

Appendix A: Material Safety Data Sheet SODIUM THIOSULFATE (Na₂S₂O₃)

Safety data sheet
according to 1907/2006/EC, Article 31

Printing date 15.01.2015

Version number 15

Revision: 15.01.2015

SECTION 1: Identification of the substance/mixture and of the company/undertaking

- **1.1 Product identifier**
- **Trade name:** Sodium Thiosulfate Pentahydrate
- **Article number:** 3946-01
- **EC number:**
231-867-5
- **Registration number** 01-2119531537-38-XXXX
- **1.2 Relevant identified uses of the substance or mixture and uses advised against**
No further relevant information available.
- **Application of the substance / the mixture :** For Laboratory, Research or Manufacturing use.
- **1.3 Details of the supplier of the safety data sheet**
- **Manufacturer/Supplier:**
Avantor Performance Materials B.V.
P.O.Box 1
7400 AA Deventer
The Netherlands
- Tel: (+31) (0)570 - 687500
Fax: (+31) (0)570 - 687574
E-mail : jt baker.nl@avantormaterials.com
- **Informing department:**
E-mail : pawel.skiba@avantormaterials.com
Avantor Performance Materials Sales Office Tel.: +31(0) 570 687500
- **1.4 Emergency telephone number:**
Environment Health & Safety department
during normal opening times (8 am till 5.30 pm) tel: (+31)(0) 570 687500

SECTION 2: Hazards identification

- **2.1 Classification of the substance or mixture**
- **Classification according to Regulation (EC) No 1272/2008**
The substance is not classified according to the CLP regulation.
- **Classification according to Directive 67/548/EEC or Directive 1999/45/EC void**
- **Information concerning particular hazards for human and environment: void**
- **2.2 Label elements**
- **Labelling according to Regulation (EC) No 1272/2008 Void**
- **Hazard pictograms Void**
- **Signal word Void**
- **Hazard statements Void**
- **2.3 Other hazards**
- **Results of PBT and vPvB assessment**
- **PBT:** Not applicable.
- **vPvB:** Not applicable.

SECTION 3: Composition/information on ingredients

- **3.1 Chemical characterisation: Substances**
- **CAS No. Designation:**
Sodium Thiosulfate Pentahydrate
- **Identification number(s):**
- **EC number:** 231-867-5

SECTION 4: First aid measures

- **4.1 Description of first aid measures**
- **General information** No special measures required.
- **After inhalation** Supply fresh air; consult doctor in case of symptoms.
- **After skin contact** The product is not skin irritating.
- **After eye contact** Rinse opened eye for several minutes under running water.
- **After swallowing** Rinse out mouth

(Contd. on page 2)

GB

Safety data sheet
according to 1907/2006/EC, Article 31

Printing date 15.01.2015

Version number 15

Revision: 15.01.2015

Trade name: Sodium Thiosulfate Pentahydrate

(Contd. of page 1)

- **4.2 Most important symptoms and effects, both acute and delayed** No further relevant information available.
- **4.3 Indication of any immediate medical attention and special treatment needed**
No further relevant information available.

SECTION 5: Firefighting measures

- **5.1 Extinguishing media**
- **Suitable extinguishing agents**
CO₂, extinguishing powder or water jet. Fight larger fires with water jet or alcohol-resistant foam.
- **For safety reasons unsuitable extinguishing agents** Water with a full water jet.
- **5.2 Special hazards arising from the substance or mixture** No further relevant information available.
- **5.3 Advice for firefighters**
- **Protective equipment:** Wear full protective suit.

SECTION 6: Accidental release measures

- **6.1 Personal precautions, protective equipment and emergency procedures** Not required.
- **6.2 Environmental precautions:** No special measures required.
- **6.3 Methods and material for containment and cleaning up:** Collect mechanically.
- **6.4 Reference to other sections**
No dangerous materials are released.
See Section 7 for information on safe handling
See Section 8 for information on personal protection equipment.
See Section 13 for information on disposal.

SECTION 7: Handling and storage

- **7.1 Precautions for safe handling** No special measures required.
- **Information about protection against explosions and fires:** no special requirements
- **7.2 Conditions for safe storage, including any incompatibilities**
- **Storage**
- **Requirements to be met by storerooms and containers:** No special requirements.
- **Information about storage in one common storage facility:** Store away from oxidising agents.
- **Further information about storage conditions:**
Store under dry conditions.
This product is hygroscopic.
- **7.3 Specific end use(s)** No further relevant information available.

SECTION 8: Exposure controls/personal protection

- **8.1 Control parameters**
- **Components with critical values that require monitoring at the workplace:**
- **Additional information:** The lists that were valid during the compilation were used as basis.
- **8.2 Exposure controls**
- **Personal protective equipment**
- **General protective and hygienic measures**
The usual precautionary measures should be adhered to in handling the chemicals.
- **Breathing equipment:** Not required.
- **Protection of hands:**
The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.

(Contd. on page 3)

Safety data sheet
according to 1907/2006/EC, Article 31

Printing date 15.01.2015

Version number 15

Revision: 15.01.2015

Trade name: Sodium Thiosulfate Pentahydrate

(Contd. of page 2)

Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation

· **Material of gloves**

The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer.

· **Penetration time of glove material**

The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.

· **Eye protection:** Not required.

· **Body protection:** Protective work clothing.

SECTION 9: Physical and chemical properties

· **9.1 Information on basic physical and chemical properties**

· **General Information**

· **Appearance:**

· **Form:** Crystalline

· **Colour:** White

· **Smell:** Odourless

· **Odour threshold:** Not determined.

· **pH-value:** Not applicable.

· **Change in condition**

· **Melting point/Melting range:** 48 °C

· **Boiling point/Boiling range:** Not determined

· **Flash point:** Not applicable

· **Inflammability (solid, gaseous)** Product is not inflammable.

· **Ignition temperature:**

· **Decomposition temperature:** Not determined.

· **Self-inflammability:** Not determined.

· **Danger of explosion:** Product is not explosive.

· **Critical values for explosion:**

· **Lower:** Not determined.

· **Upper:** Not determined.

· **Steam pressure:** Not applicable.

· **Density at 20 °C** 1 g/cm³

· **Relative density** Not determined.

· **Vapour density** Not applicable.

· **Evaporation rate** Not applicable.

· **Solubility in / Miscibility with**
· **Water at 20 °C:** 701 g/l

· **Partition coefficient (n-octanol/water):** Not determined.

· **Viscosity:**

· **dynamic:** Not applicable.

· **kinematic:** Not applicable.

· **9.2 Other information** No further relevant information available.

SECTION 10: Stability and reactivity

· **10.1 Reactivity**

· **10.2 Chemical stability**

· **Thermal decomposition / conditions to be avoided:** Heat, boiling temperatures.

· **10.3 Possibility of hazardous reactions** Reacts with oxidizing agents

(Contd. on page 4)

Safety data sheet
according to 1907/2006/EC, Article 31

Printing date 15.01.2015

Version number 15

Revision: 15.01.2015

Trade name: Sodium Thiosulfate Pentahydrate

(Contd. of page 3)

- **10.4 Conditions to avoid** No further relevant information available.
- **10.5 Incompatible materials:** No further relevant information available.
- **10.6 Hazardous decomposition products:** No dangerous decomposition products known

SECTION 11: Toxicological information

- **11.1 Information on toxicological effects**
- **Acute toxicity:**
- **Primary irritant effect:**
- **on the skin:** No irritant effect.
- **on the eye:** redness
- **Sensitisation:** No sensitizing effect known.
- **Additional toxicological information:**
When used and handled according to specifications, the product does not have any harmful effects according to our experience and the information provided to us.
The material is not subject to classification according to EC lists in the last version.

SECTION 12: Ecological information

- **12.1 Toxicity**
- **Aquatic toxicity:** No further relevant information available.
- **12.2 Persistence and degradability** No further relevant information available.
- **12.3 Bioaccumulative potential** No further relevant information available.
- **12.4 Mobility in soil** No further relevant information available.
- **Additional ecological information:**
- **General notes:** Generally not hazardous for water.
- **12.5 Results of PBT and vPvB assessment**
- **PBT:** Not applicable.
- **vPvB:** Not applicable.
- **12.6 Other adverse effects** No further relevant information available.

SECTION 13: Disposal considerations

- **13.1 Waste treatment methods**
- **Recommendation**
Must not be disposed of together with household garbage. Do not allow product to reach sewage system.
- **Uncleaned packagings:**
- **Recommendation:** Disposal must be made according to official regulations.

SECTION 14: Transport information

- | | |
|------------------------------------------|------|
| · 14.1 UN-Number | |
| · ADR, ADN, IMDG, IATA | Void |
| · 14.2 UN proper shipping name | |
| · ADR, ADN, IMDG, IATA | Void |
| · 14.3 Transport hazard class(es) | |
| · ADR, ADN, IMDG, IATA | |
| · Class | Void |
| · 14.4 Packing group | |
| · ADR, IMDG, IATA | Void |

(Contd. on page 5)

Safety data sheet
according to 1907/2006/EC, Article 31

Printing date 15.01.2015

Version number 15

Revision: 15.01.2015

Trade name: Sodium Thiosulfate Pentahydrate

(Contd. of page 4)

- | | |
|---------------------------------------------------------------------------------------|-----------------|
| · 14.5 Environmental hazards: | |
| · Marine pollutant: | No |
| · 14.6 Special precautions for user | Not applicable. |
| · 14.7 Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code | Not applicable. |
| · UN "Model Regulation": | - |

SECTION 15: Regulatory information

- **15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture**
- **Labelling according to Regulation (EC) No 1272/2008** Void
- **Hazard pictograms** Void
- **Signal word** Void
- **Hazard statements** Void
- **15.2 Chemical safety assessment:** A Chemical Safety Assessment has not been carried out.

SECTION 16: Other information

These data are based on our present knowledge. However, they shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

- **Department issuing data specification sheet:** EHS
- **Contact:** Paweł Skiba
- **Abbreviations and acronyms:**
RID: Règlement international concernant le transport des marchandises dangereuses par chemin de fer (Regulations Concerning the International Transport of Dangerous Goods by Rail)
IATA-DGR: Dangerous Goods Regulations by the "International Air Transport Association" (IATA)
ICAO: International Civil Aviation Organisation
ICAO-TI: Technical Instructions by the "International Civil Aviation Organisation" (ICAO)
ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)
IMDG: International Maritime Code for Dangerous Goods
IATA: International Air Transport Association
GHS: Globally Harmonised System of Classification and Labelling of Chemicals
EINECS: European Inventory of Existing Commercial Chemical Substances
CAS: Chemical Abstracts Service (division of the American Chemical Society)
- *** Data compared to the previous version altered.**

GB

Appendix B: Material Safety Data Sheet SODIUM HYPOCHLORITE (NaClO)

MATERIAL SAFETY DATA SHEET



ISO 9001:2000 COMPANY
6465 Eastland Road
Brook Park, Ohio 44142
440.234.3200

REVISED 1/19/09

SECTION I CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

BleachTech LLC
NUMBER:

8929 Ryan Rd.
Seville, Ohio 44273
1-330-769-5000

EMERGENCY RESPONSE

1-330-769-5000 (24 hours)

SUBSTANCE: SODIUM HYPOCHLORITE

TRADE NAME: Bleach 12.5 – 16.5% by weight

CHEMICAL NAME/SYNONYMS: Sodium Hypochlorite Solution, Bleach Solution, Bleach Liquor, Hypo-solution, Bleach, and Liquid Bleach.

CAS NUMBER: 7681-52-9

CHEMICAL FAMILY: Alkali

FORMULA: NaOCl

DOT PROPER SHIPPING NAME: Hypochlorite Solution

DOT HAZARD CLASS: 8 (Corrosive) PG III; PG II (For solutions greater than 16% available chlorine)

DOT IDENTIFICATION NO: UN1791

RQ: 100 pounds

DOT EMERGENCY GUIDE NO: 154

SECTION II COMPOSITION, INFORMATION ON INGREDIENTS

INGREDIENT (S):

Sodium Hypochlorite (NaOCl)	10.0 - 20.0% wt
Sodium Hydroxide (NaOH)	0.1 - 1.1% wt
Water (H ₂ O)	79.7 - 89.9% wt

SECTION III **HAZARDS IDENTIFICATION**

NFPA CLASSIFICATION (SCALE 0-4): Health=2 Fire=0 Reactivity=1

EC CLASSIFICATION (ASSIGNED): C (Corrosive)

EMERGENCY OVERVIEW

COLOR: Yellow PHYSICAL FORM: Liquid ODOR: Chlorine Odor

MAJOR HEALTH HAZARDS: Respiratory Tract Burns, Skin Burns, Mucous Membrane Burns, and Eye Irritation

HAZARDOUS MIXTURES WITH OTHER LIQUIDS, SOLIDS, and OR GASES: Reacts violently with acids liberating chlorine gas. Also reacts with organic substance. When heated, gives off oxygen that may increase fire hazard.

POTENTIAL HEALTH EFFECTS

INHALATION:

- SHORT TERM EXPOSURE: Irritation to respiratory tract. May have same as effects reported in other routes of exposure, burns, blisters, nausea, difficulty breathing, and lung congestion.
- LONG TERM EXPOSURE: Same as effects reported in short term exposure.

SKIN CONTACT:

- SHORT TERM EXPOSURE: Irritant, reddening of the skin. May have burns, blisters, and itching
- LONG TERM EXPOSURE: Same as effects reported in short term exposure.

EYE CONTACT:

- SHORT TERM EXPOSURE: Irritation (possibly severe), possible eye damage

- LONG TERM EXPOSURE: Same as effects reported in short term exposure.

INGESTION:

- SHORT TERM EXPOSURE: Burns, vomiting stomach pain, disorientation, bluish skin color, convulsions, coma

- LONG TERM EXPOSURE: Same as effects reported in short term exposure.

CARCINOGEN STATUS **OSHA: N** **NTP: N**
IARC: N

SECTION IV FIRST AID MEASURES

INHALATION: Remove from exposure and get fresh air. Use bag valve mask or similar device to perform artificial respiration (rescue breathing) if needed. Keep warm and at rest. Get medical attention immediately if artificial respiration required.

SKIN CONTACT: Remove contaminated clothing, jewelry, and shoes immediately. Flush affected area with large amounts of water, preferably a safety shower. Use soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). For burns, cover affected area securely with sterile, dry, loose fitting dressing. If skin is burned, get medical attention immediately.

EYE CONTACT: Wash eyes immediately with large amounts of water, occasionally lifting upper and lower lids, until no evidence of chemical remains (at least 15 minutes). Continue irrigating with a normal saline solution until ready to transport to physician. Cover with sterile bandages. Get medical attention immediately.

INGESTION: Rinse mouth with water. Drink large quantities of milk (water if no milk is available). Milk of magnesia may be helpful. **DO NOT USE ACIDIC ANTIDOTES SUCH AS SODIUM BICARBONATE.** When vomiting occurs, keep head lower than hips to help prevent aspiration. If person is unconscious, do not induce vomiting and turn their head to the side. Never make an unconscious person vomit or drink fluids. Get medical attention.

NOTE TO PHYSICIAN: For inhalation, consider oxygen. For ingestion, avoid gastric lavage, emesis, sodium bicarbonate and acid solutions. Consider the use of antacids.

SECTION V FIRE FIGHTING MEASURES

FLASH POINT: Non-flammable **FLAMMABLE LIMITS:** Non-flammable

FIRE AND EXPLOSION HAZARDS: Negligible fire hazard. Oxidizer. This material will react with some metals and cause liberation of oxygen. May ignite or explode on contact with combustible materials. Toxic fumes can be liberated by contact with acid or heat.

EXTINGUISHING MEDIA: Regular dry chemical, carbon dioxide, water, or foam suitable for surrounding fire. For large fires, use regular foam or flood with fine water spray.

FIRE FIGHTING: Wear self-contained breathing apparatus and full protective clothing. Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. Use extinguishing agents appropriate for surrounding fire. Do not get water directly on material. For large fires, flood with fine water spray. Reduce vapors with water spray. Apply water from a protected location or from a safe distance. Avoid body contact or inhalation of material or combustion by-products. Stay upwind and keep out of low areas.

-

SECTION VI ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL RELEASE: Do not touch spilled material. Stop leak if possible without personal risk. For small spills, collect spilled material in appropriate container for disposal and consider absorbing with sand or other non-combustible material (e.g., do not use sawdust or other combustible material). Be advised, however, that the use of absorbing material is creating hazardous waste and this absorbing material must now be disposed of properly. Collect spilled material in appropriate container for disposal. For small dry spills, move containers away from spill to a safe area. For large spills, dike for later disposal. If possible, do not allow material to enter sewers, streams, ponds or storm conduits as concentrated solutions will seriously injure aquatic life. Keep unnecessary people away, isolate hazard area and deny entry. Contain in as small an area as possible, such as a holding area for dilution and neutralization. Contain spill in plastic drums when available. Dispose of in accordance with Federal, State, and local regulations. Personnel engaged in cleanup operations must be equipped with NIOSH approved respirator protection, rubber boots, gloves, and clothing to avoid body contact. Reportable Quantity (RQ): 100 pounds. Notify Local Emergency Planning Committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304). If release occurs in the U.S. and reportable under CERCLA Section 103, notify the National Response Center at (800) 424-8802(USA) or (202) 426-2675 (USA).

ADVANCE PLANNING: Plan in advance for an occupational release and have necessary equipment and neutralization agents on-site. Contact Odyssey Manufacturing for assistance.

SECTION VII HANDLING AND STORAGE

Store in vented, closed containers that provide protection from direct sunlight. Keep separated from incompatible substances and do not store near acids, heat, or oxidizable materials or organics. When handling, do not mix with other cleaning agents that may liberate chlorine gas vapors (e.g., acidic agents).

Store and handle in accordance with all current regulations and standards including NFPA 430 Code for the Storage of Liquid and Oxidizing Materials.

SECTION VIII EXPOSURE CONTROLS AND PERSONNEL PROTECTION

-

EXPOSURE LIMITS: 2 mg/m³ AIHA recommended STEL 15 minute(s) for Sodium Hypochlorite

VENTILATION: Provide local exhaust ventilation system. Ensure compliance with applicable exposure limits.

EYE PROTECTION: Splash goggles are preferred to a faceshield. Another option is to wear splash resistant safety goggles with a faceshield. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

CLOTHING: It is recommended to wear appropriate chemical resistant clothing to avoid body contact such as a rubber apron or rain suit. Boots are preferred for footwear.

GLOVES: Wear appropriate chemical resistant gloves.

RESPIRATOR: Under conditions of frequent use or heavy exposure, respiratory protection may be needed. Respiratory protection is ranked in order from minimum to maximum. Consider warning properties before use.

- Any chemical cartridge respirator with organic vapor cartridge(s).
- Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s)
- Any air-purifying respirator with a full facepiece and an organic vapor canister
- Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply (Use for Unknown Concentrations or those that may be Immediately Dangerous to Life or Health)
- Any self-contained breathing apparatus with a full facepiece (Use for High Concentrations or those which are immediately Dangerous to Life or Health)

SECTION IX PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL APPEARANCE: Liquid **APPEARANCE AND ODOR:** Clear - Chlorine odor like household bleach. **COLOR:** Greenish - Yellowish cast **MOLECULAR WEIGHT:** 74.44 **MOLECULAR FORMULA:** Na-O-Cl

BOILING POINT: Degrades at 230 Degrees Fahrenheit **FREEZING POINT:** -14 Degrees Fahrenheit for 12.5% weight

And 25 degree Fahrenheit for 16.5 % by weight.

SPECIFIC GRAVITY: 1.18 - 1.27 at 60 Degrees Fahrenheit **PH:** Approximately 11 - 13

VAPOR PRESSURE (mm HG): Vapor Pressure of water + decomposition product Vapor Pressure

VAPOR DENSITY: Not Available **SOLUBILITY IN WATER:** Complete **VOLATILITY:** Not Available

EVAPORATION RATE: >1 **COEFFICIENT OF WATER /OIL DISTRIBUTION:** Not Available

SECTION X STABILITY AND REACTIVITY

REACTIVITY: Stable at normal temperatures and pressure.

CONDITIONS TO AVOID: Avoid heat, flames, sparks and other sources of ignition. Dangerous gases may accumulate in confined spaces. May ignite or explode on contact with combustible materials.

INCOMPATIBLES: Acids, metals, amines, combustible materials, reducing agents. Specific reactions with sodium hypochlorite include the following:

ACIDS: Violent reaction. ALUMINUM: Corrosive action. AMINES: Form explosive chloramines.

AMMONIA: Form explosive chloramines. AMMONIUM SALTS: May form explosive product.

BENZYL CYANIDE (ACIDIFIED): Explosive reaction. CELLOULOSE: Violent reaction

ETHYLENEIMINE: Forms explosive 1-chloroethyleneimine. FORMIC ACID: Explosive mixture.

METHANOL: May form explosive compound. NITROGEN COMPOUNDS: Forms explosive N-chloro compounds.

ORGANIC AND COMBUSTIBLE MATERIALS: Fire and explosion hazard. OXALIC ACID: Intense reaction

REDUCING AGENTS: Fire and explosion hazard ZINC: Corrosive

HAZARDOUS DECOMPOSITION: Thermal decomposition products – Chlorine and Hydrochloric Acid Vapors. Decomposition Products – Hypochlorous Acid Vapors POLYMERIZATION: Will not polymerize.

SECTION XI

SODIUM HYPOCHLORITE TOXICOLOGICAL INFORMATION

IRRITATION DATA: 10 mg eyes – rabbit moderate

TOXICITY DATA:

1gm/ kg oral-woman; TDLo; 45mg/kg intravenous-man TDLo; 5800 mg/ kg oral-mouse LD50; 140 mg/ kg/9 week(s) continuous oral-rat TDLo

CARCINOGEN STATUS: According to the IARC, animal inadequate evidence, human no adequate data, Group 3 (Hypochlorite salts)

LOCAL EFFECTS:

Corrosive: inhalation, skin contact, eye, ingestion hazards

ACUTE TOXICITYLEVEL:

Slightly Toxic if ingested

MUTAGENIC DATA:

Mutation in micro organisms – Salmonella typhimurium 1mg / plate (-S9); DNA repair – Escherichiacoli 20ug/ disc; DNA damage – Escherichiacoli 420 umol/L; phage inhibition capacity – Escherichiacoli 103 ug/ well; micronucleus test - non-mammalian species multiple 200 ppb; cytogenetic analysis - non-mammalian species multiple 120 ug/ L; cytogenetic analysis – human lymphocyte 100 ppm 24hour(s); sister chromatid exchange – human embryo 149 mg/ L; cytogenetic analysis – hamster lung 100 mg/ L

HEALTH EFFECTS:

INHALATION

ACUTE EXPOSURE: May cause severe bronchial irritation, sore throat with possible blistering, coughing, stomatitis, nausea, labored breathing, shortness of breath and pulmonary edema. 10-20 mg/m³ causes burning of the nose and throat; 40-60 mg/m³ may be fatal. If sufficient amounts are absorbed, may cause effects as detailed in acute ingestion.

CHRONIC EXPOSURE: No data available.

SKIN CONTACT

ACUTE EXPOSURE: Extent of damage depends on concentration, pH, volume of solution & time of contact. May cause redness, pain, blistering, itchy eczema & chemical burns. Sensitization reactions possible in previously exposed persons.

CHRONIC EXPOSURE: Effects depend on concentration and duration of exposure. Repeated or prolonged contact with corrosive substances may result in dermatitis or effects similar to acute exposure. Allergic dermatitis has also been reported.

EYE CONTACT

ACUTE EXPOSURE: May cause redness, pain, & blurred vision. Solutions of 5% splashed in human eyes have caused a burning sensation and later only slight superficial disturbance of the corneal epithelium which cleared completely in the next day or two without special treatment. However, one animal study reports a 5% solution causing only moderate irritation with clearing within 7 days. A higher concentration of 15% tested on rabbit eyes caused immediate severe pain, hemorrhages, rapid onset of ground-glass appearance of the corneal epithelium, moderate bluish edema of the whole cornea, chemosis and discharge for several days. Such eyes have sometimes healed in 2-3 weeks with slight or no residual corneal damage but they had neovascularization of the conjunctiva and distortion of the nictitating membrane by scarring.

CHRONIC EXPOSURE: Depending on concentration and time of exposure, symptoms may be as those of acute exposure.

INGESTION

ACUTE EXPOSURE: May cause irritation and erosion of the mucous membranes, vomiting (possibly bloody) and abdominal pain and spasms. A drop in blood pressure, shallow respiration, edema (possibly severe) of pharynx, larynx, and glottis, confusion, convulsions, delirium and coma may occur. Cyanosis and circulatory collapse are possible. Esophageal or gastric perforation and strictures are rare. Death may occur, usually due to complications of severe local injury such as toxemia, shock, perforations, hemorrhage, infection and obstruction. Massive ingestions may produce fatal hyperchloremic metabolic acidosis or aspiration pneumonitis.

CHRONIC EXPOSURE: Sensitization reactions are reported in individuals who are exposed in small amounts through their water supply. High doses have caused sperm abnormality in mice.

SECTION XII ECOLOGICAL INFORMATION

ECOTOXICITY DATA:

FISH TOXICITY: 94.0 ug/L 96h hour(s) LC50 (Mortality) Cutthroat trout (*Oncorhynchus clarki*)

INVERTEBRATE TOXICITY: 31.6 ug/L 7 hour(s) 1C50 (Species Diversity) Protozoan phylum (Protozoa)

ALGAL TOXICITY: 90 ug/L 96 hour(s) LC50 (Mortality) Algae, phytoplankton, algal mat (Algae)

PHYTOTOXICITY: 230-ug/L 35 hour(s) (Biomass) Curled pondweed (*Potamogeton crispus*)

OTHER TOXICITY: 2.1 ug/L 28 day(s) (Chlorophyll) Aquatic community (Aquatic community)

ENVIRONMENTAL SUMMARY: Highly toxic to aquatic life.

-

SECTION XIII DISPOSAL CONSIDERATIONS

Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): D001. Dispose in accordance with all applicable regulations.

SECTION XIV TRANSPORT INFORMATION

U.S. DOT 49 CFR 172.101 SHIPPING NAME-UN NUMBER: Sodium Hypochlorite) - UN1791

U.S. DOT 49 CER 172.101 HAZARD CLASS OR DIVISION: 8

U.S. DOT 49 CFR 172.101 PACKING GROUP: III(less than 16% available chlorine) / II(16% or more available chlorine)

U.S. DOT 49 CFR 172.101 AND SUBPART E LABELING REQUIREMENTS: Corrosive

U.S. DOT 49 CFR 172.101 PACKAGING AUTHORIZATIONS:

EXCEPTIONS: 49 CFR 173.154

NON- BULK PACKAGING: 49 CFR 173.203 (less than 16% available chlorine) / 49 CFR 173.202 (16% or more available chlorine)

BULK PACKAGING: 49 CFR 173.241 (less than 16% available chlorine) / : 49 CFR 173.242 (16% or more available chlorine)

U.S. DOT 49 CFR 172.101 QUANTITY LIMITATIONS:

PASSENGER AIRCRAFT OR RAILCAR: 5 LITERS / (less than 16% available chlorine) / 1 LITERS (16% or more available chlorine)

CARGO AIRCRAFT ONLY: 60 LITERS / (less than 16% available chlorine) / 30 LITERS (16% or more available chlorine)

SECTION XV REGULATORY INFORMATION

U.S. REGULATIONS

TSCA INVENTORY STATUS: Y TSCA 12(b) EXPORT NOTIFICATION: Not listed.

CERCLA SECTION 103 (40CFR302.4): Y SODIUM HYPOCHLORITE: 100 LBS RQ

SARA SECTION 302 (40CFR355.30): N SARA SECTION 304 (40CFR355.40) : N

SARA SECTION 313 (40CFR372.65): N

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40CFR370.21):

ACUTE: Y CHRONIC: N FIRE: N REACTIVE: N SUDDEN RELEASE: N

OSHA PROCESS SAFETY (29CFR1910.119): N

STATE REGULATIONS: California Proposition 65: N

EUROPEAN REGULATIONS: EC NUMBER (BINECS) : 231-668-3

EC RISK AND SAFETY PHRASES:

R 31 Contact with acids liberates toxic gas.

R 34 Causes burns.

S ½ Keep locked-up and out of reach of children.

S 28b After contact with skin, wash immediately with plenty of soap and water.

S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible)

S 50 Do not mix with incompatible materials.

CONCENTRATION LIMITS:

C>10% C R 31-34

5%≤C≤10% Xi R 31-36/38

GERMAN REGULATIONS: WATER HAZARD CLASS (WGK) : 2 (Official German Classification)

SECTION XVI OTHER INFORMATION

For additional information, contact our technical service department.

Information contained in this MSDS refers only to the specific material designated and does not relate to any process or use involving other materials. This information is based on data believed to be reliable, and the Product is intended to be used in a manner that is customary and reasonably foreseeable. Since actual use and handling are beyond our control, no warranty,

express or implied, is made and no liability is assumed by BleachTech LLC in connection with the use of this information.

Appendix C: Material Safety Data Sheet HYDROGEN (H₂)

MATERIAL SAFETY DATA SHEET

SECTION 1 CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MATHESON TRI-GAS, INC.
959 ROUTE 46 EAST
PARSIPPANY, NEW JERSEY 07054-0624

EMERGENCY CONTACT:
CHEMTREC 1-800-424-9300
INFORMATION CONTACT:
973-257-1100

SUBSTANCE: HYDROGEN

TRADE NAMES/SYNONYMS:

MTG MSDS 49; HYDROGEN GAS; HYDROGEN COMPRESSED; HYDROGEN (H₂); DIHYDROGEN;
UN 1049; H₂; MAT11120; RTECS MW8900000

CHEMICAL FAMILY: inorganic, gas

CREATION DATE: Mar 07 1990

REVISION DATE: Mar 19 2003

SECTION 2 COMPOSITION, INFORMATION ON INGREDIENTS

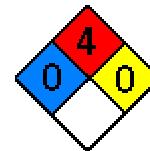
COMPONENT: HYDROGEN

CAS NUMBER: 1333-74-0

PERCENTAGE: 100.0

SECTION 3 HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=0 FIRE=4 REACTIVITY=0



EMERGENCY OVERVIEW:

COLOR: colorless

PHYSICAL FORM: gas

ODOR: odorless

MAJOR HEALTH HAZARDS: difficulty breathing

PHYSICAL HAZARDS: Flammable gas. May cause flash fire.

POTENTIAL HEALTH EFFECTS:

INHALATION:

SHORT TERM EXPOSURE: nausea, vomiting, difficulty breathing, irregular heartbeat, headache, fatigue, dizziness, disorientation, mood swings, tingling sensation, loss of coordination, suffocation, convulsions, unconsciousness, coma

LONG TERM EXPOSURE: no information is available

SKIN CONTACT:

SHORT TERM EXPOSURE: no information on significant adverse effects

LONG TERM EXPOSURE: no information is available

EYE CONTACT:

SHORT TERM EXPOSURE: no information on significant adverse effects

LONG TERM EXPOSURE: no information is available

INGESTION:

SHORT TERM EXPOSURE: ingestion of a gas is unlikely

LONG TERM EXPOSURE: ingestion of harmful amounts is unlikely

SECTION 4 FIRST AID MEASURES

INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.

SKIN CONTACT: Wash exposed skin with soap and water.

EYE CONTACT: Flush eyes with plenty of water.

INGESTION: If a large amount is swallowed, get medical attention.

NOTE TO PHYSICIAN: For inhalation, consider oxygen.

SECTION 5 FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS: Severe fire hazard. Severe explosion hazard. Vapor/air mixtures are explosive. Pressurized containers may rupture or explode if exposed to sufficient heat. Electrostatic discharges may be generated by flow or agitation resulting in ignition or explosion.

EXTINGUISHING MEDIA: carbon dioxide, regular dry chemical

Large fires: Flood with fine water spray.

FIRE FIGHTING: Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck: Stop leak if possible without personal risk. Let burn unless leak can be stopped immediately. For smaller tanks or cylinders, extinguish and isolate from other flammables. Evacuation radius: 800 meters (1/2 mile). Do not attempt to extinguish fire unless flow of material can be stopped first. Flood with fine water spray. Cool containers with water spray until well after the fire is out. Apply water from a protected location or from a safe distance. Avoid inhalation of material or combustion by-products. Stay upwind and keep out of low areas. Evacuate if fire gets out of control or containers are directly exposed to fire. Evacuation radius: 500 meters (1/3 mile). Consider downwind evacuation if material is leaking. Stop flow of gas.

LOWER FLAMMABLE LIMIT: 4.0%
UPPER FLAMMABLE LIMIT: 75%
AUTOIGNITION: 932 F (500 C)

SECTION 6 ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL RELEASE:

Avoid heat, flames, sparks and other sources of ignition. Do not touch spilled material. Stop leak if possible without personal risk. Reduce vapors with water spray. Keep unnecessary people away, isolate hazard area and deny entry. Remove sources of ignition. Ventilate closed spaces before entering.

SECTION 7 HANDLING AND STORAGE

STORAGE: Store and handle in accordance with all current regulations and standards. Grounding and bonding required. Subject to storage regulations: U.S. OSHA 29 CFR 1910.101. Keep separated from incompatible substances.

SECTION 8 EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:

HYDROGEN:

ACGIH (simple asphyxiant)

VENTILATION: Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Provide local exhaust ventilation system. Ensure compliance with applicable exposure limits.

EYE PROTECTION: Eye protection not required, but recommended.

CLOTHING: Protective clothing is not required.

GLOVES: Wear appropriate chemical resistant gloves.

RESPIRATOR: Under conditions of frequent use or heavy exposure, respiratory protection may be needed. Respiratory protection is ranked in order from minimum to maximum. Consider warning properties before use.

For Unknown Concentrations or Immediately Dangerous to Life or Health -

Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply.

Any self-contained breathing apparatus with a full facepiece.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: gas

COLOR: colorless

ODOR: odorless
TASTE: tasteless
MOLECULAR WEIGHT: 2.0
MOLECULAR FORMULA: H₂
BOILING POINT: -423 F (-253 C)
FREEZING POINT: -434 F (-259 C)
VAPOR PRESSURE: 760 mmHg @ -253 C
VAPOR DENSITY (air=1): 0.07
SPECIFIC GRAVITY: Not applicable
DENSITY: 0.08987 g/L @ 0 C
WATER SOLUBILITY: 1.82% @ 20 C
PH: Not applicable
VOLATILITY: Not applicable
ODOR THRESHOLD: Not available
EVAPORATION RATE: Not applicable
VISCOSITY: 0.008957 cP @ 26.8 C
COEFFICIENT OF WATER/OIL DISTRIBUTION: Not applicable
SOLVENT SOLUBILITY:
Slightly Soluble: alcohol, ether

SECTION 10 STABILITY AND REACTIVITY

REACTIVITY: Stable at normal temperatures and pressure.

CONDITIONS TO AVOID: Avoid heat, flames, sparks and other sources of ignition. Minimize contact with material. Containers may rupture or explode if exposed to heat.

INCOMPATIBILITIES: metals, oxidizing materials, metal oxides, combustible materials, halogens, metal salts, halo carbons

HAZARDOUS DECOMPOSITION:

Thermal decomposition products: miscellaneous decomposition products

POLYMERIZATION: Will not polymerize.

SECTION 11 TOXICOLOGICAL INFORMATION

Not available

SECTION 12 ECOLOGICAL INFORMATION

Not available

SECTION 13 DISPOSAL CONSIDERATIONS

Dispose in accordance with all applicable regulations. Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): D001.

SECTION 14 TRANSPORT INFORMATION

U.S. DOT 49 CFR 172.101:
PROPER SHIPPING NAME: Hydrogen, compressed
ID NUMBER: UN1049
HAZARD CLASS OR DIVISION: 2.1
LABELING REQUIREMENTS: 2.1
QUANTITY LIMITATIONS:
PASSENGER AIRCRAFT OR RAILCAR: Forbidden
CARGO AIRCRAFT ONLY: 150 kg



CANADIAN TRANSPORTATION OF DANGEROUS GOODS:
SHIPPING NAME: HYDROGEN, COMPRESSED
UN NUMBER: UN1049
CLASS: 2.1

SECTION 15 REGULATORY INFORMATION

U.S. REGULATIONS:

CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4): Not regulated.

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.30): Not regulated.

SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.40): Not regulated.

SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370.21):

ACUTE: Yes

CHRONIC: No

FIRE: Yes

REACTIVE: No

SUDDEN RELEASE: Yes

SARA TITLE III SECTION 313 (40 CFR 372.65): Not regulated.

OSHA PROCESS SAFETY (29CFR1910.119): Not regulated.

STATE REGULATIONS:

California Proposition 65: Not regulated.

CANADIAN REGULATIONS:

WHMIS CLASSIFICATION: A, B1.

NATIONAL INVENTORY STATUS:

U.S. INVENTORY (TSCA): Listed on inventory.

TSCA 12(b) EXPORT NOTIFICATION: Not listed.

CANADA INVENTORY (DSL/NDSL): Listed on inventory.

SECTION 16 OTHER INFORMATION

©Copyright 1984-2003 MDL Information Systems, Inc. All rights reserved.

MATHESON TRI-GAS, INC. MAKES NO EXPRESS OR IMPLIED WARRANTIES, GUARANTEES OR REPRESENTATIONS REGARDING THE PRODUCT OR THE INFORMATION HEREIN, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR USE. MATHESON TRI-GAS, INC. SHALL NOT BE LIABLE FOR ANY PERSONAL INJURY, PROPERTY OR OTHER DAMAGES OF ANY NATURE, WHETHER COMPENSATORY, CONSEQUENTIAL, EXEMPLARY, OR OTHERWISE, RESULTING FROM ANY PUBLICATION, USE OR RELIANCE UPON THE INFORMATION HEREIN.