MATERIAL SAFETY DATA SHEET

1. Identification of the substance or mixture and of the supplier

GHS product identifier : 50% Sodium Hydroxide, 50% Caustic Soda

Recommended use of the chemical and restrictions on use.

- Recommended use: raw material of the synthesis, It is also used for metal cleaning, electrolytic extraction of zinc, tin plating, oxide coating, laundering, and bleaching.
- Recommended use: The aqueous solution is strong alkaline and producing carbonate by absorbing the carbon dioxide well. It is highly soluble in water, methyl alcohol, glycerin and ethyl alcohol that it produces salt by acid reaction. The product made of steel can treat NaOH with the concentration of 8%~12% in electrolyzed effluent at 65 Celsius degrees and even higher concentration at 50 Celsius degrees. Since the product made of Al, Zn, Sn or Cu can be rapidly eroded by the caustic soda, one must avoid using one of those materials.

Supplier identifier.

- Manufacturers information
  - Manufacturers name: Hanwha Chemical Corporation
  - Address:
    - 287-9, Pyeongyeo-Dong, Yeosu-si, Jeollanam-do, Korea (Yeosu plant)
    - 482, Sanggae-dong, Nam-gu, Ulsan, Korea (Ulsan plant)
  - Emergency phone number:
    - Tel: +82-61-688-1774, +82-52-279-2403
  - Respondent: CA Production Team

- Supplier information
  - Supplier name: Hanwha Chemical Corporation
  - Address: Hanwha Building, 1, Janggyo-dong, Jung-gu, Seoul, Korea (CA department)
  - Emergency phone number:
    - Tel: +82-2-729-2516
  - Respondent: CA sales 1 team

2. Hazards identification

GHS classification of the substance/mixture:

- Corrosive to Metals: Category 1
- Acute toxicity (oral): Category 4
- Acute toxicity (dermal): Category 4
- Skin corrosion/irritation: Category 1
- Eye Damage/Irritation: Category 1
- Specific target organ toxicity (single exposure): Category 1
- Acute aquatic toxicity: Category 3

GHS label elements, including precautionary statements.

- Pictogram and symbol:

- Signal word: Danger
- Hazard statements:
  H290 May be corrosive to metals
  H302 Harmful if swallowed
  H312 Harmful in contact with skin
  H314 Causes severe skin burns and eye damage
  H318 Causes serious eye damage
  H370 Causes damage to organs
  H402 Harmful to aquatic life

- Precautionary statements:
  - Precaution:
    - P234: Keep only in original container.
    - P260: Do not breathe dust/fume/gas/mist/vapours/spray.
    - P264: Wash thoroughly after handling.
    - P270: Do not eat, drink or smoke when using this product.
    - P273: Avoid release to the environment.
  - Treatment:
    - P302+P352: IF ON SKIN: Wash with soap and water.
    - P390:Absorb spillage to prevent material damage.
    - P301+P310+P312: IF SWALLOWED: Immediately call a POISON CENTER or doctor/physicianif you feel unwell.
    - P321+P322: Specific measures and treatment urgent as reference to supplemental first aid instruction.
    - P363: Wash contaminated clothing before reuse.
    - P301+P330+P331: IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
    - P303+P361+P353: IF ON SKIN: 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 continuously with water for several minutes. Remove contact lenses if present and easy to do. continue rinsing
    - P307+P311: IF exposed Call a POISON CENTER or doctor/physician.
  - Storage:
    - P406: Store in a corrosive resistant container with a resistant inner liner.
    - P405: Store locked up.
  - Disposal:
    - P501: Dispose of contents/container to in accordance with local/regional/ national/international regulations (to be specified).

NFPA

- health: **3** fire: **0** reactive: **1**

3. Composition/information on ingredients

Chemical Name	Common Name Synonyms	CAS number	Content (%)
Sodium hydroxide	Caustic Soda	1310-73-2	49.5 ~ 50.7 wt%
Water	Dihydrogen oxide, H_2O	7732-18-5	49.3 ~ 50.5 wt%
Sodium chloride	SALT(NaCl)	7647-14-5	<150ppm wt%
Sodium sulphate	Na_2S0_4	7757-82-6	<250ppm wt%
Iron oxide(Fe_2O_3)	-	1309-37-1	<10ppm wt%

4. First aid measures

Eye contact:

- In case of contact with substance, immediately flush eyes with running water for more than 20 minutes.
- Remove contact lenses if present and easy to do.
- Get medical attention immediately.

Skin contact:

- Removing contaminated clothing and shoes.
- In case of contact with substance, immediately flush skin with running water for more than 20 minutes.

Inhalation:

- Get medical attention immediately if irritation and symptoms persist.
- Move victim to fresh air.

Ingestion:

- Do NOT induce vomiting.
- To prevent airway obstruction while vomiting, maintain the position of the head lower than hips.
- If swallowed, immediately call a POISON CENTER or doctor/physician.

Acute and delayed symptoms/effects

- Inhalation: The human respiratory and airway are stimulated and lung edemas is caused.

- Skin contact: It caused corrosion and severe necrosis on skin.
- Eye contact: May cause severe demage and corrosion, conjunctivitis, corneal opacity.

Indication of immediate medical attention and notes for physician:

- Move victim to fresh air.
- Administer oxygen if breathing is difficult.
- Give artificial respiration if victim is not breathing.
- Keep victim warm and quiet.
- Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed.
- Get medical attention immediately if need.
- Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.
- Call 911 or emergency medical service.
- For minor skin contact, avoid spreading material on unaffected skin.
- 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 device.

5. Firefighting measures

Suitable (and unsuitable) extinguishing media

- Suitable extinguishing media: Dry chemical, CO_2, water spray or alcohol-resistant foam.
- unsuitable extinguishing media: Not available
- In case of major fire and large quantities:
  - Dry chemical, CO_2, water spray or alcohol-resistant foam.
  - Dike fire-control water for later disposal; do not scatter the material.
  - Move containers from fire area if you can do it without risk.

Tank/trailer/train truck fire:

- Fight fire from maximum distance or use unmanned hose holders or monitor nozzles.
- Cool containers with flooding quantities of water until well after fire is out.
- Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.
- ALWAYS stay away from tanks engulfed in fire.
- Do not get water inside containers.
- If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions.

Specific hazards arising from the chemical

- Thermal decomposition products:
  -Thermal decomposition may produce poisonous fume of the sodium hydroxide.
  -Substance will react with water (some violently) releasing toxic or corrosive gases and heating.
  -Contact with metals may evolve flammable hydrogen gas. So Be careful in fire control.

- Fires and an explosion
  - Non-combustible, substance itself does not burn but may decompose upon heating to produce corrosive and/or toxic fumes.

- Contact with metals may evolve flammable hydrogen gas.
- Containers may explode when heated.

Special protective equipment and precautions for fire-fighters

- Wear positive pressure self-contained breathing apparatus (SCBA).
- Wear chemical protective clothing that is specifically recommended by the manufacturer.It may provide little or no thermal protection.
- Structural firefighters' protective clothing provides limited protection in fire situations ONLY; it is not effective in spill situations where direct contact with the substance is possible.
- Use extinguishing agent suitable for type of surrounding fire.
- Cool containers for quite a long time until well after fire is out.
- Move containers from fire area if you can do it without risk.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures:

- For minor skin contact, avoid spreading material on unaffected skin.
- Ventilate enclosed areas.
- Stay upwind.
- Keep out of low areas.
- As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters (150 feet) for liquids and at least 25 meters (75 feet) for solids.
- CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.

Environmental precautions and protective procedures

- Atmosphere: Not available
- Land:
  -Move spreading material in isolated space (puddle, sandbag, barrier).
  -Cover powder spill with plastic sheet or tarp to minimize spreading and contact with water.
- Underwater:
  -Move container to safe place.
  -Absorb with non-combustible material.
  -Place into containers for later disposal.
  -Isolate the danger zone and restricted area.

The methods of purification and removal

- Small spill:
  - ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area).
  - Stop leak if you can do it without risk.
  - Prevent entry into waterways, sewers, basements or confined areas.
  - Do not get water inside containers.
  - Absorb with earth, sand or other non-combustible material and transfer to containers for later disposal.
- Large spill:

- When spilled over limited quantities, inform central government and local self -government.
- Isolate exposured area. Keep unauthorized personnel away.
- Make an embankment for further processing.

7. Handling and storage

Precautions for safe handling:

- Do not eat, drink or smoke in product area.
- Wash thoroughly after handling.
- Avoid contact with skin, clothing.
- Do not breathe gas/fumes/ vapor/spray.
- Wear face protection, protective clothing.

Conditions for safe storage:

- Avoid heat, sparks, flames.
- Store in a closed container.

8. Exposure controls/personal protection

Occupational Exposure limits

- Korean Occupation of Safety and Health Regulation : Ceiling-2mg/m^3
- ACGIH: Ceiling-2mg/m^3
- OSHA: TWA-2mg/m^3
- NIOSH: Ceiling-2mg/m^3, IDLH-10mg/m^3
- Biological exposure index : Not available
- EU Regulation: Netherlands: MAC-2mg/m^3, Denmark: MAK-2mg/m^3, The United Kingdom: OES-2mg/m^3

Appropriate engineering controls:

- Provide local exhaust ventilation system or other engineering controls to keep the airborne concentrations of vapours below their respective threshold limit value.
- Check legal suitability of exposure level.
- An eye wash unit and safety shower station should be available nearby work place.

Personal protective equipment

- Respiratory protection:
  -Wear NIOSH/MESA approved full or half face piece (with goggles) respiratory protective equipment.
  50ppm: powered, air-purifying respirator with a high-efficiency particulate filter, supplied-air respirator operated in a continuous-flow mode
  100ppm: self-contained breathing apparatus with a full facepiece, supplied-air respirator with a full facepiece, air-purifying, full-facepiece respirator with an N100, R100, or P100 filter.
  250ppm: supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:
Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter, appropriate escape-type, self-contained breathing apparatus

- Eye/Face protection:
  -An eye wash unit and safety shower station should be available nearby work place.
  -Wear facepiece with goggles to protect from scattering toxic substance.
- Hand protection: Wear chemical resistant gloves.
- Body protection: Wear appropriate protective chemical-resistant clothing.

9. Physical and chemical properties

Appearance: Liquid (colorless)

Odor: Odorless

Odor threshold: Not available

Tatse: just detect the existence of the stimulus

Taste threshold: Not available

pH: >14

Melting point/freezing point: 12 ~ 15°C

Initial boiling point and boiling range: 142°C /148°C(50%)

Flash point: Not available

Evaporation rate: Not available

Flammability : Not available

Upper/lower flammability or explosive limits: Not available

Vapor pressure: 1mmHg(739°C)

Vapor density: Not available

Relative density: Not available

Solubility (ies): 52%(20°C), 42%(0°C)

Specific gravity: 2.13(25°C)

Partition coefficient: n-octanol/water: logKow=-3.88 (estimated)

Auto ignition temperature: Not available

Decomposition temperature: Not available

Viscosity: 4.0 cP (350°C)

Molecular weight: 40 g/mol

10. Stability and reactivity

Chemical stability:
-Stable under normal temperatures and pressures.
-It may occur exothermic reaction, if it contact with water.

Possibility of hazardous reactions: No dangerous reaction known under conditions of normal use.

Conditions to avoid (e.g., static discharge, shock or vibration):

- Avoid heat, sparks, flames and other sources of ignition.
- Hazardous gas may accumulate in confined areas.
- May ignite or explode contact with combustibles.

Incompatible materials:

-Acetaldehyde: violent polymerization reaction
-Acetic acid: temperature and pressure rising if it mix in closed container
-Acetic anhydride: temperature and pressure rising if it mix in closed container
-Acid: violent reaction
-Acrolein: very violent polymerization reaction
-Allyl alcohol+ Benzenesulfonyl chlorides: explosion hazard
-Aryl chloride: hydrolysis
-Aluminium: violent reaction
-Aluminium+ Arsenic trioxide+Sodium arsenic: combustible hydrogen gas
-Acrylic nitrite: violent polymerization reaction
-Ammonia+ Lunar caustic: explosive lunar caustic is precipitated
-Ammonium salt: ammonia gas occurrence and violent reaction
-Benzen-1, 4- diol: exothermic reaction
-N.N'-bis(trinitroethyl)urea: explosive compound
-Bromine: it is explosive, if you don't stir
-Chlorine trifluoride: violent reaction
-Chloroform+ Methanol: exothermic reaction
-Chlorohydrin: temperature and pressure rising if it mix in closed container
-4-Chloro 2-Methyphenol: ignition possibility
-Chloronitrotoluene: explosive possibility
-Chloropicrin: violent reaction
-Sulfuric acid chloride: temperature and pressure rising if it mix in closed container
-Cinnamaldehyde: exothermic reaction
-Coating: attacked
-Copper: Solution is slowly corrosion
-Cyanogen azide: It produced explosive azidetetrazolamide.
-2,2-dichloro-3,3-dimethylbutane: explosion hazard
-1,2-dichloroethylene: ignitable monochloroacetylene
-2-boron+octanoloxime: exothermic reaction
-Ethylene cyanohydrins: temperature and pressure rising if it mix in closed container
-Combustible liquid: fire, explosion hazard
-Glycol: hydrogen gas occur to exothermic reaction

-Glyoxylic: temperature and pressure rising if it mix in closed container
-Halogenation hydrocarbon: violent reaction
-Soft acid: temperature and pressure rising if it mix in closed container
-Hydrofluoric acid: temperature and pressure rising if it mix in closed container
-Hydroquinone: violent decomposition reaction with heat
-Iron: Solution is slowly corrosion
-Lead: Hydrogen gas occur by damaged
-Maleic anhydride: violent decomposition reaction
-Metal: Corrosion of metal and ignitable hydrogen gas are occurred.
-4-methyl-2-nitrophenol: exothermic reaction
-Nitric acid: temperature and pressure rising if it mix in closed container
-Nitrobenzen: explosive reaction if it heat in water
-Nitroethane: It forming explosive salt.
-Nirtomethane: It forming explosive salt.
-Orthonitrotoluene: explosive
-Fuming sulfuric acid: temperature and pressure rising if it mix in closed container
-Organic peroxide: It don't put like that.
-Phenol: explosive
-Phosphorus: By oneself ignitable phosphide in air.
-Phosphorus pentoxide: violent reaction by heating
-Plastic: Demaged
-Propyleneoxide: ignition or explosive reaction
-Acid sodium borotetrahydride: included 15~10% Acid sodium borohydride sodium hydroxide occur explosively hydrogen (230~270°C)
-Sulfuric acid: temperature and pressure rising if it mix in closed container
-1,2,4,5-tetrachloridebenzene: violent reaction
-tetrachloridebenzene+methane: explosive
-tetrachlorideethylene: explosive
-Tin: hydrogen gas occurrence
-1,1,1-trichlorideethane: explosive
-Trichloronitromethane+methane: violent reaction
-Zirconium: explosive reaction in heating
-Zinc(dust): fire, explosive reaction

Hazardous decomposition products: Sodium oxide

11. Toxicological information

Information on the likely routes of exposure (inhalation, ingestion, skin and eye contact);

- Inhalation: The human respiratory and airway are stimulated and lung edemas is caused.
- Skin contact: It caused corrosion and severe necrosis on skin.
- Eye contact: May cause severe demage and corrosion, conjunctivitis, corneal opacity.

Symptoms related to the physical, chemical and toxicological characteristics

- Corrosive to Metals: Category 1
- Explosives, Water reactive substances, Oxidizing, Self-reactive substances, Organic peroxides: Not applicable (no relevance to molecular structure)
- Refer to "5) Acute and delayed symptoms/effects" of "4.First aid measures"

Symptoms related to the physical, chemical and toxicological characteristics;

- Acute toxicity:
  - oral: Category 4 LD_{50}= 325 mg/kg bw (Rabbit)
  - dermal: Category 4 LD_{50}= 1350 mg/kg bw (Rabbit)
  - Inhalation: Not available
- Skin Corrosion/ Irritation: Category 1
  -It is irritating to human skin and causes severe corrosion. It caused corrosion on pig skin and severe necrosis on rabbit skin.
- Serious Eye Damage/ Irritation: Category 1
  -Severe and serious hazard were caused to human's eye. Based on eye irritation tests with New Zealand White Albino rabbits, A concentration of 2% was irritating due to the mean score for conjunctivitis and the mean score for corneal opacity.
- Respiratory sensitizer: Not available
- Skin Sensitization: Not classified
  -Based on this study sodium hydroxide has no skin sensitisation potential.
- Carcinogenecity: Not classified
  -IARC, ACGIH, NTP, OSHA, Regulation 1272/2008, US EPA: not listed
  -No suitable studies are available to assess the risk on local carcinogenic effects.
- Mutagenicity: Not classified
  -*In vitro* -Ames reversion test (S. typhimurium): Negative
  -DNA-repair test (E.coli): Negative
  -*In vivo* -Micronucleus assay(rat bone marrow): Negative
- Reproductive toxicity: Not classified
  -Since there is the description that there is no useful data in Reproductive and developmental toxicity, it is considered as not to be classified because of insufficient data.
- Specific target organ toxicity (single exposure): Category 1
  -Based on the descriptions that the human respirator and airway are stimulated and lung edemas is caused. Also it was reported corrosion/erythema in faucal and eyes.
- Specific target organ toxicity (repeat exposure): Not available
  -It injures lungs in the repeated inhalation exposure of rats, it was presupposed not to be classified because of data deficiency.
- Aspiration Hazard: Not available

12. Ecological information

Aquatic Ecotoxicity

-Acute toxicity: Not classified
-Chronic toxicity: Not available

- Fish: 96hr-LC_{50} (*Oncorhynchus mykiss*) =45.4mg/l
- Crustacea: 48hr-EC_{50}(*Daphnia magna*) =40mg/l
- Algae: Not available

Persistence degradability:

- Persistence: Low persistency (Log Kow is less than 4 (logKow=-3.38) (estimated))
- Degradability: The estimated range of atmospheric half-life is 13 second.

Bioaccumulative potential:

- Bioaccumulation: Bioaccumulation is not expected according to the BCF<500 (BCF=3.162) (estimated)
- Biodegradation: Biodegradable (estimated)

Mobility in soil: Low potency of mobility to soil. (Koc values = 13.2L/kg)

13. Disposal considerations

1) Disposal method:

-Treat with reactions such as neutralization, oxidation, reduction. And Treat by the methods of cohesion, precipitation, filter and dehydration.
-Treat by methods of evaporation and condensation.
-Purify by methods of separation, distillation, extraction and filtration.
-Take a measure and make efforts to prevent hazard. (health center, police station, fire station etc.)

2) Disposal precaution:

-Incinerate waste(liquid state) such as neutralization. And landfill.
-Be careful and treat to unaffected eyes or body.

14. Transport information

UN Number: UN 1824

UN Proper shipping name: Sodium hydroxide, solution

Transport Hazard class: Class 8

Packing group: II

Marine pollutant: Not applicable

Special precautions

- in case of fire: F-A
- in case of lickage: S-B

15. Regulatory information

Korea:

-Occupational Safety and Health Regulation : Listed in occupational exposure assessment, Hazardous agent, Occupational exposure limits
-Toxic Chemical Control Act : Poison (97-1-136)
-Dangerous Material Safety Management Regulation : Not applicable
-Wastes Control Act : Public Controlled Waste (Waste alkali, 02-02-00)

EU classification:

- Classification: C; R35
- Risk phrases: R35

- Safety phrases: S1/2, S26, S37/39, S45
- EU REACH SVHC Free Certified(Candidate list Updated by ECHA on 30th March, 2010)

U.S.A management information

- **OSHA:** Not applicable
- **CERCLA:** RQ= 1000lbs
- **EPCRA 302:** Not applicable.
- **EPCRA 304:** Not applicable.
- **EPCRA 313:** Not applicable.

Substance of Roterdame Protocol: Not applicable.

Substance of Stockholme Protocol: Not applicable.

Substance of Montreal Protocol: Not applicable.

16. Other information

Information source and references:

-ECB:ESIS (European chemical Substances Information System) (http://ecb.jrc.it/esis)
-International Uniform Chemical Information Database (IUCLID) (http://ecb.jrc.it/esis)
-European Union Risk Assessment Report (RAR)
-Screening Information Data Set (SIDS)
-IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT (Multivolume work)., p. S7 216 (1987)
-REGULATION (EC) No 1272/2008 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2008
-Korea Occupational Health & Safety Agency: http://www.kosha.net
-U.S. National library of Medicine (NLM) Hazardous Substances Data Bank (HSDB): (http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB.htm)
-ECOTOX Database, EPA(http://cfpub.epa.gov/ecotox)
-http://www.safe.nite.go.jp/japan/sougou/data/pdf/hazard/hyokasyo/No-04_1.1.pdf
-http://ull.chemistry.uakron.edu/erd/(Akron)
-ACGIH, TLV and BEIs # 0108, 2008
-PATTY 4th, 1994
-Recommendation of Korean Society of Occupational and Environmental hygiene, 1993
-DFGOT vol.19, 2003
-Society for Occupational Health Recommendation of Occupational Exposure, 1993
-Waste Control Act enforcement regulation attached [1]
-Korea dangerous material inventory management system (http://hazmat.nema.go.kr)
-National chemicals information systems (http://ncis.nier.go.kr)

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