHA 29CFR 1910.1200.

NATIONAL CHEMICAL INVENTORY LISTING: AICS, IECSC, DSL, EINECS, ENCS, KECI, PICCS, TSCA

EPCRA: This material contains no extremely hazardous substances.

SARA (311/312) REPORTABLE HAZARD CATEGORIES: Immediate Health.

SARA (313) TOXIC RELEASE INVENTORY: This material contains no chemicals subject to the supplier notification requirements of the SARA 313 Toxic Release Program.

The Following Ingredients are Cited on the Lists Below:

Chemical Name	CAS Number	List Citations
ALCOHOLS C11-C14-ISO-, C13-RICH	68526-86-3	17

--REGULATORY LISTS SEARCHED--

1 = ACGIH ALL	6 = TSCA 5a2	11 = CA P65 REPRO	16 = MN RTK
2 = ACGIH A1	7 = TSCA 5e	12 = CA RTK	17 = NJ RTK
3 = ACGIH A2	8 = TSCA 6	13 = IL RTK	18 = PA RTK
4 = OSHA Z	9 = TSCA 12b	14 = LA RTK	19 = RI RTK
5 = TSCA 4	10 = CA P65 CARC	15 = MI 293	

Code key: CARC=Carcinogen; REPRO=Reproductive

SECTION 16 OTHER INFORMATION

N/D = Not determined, N/A = Not applicable

THIS SAFETY DATA SHEET CONTAINS THE FOLLOWING REVISIONS:

Revision Changes:
Section 04: First Aid Skin was modified.
Section 04: First Aid Eye was modified.
Section 06: Notification Procedures - Header was modified.
Section 11: Eye Irritation Conclusion was modified.
Section 11: Skin Irritation Conclusion was modified.
Section 13: Empty Container Warning was modified.
Section 08: Hand Protection was modified.
Section 07: Handling and Storage - Handling was modified.
Section 07: Handling and Storage - Storage Phrases was modified.
Section 07: Static Accumulator was modified.
Section 05: Hazardous Combustion Products was modified.
Section 08: Eye Protection was modified.
Section 14: Transport Document Name was modified.
Section 14: Sea (IMDG) - Header was modified.
Section 14: Transport Document Name was modified.
Section 14: Transport Document Name was modified.
Section 16: Code to MHCs was modified.
Section 16: First Aid Eye was modified.
Section 16: First Aid Skin was modified.
Section 16: MSN, MAT ID was modified.
Section 06: Notification Procedures was modified.
Section 01: Company Contact Methods Sorted by Priority was modified.
Section 05: Fire Fighting Measures - Unusual Fire Hazards was added.
Section 05: Fire Fighting Measures - Unusual Fire Hazards - Header was added.
Section 06: Protective Measures was added.
Section 06: Accidental Release - Protective Measures - Header was added.

Section 16: Precautions was added.
Section 16: Precautions - Header was added.
Hazard Identification: Physical/Chemical Hazard was deleted.
Hazard Identification: Physical/Chemical Hazards - Header was deleted.
Section 16: Physical Hazards - Header was deleted.
Section 16: Physical Hazards additional was deleted.

PRECAUTIONARY LABEL TEXT:
WARNING!
HEALTH HAZARDS
Irritating to eyes.
Target Organs: Eye |

PRECAUTIONS
Avoid contact with skin. Avoid contact with eyes. Use proper bonding and/or grounding procedures.

FIRST AID
Eye: Flush thoroughly with water for at least 15 minutes. Get medical assistance.

Skin: Wash contact areas with soap and water. Remove contaminated clothing. Launder contaminated clothing before reuse.

FIRE FIGHTING MEDIA
Use water fog, foam, dry chemical or carbon dioxide (CO2) to extinguish flames.

SPILL/LEAK
Land Spill: Stop leak if you can do it without risk. Small Spills: Absorb with earth, sand or other non-combustible material and transfer to containers for later disposal. Recover by pumping or with suitable absorbent. Do not touch or walk through spilled material.

Water Spill: Stop leak if you can do it without risk. Confine the spill immediately with booms. Warn other shipping. Remove from the surface by skimming or with suitable absorbents. Report spills as required to appropriate authorities. Seek the advice of a specialist before using dispersants.

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MATERIAL SAFETY DATA SHEET

GENERATED 03/16/2009, **REVISION** 05/30/2006, **SUPERCEDES REVISION** 03/24/1999, **DATE CREATED** 07/13/1990

SECTION I - PRODUCT IDENTIFICATION
Uranium oxide, powder

PRODUCT NAME:	Uranium oxide, powder	
PRODUCT CODE:	U-MSDS0003	
REFERENCE #:	1344-57-6	
MANUFACTURER INFORMATION		
COMPANY NAME:	CERAC, inc.	
	1316 W. St. Paul Avenue	
	Milwaukee, WI 53233	
EMERGENCY CONTACT:	CHEMTREC	(800)424-9300
ALTERNATE EMERGENCY CONTACT:	CERAC, inc.	(414)289-9800
CHEMICAL FAMILY:	Metal oxide	
CAS NUMBER:	1344-57-6	
FORMULA:	UO2	
MOLECULAR WEIGHT:	270.03	

SYNONYMS

Uranium oxide, uranium dioxide, uranous oxide, black uranium oxide, uranic oxide, urania, yellow cake, uranium (IV) oxide

SECTION II - HAZARDOUS INGREDIENTS/IDENTITY INFORMATION
Uranium oxide, powder

Hazardous Components (Chemical Name)	CAS #	Concentration	OSHA PEL	ACGIH TLV	Other Limits
Urnaium oxide	1344-57-6	0.0 -100.0 %	.25 mg(U)/m3	.2 mg(U)/m3	STEL-.6mg/m3
NRC maximum permissible dose for occupational exposure	NA	0.0 -100.0 %	5000 mrem/yr	No data.	No data.
NRC maximum permissible dose for non-occupational exposure	NA	0.0 -100.0 %	100 mrem/yr	No data.	No data.
Derived air concentration: 2E-10 uci/ml	NA	0.0 -100.0 %	No data.	No data.	No data.
Annual limit of intake: 4E-1 uci	NA	0.0 -100.0 %	No data.	No data.	No data.
See SECTION IX-ADDITIONAL COMMENTS FOR COSHH Regulations	NA	0.0 -100.0 %	No data.	No data.	No data.

US EPA SARA TITLE III

Hazardous Components (Chemical Name)	CAS #	Sec.302 (EHS)	Sec.304 RQ	Sec.313 (TRI)
Urnaium oxide	1344-57-6	No	No	No
NRC maximum permissible dose for occupational exposure	NA	No	No	No
NRC maximum permissible dose for non-occupational exposure	NA	No	No	No
Derived air concentration: 2E-10 uci/ml	NA	No	No	No
Annual limit of intake: 4E-1 uci	NA	No	No	No
See SECTION IX-ADDITIONAL COMMENTS FOR COSHH Regulations	NA	No	No	No

SECTION III - PHYSICAL/CHEMICAL CHARACTERISTICS
Uranium oxide, powder

PHYSICAL STATES:	[ ] Gas [ ] Liquid [X] Solid
MELTING POINT:	2858.00 C (5176.4 F) - 2988.00 C (5410.4 F)
BOILING POINT:	N.A.
SPECIFIC GRAVITY (WATER = 1):	10.96gm/cc
BULK DENSITY:	No data.
VAPOR PRESSURE (VS. AIR OR MM HG):	NE or NA
VAPOR DENSITY (VS. AIR = 1):	NE or NA
EVAPORATION RATE (VS BUTYL ACETATE=1):	NE or NA
SOLUBILITY IN WATER:	insoluble
PERCENT VOLATILE:	N.A.
CORROSION RATE:	No data.

APPEARANCE AND ODOR

Brown-black powder, no odor.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA
Uranium oxide, powder

FLASH PT:	N.A. Method Used: Unknown
EXPLOSIVE LIMITS:	LEL: NE UEL: NE

EXTINGUISHING MEDIA

USE: Use suitable extinguishing media for surrounding materials and type of fire.

SPECIAL FIRE FIGHTING PROCEDURES

Firefighters must wear full face, self-contained breathing apparatus with full protective clothing to prevent contact with skin and eyes. Fumes from fire are hazardous and may be radioactive. Isolate runoff to prevent environmental pollution.

UNUSUAL FIRE AND EXPLOSION HAZARDS

RADIATION HAZARD
Powder ignites spontaneously in heated air.
May emit toxic and radioactive fumes if involved in a fire.

SECTION V - REACTIVITY DATA
Uranium oxide, powder

STABILITY: Unstable [ ] Stable [X]

CONDITIONS TO AVOID - INSTABILITY

None

INCOMPATIBILITY - MATERIALS TO AVOID

Strong acids and bases

HAZARDOUS DECOMPOSITION OR BYPRODUCTS

Uranium daughters, alpha, beta and gamma radiation

HAZARDOUS POLYMERIZATION: Will occur [ ] Will not occur [X]

CONDITIONS TO AVOID - HAZARDOUS POLYMERIZATION

None

SECTION VI - HEALTH HAZARD DATA
Uranium oxide, powder

HEALTH HAZARDS (ACUTE AND CHRONIC)

To the best of our knowledge the chemical, physical and toxicological properties of uranium oxide have not been thoroughly investigated and recorded.

Uranium is a highly toxic element on an acute basis. The permissible levels for soluble compounds are based on chemical toxicity, while the permissible body level for insoluble compounds is based on radiotoxicity. The high chemical toxicity of uranium and its salts is largely shown in kidney damage which may not be reversible. Acute arterial lesions may occur after acute exposures. The high toxicity effect of insoluble compounds is largely due to lung irradiation by inhaled particles. (Sax, Dangerous Properties of Industrial Materials, eighth edition)

URANIUM SALTS CAUSE HARMFUL EFFECTS CHEMICALLY AND RADIOLOGICALLY.

INHALATION:
Acute: May cause acute arterial lesions.
Chronic: May cause kidney damage.

INGESTION:
Acute: May cause nausea and vomiting.
Chronic: No chronic health effects recorded.

SKIN:
Acute: May cause irritation.
Chronic: May cause dermatitis.

EYE:
Acute: May cause irritation.
Chronic: Studies indicate probability of cataracts.

TARGET ORGANS: May affect the lymphatics, kidneys, skin and bone marrow.

CARCINOGENICITY: NTP? No IARC Monographs? No OSHA Regulated? No

RECOMMENDED EXPOSURE LIMITS

See "Section II"

LD 50 / LC 50

No toxicity data recorded

SIGNS AND SYMPTOMS OF EXPOSURE

INHALATION: May cause shortness of breath, coughing and changes in the blood.

INGESTION: May cause nausea, vomiting, changes in the blood and urine.

SKIN: May cause redness, itching, burning sensation and inflammation.

EYE: May cause redness, itching, burning, watering and inflammation.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

Pre-existing respiratory and skin disorders.

EMERGENCY AND FIRST AID PROCEDURES

INHALATION: Remove victim to fresh air; keep warm and quiet; give oxygen if breathing is difficult and seek medical attention immediately.

INGESTION: Give 1-2 glasses of milk or water and induce vomiting; seek medical attention. Never induce vomiting or give anything by mouth to an unconscious person.

SKIN: Remove contaminated clothing; brush material off skin; wash affected area with mild soap and water; check for radioactive contamination; seek medical attention.

EYE: Flush eyes with lukewarm water, lifting upper and lower eyelids, for at least 15 minutes. Seek medical attention immediately.

SECTION VII - PRECAUTIONS FOR SAFE HANDLING AND USE
Uranium oxide, powder

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Wear appropriate respiratory and protective equipment specified in section VIII-control measures. Isolate spill area, provide ventilation and extinguish sources of ignition. Vacuum up spill using a high efficiency particulate absolute (HEPA) air filter and place in a closed container for proper disposal. Use non-sparking tools. Take care not to raise dust.

WASTE DISPOSAL METHOD

Dispose of in accordance with local, state and federal regulations.

HAZARD LABEL INFORMATION:

Store in cool, dry area Store in tightly sealed container Wash thoroughly after handling Store in an inert atmosphere

PRECAUTIONS TO BE TAKEN IN HANDLING

Radioactive: Store away from radiation sensitive equipment and devices.

OTHER PRECAUTIONS

Uranium oxide ignites spontaneously in air and water. Handle and store in an inert gas.

SECTION VIII- CONTROL MEASURES
Uranium oxide, powder

PROTECTIVE EQUIPMENT SUMMARY - HAZARD LABEL INFORMATION:

NIOSH approved respirator Impervious gloves Safety goggles Clothes to prevent skin contact

RESPIRATORY EQUIPMENT (SPECIFY TYPE)

NIOSH - approved radionuclides and acid gas respirator

EYE PROTECTION

Safety goggles

PROTECTIVE GLOVES

Butyl and polycarbonate

OTHER PROTECTIVE CLOTHING

Protective gear suitable to prevent contamination

VENTILATION

Local Exhaust: Local exhaust ventilation may be necessary to control any air contaminants to within their PELs or TLVs during the use of this product.

Special: Use a filtered ventilation system
Mechanical (Gen): Not recommended
Other: Prevent discharge of radioactivity

WORK/HYGIENIC/MAINTENANCE PRACTICES

Implement engineering and work practice controls to reduce and maintain concentration of exposure at low levels. Use good housekeeping and sanitation practices. Do not use tobacco or food in work area. Wash thoroughly before eating and smoking. Do not blow dust off clothing or skin with compressed air.
.

SECTION IX - ADDITIONAL COMMENTS
Uranium oxide, powder

Control of Substances Hazardous to Health Regulations
EH40 Occupational Exposure Limits

URANIUM COMPOUNDS
Maximum Exposure Limit: NE
Occupational Exposure Standard: 0.2 mg/m3
0.6 mg/m3 Short-term Exposure Limit
.

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The above information is accurate to the best of our knowledge. However, since data, safety standards, and government regulations are subject to change, and the conditions of handling and use or misuse are beyond our control, CERAC MAKES NO WARRANTY, EITHER EXPRESSED NOR IMPLIED, WITH RESPECT TO THE COMPLETENESS OR CONTINUING ACCURACY OF THE INFORMATION CONTAINED HEREIN, AND DISCLAIMS ALL LIABILITY FOR RELIANCE THEREON. Users should satisfy themselves that they have all current data relevant to their particular use.

Abbreviations used: NA=Not Applicable NE: Not Established

GENERATED 03/16/2009, **REVISION** 05/30/2006, **SUPERCEDES REVISION** 03/24/1999, **DATE CREATED** 07/13/1990

Disclaimer: The information contained in these guidelines is intended for reference purposes only. It provides a summary of information about chemicals that workers may be exposed to in their workplaces. The information may be superseded by new developments in the field of industrial hygiene. Readers are therefore advised to regard these recomendations as general guidelines and to determine whether new information is available.

OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR URANIUM AND INSOLUBLE COMPOUNDS

INTRODUCTION

This guideline summarizes pertinent information about uranium and insoluble uranium compounds (measured as uranium) for workers and employers as well as for physicians, industrial hygienists, and other occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs. Recommendations may be superseded by new developments in these fields; readers are therefore advised to regard these recommendations as general guidelines and to determine periodically whether new information is available.

APPLICABILITY

This guideline applies to metallic uranium and all insoluble uranium compounds; examples of such compounds include triuranium octaoxide, uranium dioxide, uranium hydride, uranium tetrafluoride, and uranium trioxide. The physical and chemical properties of uranium and of some insoluble uranium compounds are presented below for illustrative purposes.

SUBSTANCE IDENTIFICATION

Metallic uranium

* Formula

U

* Structure

(For Structure, see paper copy)

* Synonyms

U; Uranium metal, pyrophoric; uranium.

* Identifiers

1. CAS 7440-61-1.

2. RTECS YR3490000.

3. DOT UN: 2979 65 (for the pyrophoric forms of the metal).

4. DOT labels: Radioactive and Flammable Solid.

* Appearance and odor

Elemental uranium is a heavy, malleable, silvery white, lustrous, radioactive metal that is pyrophoric when finely divided. When uranium is obtained by reduction, it takes the form of a black powder. In its natural state, uranium has three isotopes: (234)U, (235) U, and (238)U. U-238 has a half life of 4,510,000,000 years.

CHEMICAL AND PHYSICAL PROPERTIES

* Physical data

1. Atomic number: 92.

2. Atomic weight: 238.03.

3. Boiling point (760 torr): 3818 degrees C (6904 degrees F).

4. Specific gravity (water = 1): 19.05 + 0.02 at 20 degrees C (68 degrees F).

5. Vapor density: Not applicable.

6. Melting point: 1132.3 degrees C (2070 degrees F).

7. Vapor pressure at 20 degrees C (68 degrees F): Nearly zero.

8. Solubility: Insoluble in water, alcohol, and alkalies; soluble in acids.

9. Evaporation rate: Not applicable.

Triuranium Octaoxide

* Formula

U(3)O(8)

* Structure

(For Structure, see paper copy)

* Synonyms

Uranium oxide, pitchblende, nasturan, uraninite.

* Identifiers

1. CAS 1317-99-3.

2. RTECS YR3400000.

3. Specific DOT number: None.

4. Specific DOT label: None.

* Appearance and odor

Triuranium octaoxide is an olive green to black, odorless solid.

CHEMICAL AND PHYSICAL PROPERTIES

* Physical data

1. Molecular weight: 842.1.

2. Boiling point: Not applicable.

3. Specific gravity (water = 1): 8.30 at 20 degrees C (68 degrees F).

4. Vapor density: Not applicable.

5. Melting point: 1300 degrees C (2372 degrees F) (decomposes to uranium dioxide).

6. Vapor pressure at 20 degrees C (68 degrees F): Nearly zero.

7. Solubility: Insoluble in water; soluble in nitric and sulfuric acids.

8. Evaporation rate: Not applicable.

Uranium dioxide

* Formula

UO(2)

* Structure

(For Structure, see paper copy)

* Synonyms

Uranous oxide, black uranium oxide, uranium oxide, uranic oxide, urania, yellow cake.

* Identifiers

1. CAS 1344-57-6.

2. RTECS: None.

3. Specific DOT number: None.

4. Specific DOT label: None.

* Appearance and odor

Uranium dioxide is a pyrophoric, black, crystalline solid. It occurs naturally in various minerals including uraninite, pitchblende, and tyuyamunite. The latter is the most important mineral commercially.

CHEMICAL AND PHYSICAL PROPERTIES

* Physical data

1. Molecular weight: 270.03.

2. Boiling point: Data not available.

3. Specific gravity (water = 1): 10.96 at 20 degrees C (68 degrees F).

4. Vapor density: Not applicable.

5. Melting point: 2858-2898 degrees C (5176-5248 degrees F).

6. Vapor pressure: Not applicable.

7. Solubility: Insoluble in water; soluble in concentrated sulfuric acid and nitric acid.

8. Evaporation rate: Not applicable.

Uranium hydride

* Formula

UH(3)

* Structure

(For Structure, see paper copy)

* Synonyms

Uranium trihydride.

* Identifiers

1. CAS 13598-56-6.

2. RTECS: None.

3. Specific DOT number: None.

4. Specific DOT label: None.

* Appearance and odor

Uranium hydride is a brownish-black or brownish-gray, pyrophoric powder.

CHEMICAL AND PHYSICAL PROPERTIES

* Physical data

1. Molecular weight: 241.05.

2. Boiling point (760 torr): Not applicable.

3. Specific gravity (water = 1): 10.95 at 20 degrees C (68 degrees F).

4. Vapor density: Not applicable.

5. Melting point: Decomposes.

6. Vapor pressure at 20 degrees C (68 degrees F): Nearly zero.

7. Solubility: Insoluble in water, alcohol, acetone, or liquid ammonia; slightly soluble in dilute hydrogen chloride; decomposes in nitric acid.

8. Evaporation rate: Not applicable.

Uranium tetrafluoride

* Formula

UF(4)

* Structure

(For Structure, see paper copy)

* Synonyms

Green salt.

* Identifiers

1. CAS 10049-14-6.

2. RTECS: None.

3. Specific DOT number: None.

4. Specific DOT label: None.

* Appearance and odor

Uranium tetrafluoride is a nonvolatile, green, odorless, crystalline solid.

CHEMICAL AND PHYSICAL PROPERTIES

* Physical data

1. Molecular weight: 314.

2. Boiling point (760 torr): 1417 degrees C (2582 degrees F).

3. Specific gravity (water = 1): 6.7 at 20 degrees C (68 degrees F).

4. Vapor density: Not applicable.

5. Melting point: 955-965 degrees C (1751-1769 degrees F).

6. Vapor pressure at 20 degrees C (68 degrees F): Nearly zero.

7. Solubility: Insoluble in water; soluble (decomposes) in concentrated acids and alkalies.

8. Evaporation rate: Not applicable.

* Reactivity

1. Conditions contributing to instability: Heat, flame, or exposure to air. Uranium metal reacts with nearly all nonmetals. Uranium turnings and fines stored out-of-doors in closed containers under water or water-soluble oil will convert partially to the hydride and will eventually ignite during hot weather.

2. Incompatibilities: Pure uranium is very reactive and is a strong reducing agent. Clean uranium turnings or chips oxidize readily in air. Contact of uranium with carbon dioxide, carbon tetrachloride, or nitric acid causes fires or explosions. Uranium hydride is spontaneously flammable in air, and contact of the hydride with strong oxidizers may cause fires and explosions. Contact of uranium hydride with water forms flammable and explosive hydrogen gas, and contact of the hydride with halogenated hydrocarbons can cause violent reactions. In finely divided form, uranium dioxide ignites spontaneously in air.

3. Hazardous decomposition products: Toxic particulates, gases, and vapors (such as uranium metal fume, oxides of uranium, hydrogen fluoride, carbon monoxide, and

dangerous radioactive materials) may be released when uranium or an insoluble uranium compound decomposes.

4. Special precautions: Uranium is radioactive and highly reactive and should be handled with extreme caution at all times. Uranium tetrafluoride is highly corrosive.

* Flammability

The National Fire Protection Association has not assigned a flammability rating to uranium or the insoluble uranium compounds. Other sources rate uranium in solid or powder form as a very dangerous fire hazard when this substance is exposed to heat or open flame.

1. Flash point: Data not available.

2. Autoignition temperature: The ignition temperature depends on the extent to which the metal is subdivided. The ignition temperature of the metal is 170 degrees C (338 degrees F) (if oxygen is present); finely divided uranium metal (dust) ignites at room temperature (20 degrees C (68 degrees F)).

3. Flammable limits in air: Not applicable.

4. Minimum explosive concentration: 60 g/m(3).

5. Extinguishant: Use graphite chips, carbon dust, asbestos blankets, or flooding with water to extinguish small uranium fires. There is no effective way to extinguish large uranium fires.

Fires involving uranium or an insoluble uranium compound should be fought upwind and from the maximum distance possible. Keep unnecessary people away; isolate hazard area and deny entry. Emergency personnel should stay out of low areas and ventilate closed spaces before entering. Finely divided uranium (chips, turnings, shavings, etc.) are much more reactive than uranium in bulk form. If these are present during a fire, do not disperse them into a dust cloud, which may be explosive. Uranium metal may ignite spontaneously if exposed to air or other substances, may burn rapidly with a flare-burning effect, and may re-ignite after the fire has been extinguished. Containers of uranium or an insoluble uranium compound may explode in the heat of the fire and should be moved from the fire area if it is possible to do so safely. If this is not possible, cool containers from the sides with water until well after the fire is out. Stay away from the ends of containers. Personnel should withdraw immediately if a rising sound from a venting safety device is heard or if there is discoloration of a container due to fire. Dikes should be used to contain fire-control water for later disposal. If a tank car or truck is involved in a fire, personnel should isolate an area of a half a mile in all directions. Delay cleanup until arrival of, or instruction from, a qualified radiation authority. Firefighters should wear a full set of protective clothing, including a self-contained breathing apparatus, when fighting fires involving uranium or an insoluble uranium compound. Firefighters' protective clothing may provide limited protection against fires involving uranium or an insoluble uranium compound.

* Warning properties

No quantitative data are available on the odor threshold for uranium or insoluble uranium compounds; several of these substances are odorless. For the purpose of selecting appropriate respiratory protection, these substances are therefore considered to have inadequate odor warning properties.

* Eye irritation properties

No quantitative data are available on the eye irritation threshold for uranium or the insoluble uranium compounds.

EXPOSURE LIMITS

The current Occupational Safety and Health Administration (OSHA) permissible exposure limits (PELs) for uranium and the insoluble uranium compounds (measured as uranium) are 0.2 milligram per cubic meter (mg/m(3)) of air as an 8-hour time-weighted average (TWA) concentration and 0.6 mg/m(3) as a 15-minute TWA short-term exposure limit (STEL). A STEL is the maximum 15-minute concentration to which workers may be exposed during any 15-minute period of the working day [29 CFR 1910.1000, Table Z-1-A]. The National Institute for Occupational Safety and Health (NIOSH) has not issued a recommended exposure limit (REL) for uranium or its insoluble uranium compounds; however, NIOSH concurs with the PEL established for this substance by OSHA [NIOSH 1988]. The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned uranium and the insoluble uranium compounds a threshold limit value (TLV) of 0.2 mg/m(3) as a TWA for a normal 8-hour workday and a 40-hour workweek and a short-term exposure limit (STEL) of 0.6 mg/m (3) for periods not to exceed 15 minutes [ACGIH 1988, p. 37]. The OSHA and ACGIH limits are based on the risk of kidney and blood disorders and on the radiological damage associated with exposure to uranium or an insoluble uranium compound.

HEALTH HAZARD INFORMATION

* Routes of exposure

Exposure to uranium or an insoluble uranium compound can occur via inhalation, ingestion, and eye or skin contact. Exposure to uranium trioxide can occur by absorption through the skin, eyes, and mucous membranes.

* Summary of toxicology

1. Effects on Animals: Metallic uranium and insoluble uranium compounds may produce both chemical poisoning and radiation injury to the kidneys and lungs of exposed animals [Clayton and Clayton 1981, p. 1996]. The insoluble uranium compounds are less toxic chemically than the soluble compounds, but uranium and all uranium compounds have the potential to cause radiation damage [Clayton and Clayton 1981, p. 2000; Klaassen, Amdur, and Doull 1986, p. 695]. The inhalation toxicity of uranium and the insoluble compounds of uranium is much greater than their oral toxicity [Clayton and Clayton 1981, p. 2000]. No dietary amount of insoluble uranium compounds acceptable to rats was lethal, and no evidence of systemic poisoning developed after the application of an insoluble compound to rabbit skin [Clayton and Clayton 1981, p. 2000]. However, uranium trioxide is lethal when placed in the conjunctival sac of rabbits' eyes, and uranium tetrafluoride causes direct eye injury [Grant 1986, p. 965]. Acute inhalation exposure to 20-mg/m(3) concentrations of uranium tetrafluoride, uranium dioxide, or high-grade uranium ore was occasionally fatal to some laboratory animals; exposure to a 2.5-mg/m(3) concentration of uranium tetrafluoride, uranium dioxide, or high-grade uranium ore caused mild or no renal damage and no fatalities in these animals [Clayton and Clayton 1981, p. 2001]. Chronic inhalation exposure to an insoluble uranium compound may produce radiation injury. In dogs and monkeys exposed to 5 mg/m(3) uranium dioxide for 6 hours/day, 5 days/week for up to 5 years, fibrotic changes suggestive of radiation injury were found in the tracheobronchial lymph nodes of both species and in the lungs of monkeys. No kidney damage was observed in these animals [Clayton and Clayton 1981, p. 2002]. Dogs tolerated inhalation of a 10-mg/m(3) concentration of uranium dioxide every day for 1 year and dietary exposure to 10 g/kg/day for 1 year [Clayton and Clayton 1981, pp. 2001-2002]. Rats injected with metallic uranium in the femoral bone marrow and chest wall developed site-of-contact sarcomas; in these cases, the effects of chemical injury could not be distinguished from those of radiation damage [Clayton and Clayton 1981, p. 2003].

2. Effects on Humans: Metallic uranium and insoluble uranium compounds may produce both chemical poisoning and radiation injury [Clayton and Clayton 1981, p. 1996]. The insoluble uranium compounds are less toxic chemically than the soluble compounds, but uranium and all uranium compounds have the potential to cause radiation damage [Clayton and Clayton 1981, p. 2000; Klaassen, Amdur, and Doull 1986, p. 695]. Exposure to the dusts of uranium or to an insoluble uranium compound may cause respiratory irritation, cough, and shortness of breath [Genium MSDS 1988, No. 238]. Dermatitis has also been reported, and prolonged skin contact causes radiation injury to

the basal cells [Proctor, Hughes, and Fischman 1988, p. 502]. Studies have shown that uranium workers are at increased risk of death from respiratory, lymphatic, and hematopoietic cancers; these deaths are presumed to be caused by radiation injury from radon gas, a byproduct of uranium decay [Rom 1983, p. 688]. A study of the risk of respiratory deaths among uranium miners in the United States showed the following dose-response: miners exposed occupationally for 5 to 9.9 years had a 2-fold increase in risk; miners exposed for 10 to 24.9 years had a 3.6-fold increase in risk; and those exposed for greater than 24.9 years had a 3.75-fold increase in risk. Smoking was shown both to increase the risk of death from respiratory disease and to shorten the neoplastic latency period [Clayton and Clayton 1981, pp. 2010-2011].

* Signs and symptoms of exposure

1. Acute exposure: The signs and symptoms of acute exposure to uranium or an insoluble uranium compound include respiratory irritation, cough, and shortness of breath.

2. Chronic exposure: The signs and symptoms of chronic exposure to uranium or an insoluble uranium compound include those of lung damage: shortness of breath, dry or productive cough, rales, cyanosis, and clubbing of the fingers. Long-term exposure also may cause cancer of the blood-forming system, the lymph system, and the respiratory tract, as well as anemia and leukopenia. The signs and symptoms of uranium-induced dermatitis may include irritation, redness, blistering, thickening, or hyperpigmentation of the skin.

* Emergency procedures:

In the event of an emergency, remove the victim from further exposure, send for medical assistance, and initiate the following emergency procedures:

1. Eye exposure: If uranium or an insoluble uranium compound gets into the eyes, immediately flush the eyes with large amounts of water for a minimum of 15 minutes, lifting the lower and upper lids occasionally. If irritation persists, get medical attention as soon as possible.

2. Skin exposure: If uranium or an insoluble uranium compound contacts the skin, the contaminated skin should be washed with soap and water. Contaminated body surfaces should immediately be decontaminated in accordance with radiation procedures. Get medical attention.

3. Inhalation: If uranium or an insoluble uranium compound is inhaled, move the victim at once to fresh air and get medical care as soon as possible. If the victim is not breathing, perform cardiopulmonary resuscitation; if breathing is difficult, give oxygen. Keep the victim warm and quiet until medical help arrives.

4. Ingestion: If uranium or an insoluble uranium compound is ingested, give the victim several glasses of water to drink and then induce vomiting by having the victim touch the back of the throat with the finger or by giving syrup of ipecac as directed on the package. Do not force an unconscious or convulsing person to drink liquids or to vomit. Get medical help immediately. Keep the victim warm and quiet until medical help arrives.

5. Rescue: Remove an incapacitated worker from further exposure and implement appropriate emergency procedures (e.g., those listed on the Material Safety Data Sheet required by OSHA's Hazard Communication Standard, 29 CFR 1910.1200). All workers should be familiar with emergency procedures and the location and proper use of emergency equipment.

EXPOSURE SOURCES AND CONTROL METHODS

The following operations may involve uranium and insoluble uranium compounds and lead to worker exposures to these substances:

- Mining, grinding, and milling of uranium ores
- Use in nuclear reactors as fuel and to pack nuclear fuel rods and in the production of nuclear weapons
- Burning of uranium metal chips and smelting operations
- Use in the ceramics industry for pigments, coloring porcelain, painting on porcelain, and enamelling
- Use as catalysts for many reactions, in gas manufacture, and in production of fluorescent glass
- Use in photographic processes, for alloying steel, in radiation shielding, and in aircraft counterweights
- Use as a source of plutonium and radium salts

Uranium hydride:

* Use as a lab source for pure hydrogen, for separation of hydrogen isotopes, and as a reducing agent

Methods that are effective in controlling worker exposures to uranium and insoluble uranium compounds, depending on the feasibility of implementation, are

- Process enclosure,
- Local exhaust ventilation,
- General dilution ventilation, and
- Personal protective equipment.

The following publications are good sources of information on control methods:

1. ACGIH [1986]. Industrial ventilation--a manual of recommended practice. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

2. Burton DJ [1986]. Industrial ventilation--a self study companion. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

3. Alden JL, Kane JM [1982]. Design of industrial ventilation systems. New York, NY: Industrial Press, Inc.

4. Wadden RA, Scheff PA [1987]. Engineering design for control of workplace hazards. New York, NY: McGraw-Hill.

5. Plog BA [1988]. Fundamentals of industrial hygiene. Chicago, IL: National Safety Council.

MEDICAL MONITORING

Workers who may be exposed to chemical and radiation hazards should be monitored in a systematic program of medical surveillance that is intended to prevent occupational injury and disease. The program should include education of employers and workers about work-related hazards, placement of workers in jobs that do not jeopardize their safety or health, early detection of adverse health effects, and referral of workers for diagnosis and treatment. The occurrence of disease or other work-related adverse health effects should prompt immediate evaluation of primary preventive measures (e.g., industrial hygiene monitoring, engineering controls, and personal protective equipment). A medical monitoring program is intended to supplement, not replace, such measures. To place workers effectively and to detect and control work-related health effects, medical evaluations should be performed (1) before job placement, (2) periodically during the period of employment, and (3) at the time of job transfer or termination.

* Preplacement medical evaluation

Before a worker is placed in a job with a potential for exposure to uranium or an insoluble uranium compound, the examining physician should evaluate and document

the worker's baseline health status with thorough medical, environmental, and occupational histories, a physical examination, and physiologic and laboratory tests appropriate for the anticipated occupational risks. These should concentrate on the function and integrity of the kidneys, respiratory system, blood, liver, bone marrow, skin, and lymphatics. Medical monitoring for respiratory disease should be conducted using the principles and methods recommended by NIOSH and the American Thoracic Society.

A preplacement medical evaluation is recommended to assess an individual's suitability for employment at a specific job and to detect and assess medical conditions that may be aggravated or may result in increased risk when a worker is exposed to uranium or an insoluble uranium compound at or below the prescribed exposure limit. The examining physician should consider the probable frequency, intensity, and duration of exposure as well as the nature and degree of any applicable medical condition. Such conditions (which should not be regarded as absolute contraindications to job placement) include a history and other findings consistent with diseases of the kidneys, respiratory system, blood, liver, bone marrow, skin, or lymphatics.

* Periodic medical examinations and biological monitoring

Occupational health interviews and physical examinations should be performed at regular intervals during the employment period, as mandated by any applicable Federal, State, or local standard. Where no standard exists and the hazard is minimal, evaluations should be conducted every 3 to 5 years or as frequently as recommended by an experienced occupational health physician. Additional examinations may be necessary if a worker develops symptoms attributable to uranium exposure. The interviews, examinations, and medical screening tests should focus on identifying the adverse effects of uranium on the kidneys, respiratory system, blood, liver, bone marrow, skin, or lymphatics. Current health status should be compared with the baseline health status of the individual worker or with expected values for a suitable reference population.

Biological monitoring involves sampling and analyzing body tissues or fluids to provide an index of exposure to a toxic substance or metabolite. Urinary uranium concentrations correlate well with airborne uranium levels. Some sources report that urinary concen-trations of 50 þg uranium per liter of urine or 100 þg uranium per liter of urine correspond to constant daily exposures of approximately 0.05 mg/m(3) or 0.25 mg/m(3), respectively. Because there is great interindividual and intraindividual variability in urinary uranium concentrations, a pattern of urinary uranium excretion should be established for every exposed worker by sampling individuals at the same time on several different shifts and by sampling frequently.

* Medical examinations recommended at the time of job transfer or termination

The medical, environmental, and occupational history interviews, the physical examination, and selected physiologic or laboratory tests that were conducted at the time of placement should be repeated at the time of job transfer or termination to determine the worker's medical status at the end of his or her employment. Any changes in the worker's health status should be compared with those expected for a suitable reference population. Because occupational exposure to uranium or an insoluble uranium compound may cause diseases with prolonged latent periods, the need for medical monitoring may extend well beyond the termination of employment.

WORKPLACE MONITORING AND MEASUREMENT PROCEDURES

Determination of a worker's exposure to airborne uranium or an insoluble uranium compound (measured as uranium) is made using a mixed cellulose ester filter (0.8 micron). Samples are collected at a maximum flow rate of 2 liters per minute until a maximum air volume of 960 liters is collected. Analysis is conducted by neutron activation. This method is included in the OSHA In-House Methods File.

PERSONAL HYGIENE PROCEDURES

If uranium or an insoluble uranium compound contacts the skin, workers should immediately wash the affected areas with soap and water. Contaminated body surfaces should immediately be decontaminated in accordance with radiation procedures.

Clothing contaminated with uranium or an insoluble uranium compound should be removed immediately, and provisions should be made for the safe removal of the chemical from the clothing. Persons laundering the clothes should be informed of the toxic and radioactive hazards of uranium.

A worker who handles uranium or an insoluble uranium compound should thoroughly wash hands, forearms, and face with soap and water before eating, using tobacco products, or using toilet facilities.

Workers should not eat, drink, or use tobacco products in areas where uranium or an insoluble uranium compound is handled, processed, or stored.

STORAGE

Uranium and insoluble uranium compounds should be stored in a cool, dry, well-ventilated area in tightly sealed containers that are labeled in accordance with OSHA's Hazard Communication Standard [29 CFR 1910.1200]. Containers of uranium or of insoluble uranium compounds should be protected from physical damage and should be stored separately from carbon dioxide, carbon tetra-chloride, nitric acid, air, nonmetals, heat, sparks, and open flame. Uranium hydride should not be allowed to contact air, water, strong oxidizers, or halogenated hydrocarbons. Because empty containers that formerly contained uranium or a uranium compound may still hold product residues, they should be handled appropriately.

SPILLS AND LEAKS

In the event of a spill or leak involving uranium or an insoluble uranium compound, persons not wearing protective equipment and clothing should be restricted from contaminated areas until cleanup has been completed. A clean-up plan must be available to address an accidental leak or spill of uranium or an insoluble uranium compound because special radiation procedures are required and professional assistance is needed. The following steps should be undertaken following a spill or leak:

1. Do not touch the spilled material; stop the leak if it is possible to do so without risk.

2. Notify safety personnel.

3. Remove all sources of heat and ignition.

4. Ventilate the area of the spill or leak.

5. Protect cleanup personnel from contact with or inhalation of uranium dust.

EMERGENCY PLANNING, COMMUNITY RIGHT-TO-KNOW, AND HAZARDOUS WASTE MANAGEMENT REQUIREMENTS

The Environmental Protection Agency's (EPA's) regulatory requirements for emergency planning, community right-to-know, and hazardous waste management may vary over time. Users are therefore advised to determine periodically whether new information is available.

* Emergency planning requirements

Uranium and insoluble uranium compounds are not subject to EPA emergency planning requirements under the Superfund Amendments and Reauthorization Act (Title III).

* Reportable quantity requirements (releases of hazardous substances)

Employers are not required by the emergency release notification provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) [40 CFR Part 355.40] to notify the National Response Center of an accidental release of uranium or an insoluble uranium compound; there is no reportable quantity for these substances.

* Community right-to-know requirements

Employers are not required by Section 313 of the Superfund Amendments and Reauthorization Act (SARA) to submit a Toxic Chemical Release Inventory form (Form R) to EPA reporting the amount of uranium or an insoluble uranium compound emitted or released from their facility annually.

* Hazardous waste management requirements

EPA considers a waste to be hazardous if it exhibits any of the following characteristics: ignitability, corrosivity, reactivity, or toxicity, as defined in 40 CFR 261.21-261.24. Under the Resource Conservation and Recovery Act (RCRA), EPA has specifically listed many chemical wastes as hazardous. Although uranium and insoluble uranium compounds are not specifically listed as a hazardous waste under RCRA, EPA requires employers to treat any waste as hazardous if it exhibits any of the characteristics discussed above.

Providing more information about the removal and disposal of specific chemicals is beyond the scope of this guideline. EPA, U.S. Department of Transportation, and State and local regulations should be followed to ensure that removal, transport, and disposal of this substance are conducted in accordance with existing regulations. To be certain that chemical waste disposal meets EPA regulatory requirements, employers should address any questions to the RCRA hotline at (202) 382-3000 (in Washington, D.C.) or toll-free at (800) 424-9346 (outside Washington, D.C.). In addition, relevant State and local authorities should be contacted for information on any requirements they may have for the waste removal and disposal of this substance.

RESPIRATORY PROTECTION

* Conditions for respirator use

Good industrial hygiene practice requires that engineering controls be used where feasible to reduce workplace concentrations of hazardous materials to the prescribed exposure limit. However, some situations may require the use of respirators to control exposure. Respirators must be worn if the ambient concentration of uranium or an insoluble uranium compound exceeds prescribed exposure limits. Respirators may be used (1) before engineering controls have been installed, (2) during work operations such as maintenance or repair activities that involve unknown exposures, (3) during operations that require entry into tanks or closed vessels, and (4) during emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by NIOSH and the Mine Safety and Health Administration (MSHA).

* Respiratory protection program

Employers should institute a complete respiratory protection program that, at a minimum, complies with the requirements of OSHA's Respiratory Protection Standard [29 CFR 1910.134]. Such a program must include respirator selection (see Table 1), an evaluation of the worker's ability to perform the work while wearing a respirator, the regular training of personnel, fit testing, periodic workplace monitoring, and regular respirator maintenance, inspection, and cleaning. The implementation of an adequate respiratory protection program (including selection of the correct respirator) requires that a knowledgeable person be in charge of the program and that the program be evaluated regularly. For additional information on the selection and use of respirators and on the medical screening of respirator users, consult the **NIOSH Respirator Decision Logic** and the **NIOSH Guide to Industrial Respiratory Protection**.

Table 1 lists the respiratory protection that NIOSH recommends for workers exposed to uranium or an insoluble uranium compound. The recommended protection may vary over time because of changes in the exposure limit for uranium or the insoluble uranium compounds or in respirator certification requirements. Users are therefore advised to determine periodically whether new information is available.

PERSONAL PROTECTIVE EQUIPMENT

Protective clothing should be worn to prevent skin contact with uranium or an insoluble uranium compound. Impervious gloves, boots, and aprons should be worn as appropriate when handling any of these substances. Chemical protective clothing should be selected on the basis of available performance data, manufacturers' recommendations, and evaluation of the clothing under actual conditions of use. No reports have been published on the resistance of various protective clothing materials to permeation by uranium or an insoluble uranium compound; however, one source recommends natural rubber, neoprene, or polyvinyl chloride as a protective clothing material. If permeability data are not readily available, protective clothing manufacturers should be requested to provide information on the best chemical protective clothing for workers to wear when they are exposed to uranium or an insoluble uranium compound.

If uranium or an insoluble uranium compound is dissolved in an organic solvent, the permeation properties of both the solvent and the mixture must be considered when selecting personal protective equipment and clothing.

Safety glasses, goggles, or faceshields should be worn during operations in which uranium or an insoluble uranium compound might contact the eyes. Eyewash fountains and emergency showers should be available within the immediate work area whenever the potential exists for eye or skin contact with uranium or its insoluble compounds. Contact lenses should not be worn if the potential exists for exposure to any of these substances.

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Table 1

NIOSH recommended respiratory protection for workers exposed to uranium or an insoluble uranium compound*

Condition	Minimum respiratory protection**
Airborne concentration of uranium or an insoluble uranium compound:	
0.2 to 2 mg/m(3) (10 X PEL)	Any air-purifying, half-mask respirator equipped with a fume or high-efficiency filter approved for radon daughters or radionuclides, or
	Any air-purifying, full-facepiece respirator equipped with a fume filter approved for radon daughters, or
	Any supplied-air respirator equipped with a half mask and operated in a demand (negative-pressure) mode
0.2 to 5 mg/m(3) (25 X PEL)	Any powered, air-purifying respirator equipped with a hood or helmet and a fume or high-efficiency filter approved for radon daughters or radio-nuclides, or
	Any supplied-air respirator equipped with a hood or helmet and operated in a continuous-flow mode
0.2 to 10 mg/m(3) (50 X PEL)	Any air-purifying, full-facepiece respirator equipped with a high-efficiency filter approved for radon daughters or radio-nuclides, or
	Any powered, air-purifying respirator equipped with a tight-fitting facepiece and a high-efficiency filter approved for radon daughters or radio-nuclides, or
	Any supplied-air respirator equipped with a full facepiece and operated in a demand (negative-pressure) mode, or
	Any supplied-air respirator equipped with a tight-fitting facepiece and operated in a continuous-flow mode, or
	Any self-contained respirator equipped with a full facepiece and operated in a demand (negative-pressure) mode
0.2 to 30 mg/m(3) (150 X PEL)	Any supplied-air respirator operated in a pressure-demand or other positive-pressure mode
Entry into IDLH(+) or unknown concentrations	Any self-contained respirator equipped with a full facepiece and operated in a pressure-demand or other positive-pressure mode, or
	Any supplied-air respirator equipped with a full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode
Firefighting	Any self-contained respirator equipped with a full facepiece and operated in a pressure-demand or other positive-pressure mode
Escape	Any air-purifying, full-facepiece respirator equipped with a

high-efficiency filter approved for radon daughters or radionuclides, or

Any escape-type, self-contained breathing apparatus with a suitable service life (number of minutes required to escape the environment)

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* The OSHA PEL is 0.2 mg/m(3) as an 8-hour TWA. No NIOSH REL has been issued.

** Only NIOSH/MSHA-approved equipment should be used. Also note the following:

1. Respirators accepted for use at higher concentrations may be used at lower concentrations; respirators must not, however, be used at concentrations higher than those for which they are approved.

2. Air-purifying respirators may not be used in oxygen-deficient atmospheres or in airborne concentrations that are immediately dangerous to life or health (IDLH).

(+) The uranium or an insoluble uranium compound concentration that is immediately dangerous to life and health (IDLH) is 30 mg/m(3) [NIOSH 1987b].

Occupational Safety & Health Administration
200 Constitution Avenue, NW
Washington, DC 20210

Material Safety Data Sheet

Science Stuff, Inc.
1104 Newport Ave
Austin, TX 78753

Phone (512) 837-6020
Chemtrec 800-424-9300
24 Hour Emergency Assistance

Section 1 Identification

Product Number:	C1668
Product Name:	Diatomaceous Earth
Trade/Chemical Synonyms	
Formula:	N/A
RTECS:	VV7311000
C.A.S	CAS# 61790-53-2

Health:	0
Flammability	0
Reactivity	0

Hazard Rating:

Least Slight Moderate High Extreme
0 1 2 3 4

NA = Not Applicable NE = Not Established

Section 2 Component Mixture

Sara 313	Component	CAS Number	%	Dim	Exposure Limits:
	Diatomaceous Earth	CAS# 61790-53-2	100%	W/W	TXDS: orl-rat LD•□: 3.16 g/Kg

Section 3 Hazard Identification (Also see section 11)

Generally not hazardous in normal handling, however good laboratory practices should always be used. Avoid long term exposure to skin or by inhalation.

Section 4 First Aid Measures

Generally not hazardous in normal handling, however good laboratory practices should always be used. Avoid long term exposure to skin or by inhalation.

FIRST AID: SKIN: Wash exposed area with soap and water. If irritation persists, seek medical attention.

EYES: Wash eyes with plenty of water for at least 15 minutes, lifting lids occasionally. Seek Medical Aid. INHALATION: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen

Section 6 Accidental Release Measures

Evacuate area. Wear self-contained breathing apparatus and protective clothing. Eliminate all sources of ignition.sweep up and containerize for reclamation or disposal. Vacuuming or wet sweeping may be used to aviod dust.

Section 7 Handling and Storage

keep in tightly closed container,store in cool , dry ,ventilated area. Protect against physical damage.

Section 8 Exposure Controls & Personal Protection

Respiratory Protection:NIOSH/MSHA-approved respirator.if tlv is exceeded.

Ventilation: Mechanical: Local Exhaust:

Hand Protection: none required

Eye Protection: Splash Goggles

Other Protective Equipment: Wear appropriate clothing to prevent skin exposure.maintain eye wash and quick drench facilites .

Section 9 Physical and Chemical Properties

Melting Point:	1710°c	Specific Gravity	2.2
Boiling Point:	2232°c	Percent Volatile by Volume:	n/a
Vapor Pressure:	Information not available	Evaporation Rate:	n/a
Vapor Density:	Information not available	Evaporation Standard:	n/a
Solubility in Water:	less than 2.0%	Auto ignition Temperature:	Not applicable
Appearance and Odor:	buff to off white granules w/no odor.	Lower Flamm. Limit in Air:	Not applicable
Flash Point:	n/a	Upper Flamm. Limit in Air:	Not applicable

Section 10 Stability and Reactivity Information

Stability: yes Conditions to Avoid: substance can explode when wet and heated with magnesium.

INGESTION: Give several glasses of milk or water. Vomiting may occur spontaneously, but it is not necessary to induce. Never give anything by mouth to an unconscious person.

Section 5 Fire Fighting Measures

Fire Extinguisher Type:	Any means suitable for extinguishing surrounding fire
Fire/Explosion Hazards:	Negligible fire hazard when exposed to heat or flame
Fire Fighting Procedure:	Wear self-contained breathing apparatus and protective clothing to prevent contact with skin and clothing.

Materials to Avoid:
hydrogen flouride,hydrogenated vegtable oils,xenon hexafluoride, oxgyen difluoride and chlorine trifluoride.

Hazardous Decomposition Products:
Not known to occur

Hazardous Polymerization:Will Not Occur

Condition to Avoid:None known

Section 11 Additional Information

acute:inhalation of large amounts of dust may cause dryness and irritation to mucus membranes, nose and throat. Conditions aggravated/target organs. Persons with pre-existing eyes,skin.or respiratorry conditionway be more susceptible.

DOT Classification: Not Regulated

DOT regulations may change from time to time. Please consult the most recent version of the relevant regulations.

Revision No:0 Date Entered: 9/1/2006 Approved by: WPF

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Engineered Drilling Solutions Inc.

Engineered Drilling Solutions Inc.

MATERIAL SAFETY DATA SHEETS

Effective October 01, 2006

Engineered Drilling Solutions Inc.

SECTION 1 – IDENTIFICATION OF PRODUCT

Product Name: Percol 351
Chemical Family: Polyacrylamide
Product Use: Drilling Mud Additive

Work Place Hazardous Information Systems Data (WHMIS)	Transportation Of Dangerous Goods (TDG)
WHMIS Classification: Not a controlled product **Work Place Hazard:** N / A	**TDG Classification:** Not a regulated product **Package Group:** N / A **UN Number (PIN):** N / A

SECTION 2 – HAZARDOUS INGREDIENTS

No Hazardous Ingredients

SECTION 3 – PHYSICAL DATA

Physical State: Solid
Odour and Appearance: White granular solid, little odour
Odour Threshold: N / A
Vapor Pressure: N / A
Vapor Density: N / A
Evaporation Rate: N / A
Coefficient of Water To Oil Distribution: N / A
Boiling Point: N / A
Freezing Point: N / A
Melting Point: N / A
pH: N / A
Solubility: Soluble
Specific Gravity: N / A
Percent Volatile by Volume: N / A

Engineered Drilling Solutions Inc.

SECTION 4 – FIRE AND EXPLOSION DATA

Conditions Of Flammability: Very low risk
Flashpoint: N / A
Lower Flammable Limit: N / A
Upper Flammable Limit: N / A
Auto Ignition Temperature: N / A

Means Of Extinction
Dry Chemical, Carbon Dioxide, Foam

Hazardous Combustion Products
None known

Explosion Data
Dust generated in handling this product can be explosive, if sufficient quantities are mixed with air, in which case ignition sources should be avoided

Special Firefighting Procedures
Firefighters must wear appropriate breathing apparatus and clothing. Water may cause slipperiness

SECTION 5 – REACTIVITY DATA

Chemically Stable?: Yes

Conditions Of Chemical Instability

Incompatible With Other Substances?: Yes

Incompatible Substances
Avoid strong oxidizing agents and caustic solutions

Conditions Of Reactivity
None known

Hazardous Decomposition Products
None known

Hazardous Polymerization:
Will not occur

Engineered Drilling Solutions Inc.

SECTION 6 – TOXICOLOGICAL PROPERTIES

	Skin	Skin Absorption	Eye Contact	Inhalation	Ingestion
Routes Of Entry:	Yes	Yes	Yes	Yes	Yes
Irritation:	Prolonged exposure may cause irritation, swelling, or dermatitis		Exposure may cause irritation to eyes and eye lids	May cause slight irritation of nose and throat	May cause nausea and vomiting

General Irritancy Of Product

Exposure Limits
(8 hour TWA, total inhalable dust) ACGIH: 10 mg/m cubed; OSHA PEL: 10mg/m cubed; MFRS: recommendation: 10 mg/m cubed

Effects Of Acute Exposure: None known
Effects Of Chronic Exposure: None known
Sensitization To Product: Not a senzitizer
Carcinogenicity: N / A
Teratogenicity: N / A
Reproductive Toxicity: N / A
Mutagenicity: N / A
Synergistic Products: N / A

SECTION 7 – PREVENTIVE MEASURES

Gloves: See Clothing
Respirator: If using in a confined non ventilated space, use of an approved dust mask is advised
Eye: See Clothing
Clothing: Chemical resistant clothing is recommended including gloves, apron, and goggles
Other:

Engineering Controls

Storage and Handling Requirements
Avoid inhalation of vapour and mist. Avoid prolonged skin contact. Use with appropriate ventilation. Avoid high temperatures, ingestion, dusty conditions, and all sources of ignition. Wet material may cause slippery conditions.
Leak And Spill Procedures
Wear protective equipment. Recover material into approved containers. Do not allow into water ways. Wash spill site after cleanup.

Engineered Drilling Solutions Inc.

Waste Disposal

All waste should be disposed of according to Federal, Provincial, and Local Regulations. Containers should NOT be reused. Containers should be disposed of in accordance with government regulations

SECTION 8 – FIRST AID MEASURES / OTHER HAZARDOUS INFORMATION

Specific Measures

Skin First Aid

Wash with soap and water. If adverse symptoms develop, seek medical attention

Eye First Aid

Flush eyes with running water for at least 15 minutes. If adverse symptoms develop, seek medical attention

Inhalation First Aid

Move victim to fresh air. If breathing has stopped, apply artificial respiration. If breathing is difficult, administer Oxygen. Seek immediate medical attention.

Ingestion First Aid

Do not induce vomiting. Give large quantities of water, if conscious. Call a physician

SECTION 9 – PREPARATION INFORMATION

Prepared By: Safety Department

Phone: (403) 234-7771 **Preparation Date:** October 01, 2006

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