SAFETY DATA SHEET

Date Printed: January 7, 2020
Version: 3rd
Regulation: According to Regulation 2012 OSHA Hazard Communication Standard; 29 CFR Part 1910.1200

1. Identification

1.1 Product identifier

1.1.1 Product name: Chlorine

1.1.2 Other means of identification: Bertholite

1.2 Recommended use of the chemical and restrictions on use

1.2.1 Recommended use: It is used for PVC production, solvent production, textile industry, pulp industry, wastewater treatment, disinfection of drinking water.

1.2.2. Restrictions on use: Do not use for purposes other than those recommended.

1.3 Details of the supplier of the safety data sheet

1.3.1 Manufacturer

Company name: Hanwha Solutions Co, Ltd.
Address: Yeosu plant, Hanwha Solutions Co, Ltd., 117, Yeosusandan 3-ro, Yeosu-si, Jeollanam-do, Korea
Prepared by: CA Production Team
Contact Telephone (Yeosu plant) +82-61-688-1774

1.3.2 Supplier & Distributor

Company name: Hanwha Solutions Co, Ltd.
Address: 21F, Hanwha Bldg., Janggyo-dong, Jung-gu, Seoul, Korea
Prepared by: CA Marketing Team
Contact Telephone: +82-2-729-3107

1.4 Emergency phone number

Emergency phone: +82-2-729-3107

2. Hazard(s) identification

2.1 Classification of the substance or mixture

According to Regulation 2012 OSHA Hazard Communication Standard; 29 CFR Part 1910.1200

Physical / Chemical Hazards:

Oxidizing gases: Category 1
Gases under pressure: Liquefied gas

Health Hazards:

Acute toxicity (inhalation gases): Category 2
Skin corrosion/irritation: Category 1
Serious eye damage /eye irritation: Category 1
Specific target organ toxicity (single exposure): Category 3 (respiratory tract irritation)

Environmental Hazards:

Hazardous to the aquatic environment (acute hazard): Category 1

2.2 Label elements, including precautionary statements

o **Pictogram and symbol**:

- **Signal word**: Danger
- **Hazard statements**:

H270 May cause or intensify fire; oxidizer
H280 Contains gas under pressure; may explode if heated.
H314 Causes severe skin burns and eye damage.
H318 Causes serious eye damage.
H330 Fatal if inhaled.
H335 May cause respiratory irritation.
H400 Very toxic to aquatic life.

- **Precautionary statements:**

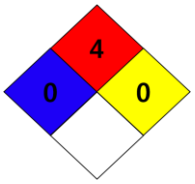
- Prevention:
P220 Keep/Store away from clothing, combustible materials.
P244 Keep reduction valves free from grease and oil.
P260 Do not breathe dust/fume/gas/mist/vapor/spray.
P264 Wash your hands thoroughly after handling.
P271 Use only outdoors or in a well-ventilated area.
P273 Avoid release to the environment.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P284 Wear respiratory protection.

- Treatment:
P301+P330+P331 If swallowed: Rinse mouth. Do not induce vomiting.
P303+P361+P353 If on skin (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
P304+P340 If inhaled: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310 Immediately call a poison center or doctor/physician.
P312 Call a poison center or doctor/physician you feel unwell.
P320 Specific treatment is urgent (see Section 8 on this label).
P363 Wash contaminated clothing before reuse.
P370+P376 In case of fire: Stop leak if safe to do so.
P391 Collect spillage.

- Storage:
P403 Store in a well-ventilated place.
P403+P233 Store in a well ventilated place. Keep container tightly closed.
P405 Store locked up.
P410+P403 Protect from sunlight. Store in a well-ventilated place.

- Disposal:
P510 Dispose the contents/container in accordance with local/regional/national/international regulations.

2.3 Other hazard information not included in hazard classification (National Fire Protection Association; NFPA)



- **Health:** 4
- **Flammability:** 0
- **Reactivity:** 0
- **Specific hazard:** -

3. Composition/information on ingredients

Component	Common name and synonyms	CAS No.	Conc. / %
Chlorine	Bertholite	7782-50-5	99.9
Water	Dihydrogen oxide	7732-18-5	<0.00003

4. First aid measures

4.1 Description of first aid measures

Eye contact

- Call emergency medical service.
- IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

Skin contact

- For hot product, immediately immerse in or flush the affected area with large amounts of cold water to dissipate heat.
- Call emergency medical service.
- Remove and isolate contaminated clothing and shoes.
- Clothing frozen to the skin should be thawed before being removed.
- Contact with gas or liquefied gas may cause burns, severe injury and/or frostbite.
- If on skin (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
- Call a poison center or doctor/physician you feel unwell.
- Wash contaminated clothing before reuse.

Inhalation

- If exposed to excessive levels of dusts or fumes, remove to fresh air and get medical attention if cough or other symptoms develop.
- Immediately call a poison center or doctor/physician.

Ingestion

- Call emergency medical service.
- Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical equipment.
- If swallowed: Rinse mouth. Do not induce vomiting.

4.2 Most important symptoms and effects, both acute and delayed

Symptoms and effect:

Inhalation: May cause severe irritation of respiratory.

Skin contact: Contact with liquid chlorine will cause burn skin and frostbite.

Eye contact: May cause severe irritation of eyes like wound or lose.

4.3 Indication of immediate medical attention and notes for physician

- Effects of contact or inhalation may be delayed.
- Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.
- Keep victim under observation.

5. Fire-fighting measures

5.1 Extinguishing media

- **Suitable extinguishing media:** Water
- **Unsuitable extinguishing media**: Dry chemical, Carbon dioxide, Extinguishing halogen compounds, Straight streams

5.2 Specific hazards arising from the chemical

- Irritating, corrosive and toxic gases, Oxides of carbon, Halogenated compounds
- May ignite combustibles. (Wood, paper, oil, clothing, etc.)
- Contains gas under pressure; may explode if heated.
- May cause or intensify fire; oxidizer
- Cylinders exposed to fire may release flammable gas.
- TOXIC; may be fatal if inhaled or absorbed through skin.
- Spilled material may create fire or explosion hazard.
- Some of these materials may burn, but none ignite readily.
- Substance does not burn but will support combustion.
- Some are oxidizers and may ignite combustibles.
- Some of these materials, if spilled, may leave a flammable residue after evaporation.

5.3 Special protective equipment and precautions for fire-fighters

- DO NOT GET WATER on spilled substance or inside containers.
- In case of fire: Stop leak if safe to do so.
- Evacuate area and fight fire from a safe distance.
- For small fires, contain and let burn.
- Avoid inhalation of material or combustion by-products.
- Stay upwind and keep out of low areas.
- Vapors from liquefied gas are initially heavier than air and spread along ground.
- Ruptured cylinders may rocket.
- Move containers from fire area if you can do it without risk.
- Fire involving Tanks; Do not direct water at source of leak or safety devices; icing may occur.
- Fire involving Tanks; Fight fire from maximum distance or use unmanned hose holders or monitor nozzles.
- Fire involving Tanks; Cool containers with flooding quantities of water until well after fire is out.
- Fire involving Tanks; Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.
- Fire involving Tanks; Always stay away from tanks engulfed in fire.
- Fire involving Tanks; For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.
- Wear full protective fire fighting gear including self-contained breathing apparatus (SCBA) for protection against possible exposure.

6. Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

- Clean up spills immediately, observing precautions in Protective Equipment section.
- Isolate hazard area.
- If possible, turn leaking containers so that gas escapes rather than liquid.
- Isolate area until gas has dispersed.
- Keep combustibles away from spilled material.
- Do not touch or walk through spilled material.
- Do not direct water at spill or source of leak.

- Use water spray to reduce vapors or divert vapor cloud drift. Avoid allowing water runoff to contact spilled material.
- Ventilate the area.
- Stop leak if you can do it without risk.
- Fully encapsulating, vapor protective clothing should be worn for spills and leaks with no fire.
- Please note that there are materials and conditions to avoid.
- Avoid breathing dust/fume/gas/mist/vapor/spray.

6.2 Environmental precautions

- Atmosphere: Not available
- Land: Avoid release to the environment.
  Runoff from fire control or dilution water may cause pollution.
- Underwater: Prevent entry into waterways, sewers, basements or confined areas.

6.3 Methods and materials for containment and cleaning up

- Absorb spills with inert material (e.g., dry sand or earth), then place in a chemical waste container.
- Absorb the liquid and scrub the area with detergent and water.
- Collect spillage.
- Reduce dust and prevent scattering by moistening with water.
- With clean shovel place material into clean, dry container and cover loosely; move containers from spill area.
- Powder Spill; Cover powder spill with plastic sheet or tarp to minimize spreading and keep powder dry.
- Large Spill; Dike far ahead of liquid spill for later disposal.
- Small Spill; Take up with sand or other non-combustible absorbent material and place into containers for later disposal.

7. Handling and storage

7.1 Precautions for safe handling

- Follow all MSDS/label precautions even after container is emptied because they may retain product residues.
- Use carefully in handling/storage.
- Loosen closure cautiously before opening.
- Avoid prolonged or repeated contact with skin.
- Please work with reference to engineering controls and personal protective equipment.
- Wash your hands thoroughly after handling.
- Use only outdoors or in a well-ventilated area.

7.2 Conditions for safe storage, including any incompatibilities

- Empty drums should be completely drained, properly bunged, and promptly returned to a drum reconditioning, or properly disposed of.
- Store in a well-ventilated place. Keep container tightly closed.

8. Exposure controls/personal protection

8.1 Occupational Exposure limits

- **ACGIH**: TWA=0.5ppm
- **Biological exposure index**: Not available
- **OSHA**: TWA=0.5ppm(1.5mg/m^3), STEL=1ppm(3mg/m^3), Ceiling=1ppm(3mg/m^3)
- **NIOSH**: Ceiling=0.5ppm(1.45mg/m^3) (15min)
- **EU regulation**:

- Austria: TWA=0.5ppm(1.5mg/m^3)
- Czech Republic: TWA=0.5mg/m^3
- Germany: TWA=0.5ppm(1.5mg/m^3)

o **Other**:

- Argentina: TWA=0.5ppm
- Brazil: TWA=0.8ppm(2.3mg/m^3)
- Bahrain: TWA=0.5ppm(1.5mg/m^3)

8.2 Exposure controls

Appropriate engineering controls

- Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits.
- If user operations generate dust, fume, or mist, use ventilation to keep exposure to airborne contaminants below the recommended exposure limit.
- Facilities for storing or utilizing this material should be equipped with an eyewash facility and a safety shower.

Individual protection measures, such as personal protective equipment

Respiratory protection

- Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard
- Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator. (See 8.1)

Eye protection

- Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts.
- If contact is possible, use chemical splash goggles and/ or face shield.
- If inhalation hazards exist, use a full-face respirator

Hand protection

- Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times.
- Check during use that the gloves are still retaining their protective properties.

Body protection

- Wear appropriate chemical resistant clothing.

9. Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance

Description:	Gas
Color:	Greenish-yellow colour
Odor:	Characteristic stringent
Odor threshold:	Not available
pH:	Not available
Melting point/freezing point:	-101°C
Initial boiling point and boiling range:	-34°C(1013hPa)
Flash point:	Not applicable
Evaporation rate:	Not available
Flammability (solid, gas):	Flammable
Upper/lower flammability or explosive limits:	Not available
Vapor pressure:	6780hPa(20°C)
Vapor density:	2.48(Air=1)
Solubility:	6.9g/L(20°C)
Solubility in organic solvents:	Not available

Partition coefficient: n-octanol/water:	Not available
Auto ignition temperature:	Not available
Decomposition temperature:	Not available
Viscosity:	14 Pa.sec (20 °C)

"NOTE: The physical data presented above are typical values and should not be construed as a specification"

10. Stability and reactivity

10.1 Reactivity/Chemical stability/Possibility of hazardous reactions:

- Stable at room temperature and atmospheric pressure
- There is no polymerization reaction.

10.2 Conditions to avoid:

- Keep away from combustible materials.
- Please avoid grease and oil to the control valve.
- Be careful not to cause an impact on the environment due to river discharge.

10.3 Incompatible materials:

- Combustible materials, bases, metals, halogens, amines, metallic salts, metal carbide, metal oxide, oxidant, halo- carbon compounds, acid, organic compounds, ammonia, hydrogen

10.4 Hazardous decomposition products:

- Irritating, corrosive and toxic gases, Halogenated compounds, Oxides of carbon

11. Toxicological information

Information on toxicological effects	
(a) Acute toxicity	
Oral	Not classified (Difficult to apply to classification due to low reliability)
	Rat(male), LD_{50}=1,100 mg/kg bw (OECD TG 401, read-across)
Dermal	Not classified
	Rabbit, LD_{50}>20,000mg/kg bw (read-across)
Inhalation	Category 2
	Mouse, LC_{50}=0.52mg/L (OECD TG 403, GLP)
(b) Skin Corrosion/ Irritation	Category 1
	Chlorine is corrosive to the skin and severe effects can be expected from exposure to the eyes.
(c) Serious Eye Damage/ Irritation	Category 1
	Chlorine gas can lead to ocular irritation and burns.
(d) Respiratory sensitization	Not available
(e) Skin Sensitization	Not classified
	In Skin Sensitization test with guinea pig, the test material is not considered to be skin sensitizing.

(f) Carcinogenicity	Not classified
	ACGIH: A4 (Not Classifiable as a Human Carcinogen)
(g) Mutagenicity	Not classified
	In vitro: In vitro Mammalian Chromosome Aberration Test (*CHL cells*): Ambiguous *In vivo*: Mammalian Erythrocyte Micronucleus Test (*Mouse*): Negative
(h) Reproductive toxicity	Not classified
	Rat, 10days, 1, 2, or 5 mg/kg bw/day, Male and female reproductive organ weights were comparable to the control groups and no significant histopathological changes were observed among treated male female rats. (One-Generation Reproduction Toxicity Study) (NOAEL>=5mg/kg/day) (OECD TG 415, read-across)
(i) Specific target organ toxicity (single exposure)	Category 3 (respiratory tract irritation)
	Rat, 1h, 935 mg/L~16.801 mg/L, Most of the effects of chlorine occurred in the alveoli. Exposure to chlorine resulted additionally in changes in the conductive airways in some animals. (LC_{50}=0.2085mg/L 4h) (OECD TG 403)
(j) Specific target organ toxicity (repeat exposure)	Not classified
	Monkey, a year, 0.1±0.03 ppm, 0.5±0.1 ppm, 2.3±0.4 ppm, Treatment-induced histopathological changes were found in the respiratory epithelium of the nasal passages and trachea and were limited to focal, concentration-related epithelial hyperplasia with loss of cilia and decreased numbers of goblet cells in affected areas. (OECD TG 413)
(k) Aspiration Hazard	Not available

12. Ecological information

12.1 Toxicity	
Acute toxicity	Category 1
	Fish: 96hr LC_{50} (*Coho salmon*) = 0.032mg/L (read-across) Invertebrate: 48hr EC_{50} (*Daphnia magna*) = 0.141mg/L (read-across) Algae: Not available
Chronic toxicity	Not classified (Difficult to apply to classification due to low reliability)
	Fish: 28d NOEC (*Menidia peninsulae*) = 0.04mg/L (read-across) Invertebrate: 15d NOEC=0.007mg/L (read-across) Algae: 7d EC_{50} (*Periphytic communities*) = NOEC=0.002mg/L (read-across)
12.2 Persistence and degradability	Persistence: Not available Degradability: Not available
12.3 Bioaccumulative potential	Bioaccumulation: Bioaccumulation is expected to be low according to the BCF <500. (BCF = 3.162L/kg(estimated)) Biodegradation: Not available
12.4 Mobility in soil	High potency of mobility to soil. (Koc = 6.146E+014(estimated))
12.5 Hazardous to the ozone layer	Not classified
12.6 Other adverse effects	Not available

13. Disposal considerations

13.1 Disposal method

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

13.2 Disposal precaution

Consider the required attentions in accordance with waste treatment management regulation.

14. Transport information

14.1 UN No.: 1017

14.2 UN Proper shipping name: CHLORINE

14.3 Transport Hazard class

ADR: 2.3, 5.1/8P
IMDG: 2.3, 5.1/8P
ICAO/IATA: 2.3, 5.1/8P
RID: 2.3, 5.1/8P

14.4 Packing group: Not applicable

14.5 Environmental hazards:

Marine pollutant: Applicable

14.6 Transport in bulk (according to Annex II of MARPOL 73/78 and the IBC Code): Not established

14.7 Special precautions for user

in case of fire: F-C
in case of leakage: S-U

15. Regulatory information

15.1 Safety, health and environmental regulation/legislation specific for the substance or mixture USA Regulatory Information

TSCA (Toxic Substances Control Act): Section 8(b) inventory (Present)

Proposition 65: Not regulated

OSHA Regulation: 1500lbs

CERCLA Regulation: 10lbs, 4.54 kg

SARA 311/312 Hazard classes: Fire hazard sudden release of pressure, Immediate (Acute) health hazard

SARA 302 Regulation: 100lbs

SARA 304 Regulation: 10lbs/4.5kg

SARA 313 Regulation: Regulated

Foreign Regulatory Information

Substance of Rotterdam Protocol: Not regulated

Substance of Stockholm Protocol: Not regulated

Substance of Montreal Protocol: Not regulated

Foreign Inventory Status

- Korea management information: Existing Chemical Substance (KE-05486),
Phase-in substance subject to registration,
Accident precaution chemicals

- China management information: Inventory of Existing Chemical Substances (IECSC): Present (23595)
- Australia management information: Inventory of Chemical Substances (AICS): Present
- Canada management information: Domestic Substances List (DSL): Present
- New Zealand management information: New Zealand Inventory of Chemicals (NZIoC): HSNO Approval: HSR001058
- Philippines management information: Philippines Inventory of Chemicals and Chemical Substances (PICCS): Present

16. OTHER INFORMATION

16.1 Indication of changes:

Preparation date: June 20, 2016
Version: 3
Revision date: January 7, 2020

16.2 Key literature reference and sources for data:

○ National chemicals information systems; http://ncis.nier.go.kr
○ Pubchem; http://pubchem.ncbi.nlm.nih.gov/
○ AKRON; http://ull.chemistry.uakron.edu/erd/
○ IARC Monographs on the Evaluation of Carcinogenic Risks to Humans; http://monographs.iarc.fr
○ ECHA; http://echa.europa.eu/web/guest
○ HSDB; http://toxnet.nlm.nih.gov/
○ OECD SIDS; http://webnet.oecd.org/
○ NIOSH(The National Institute for Occupational Safety and Health)
○ ACGIH(American Conference of Governmental Industrial Hygienists)
○ TOMES-LOLI®; http://www.rightanswerknowledge.com/loginRA.asp
○ National Emergency Management Agency-Korea dangerous material inventory management system; http://hazmat.mpss.kfi.or.kr/index.do
○ Waste Control Act enforcement regulation attached [1]
○ EPISUITE Program ver.4.1

16.3 Abbreviations

ACGIH: American Conference of Governmental Industrial hygienists
NIOSH: The National Institute for Occupational Safety and Health
OSHA: Occupational Safety & Health Administration
IARC: International Agency for Research on Cancer
ADR: European Agreement concerning the International Carriage of Dangerous Goods by Road
IMDG: International Maritime Dangerous Goods
ICAO/IATA: International Civil Aviation Organization/ International Air Transport Association
RID: Regulations Concerning the International Transport of Dangerous Goods by Rail

16.4 Other

- Product should be handled, stored, and used in accordance with the generally accepted industrial hygiene practices and in conformity with all the applicable legal regulations.
- The information provided herein is based on the knowledge possessed at this present time from the view point of safety requirements.
- It should, therefore, not be construed as guaranteeing specific properties.