SAFETY DATA SHEET

Date Printed: January 20, 2022
Version: 5
Regulation: According to Regulation 2012 OSHA Hazard Communication Standard; 29 CFR Part 1910.1200

1. Identification

1.1 Product identifier
1.1.1 Product of name: VCM
1.1.2 Other means of identification: Chloroethylene

1.2 Recommended use of the chemical and restrictions on use
1.2.1 Recommended use: Raw materials and intermediates, solvents and extractants
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 (Wolha-dong), Yeosusandan 3-ro, Yeosu-si, Jeollanam-do, Korea
- Ulsan plant 1, Hanwha Solutions Co, Ltd., 141 (Sanggae-dong), Sanggae-ro, Nam-gu, Ulsan, Korea
- Ulsan plant 2, Hanwha Solutions Co, Ltd., 440-22 (Yeocheon-dong), Saneop-ro, Nam-gu, Ulsan, Korea

Prepared by: VCM Production Team
Contact Telephone: (Yeosu plant) +82-61-688-1724
(Ulsan plant) +82-52-279-2323

1.3.2 Supplier & Distributor
Company name: Hanwha Solutions Co, Ltd.
Address: 21F, Hanwha Bldg., 86 (Janggyo-dong), Cheonggyecheon-ro, Jung-gu, Seoul, Korea
Prepared by: CA Global Sales Team
Contact Telephone: +82-10-3484-9108

1.4 Emergency phone number
Emergency phone: +82-10-3484-9108

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:
Flammable gases: Category 1
Gases under pressure: Liquefied gas

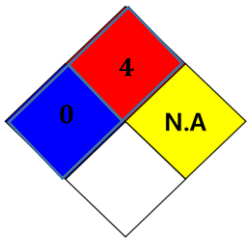
Health Hazards:
Mutagenicity: Category 2
Carcinogenicity: Category 1A

Environmental Hazards: Not classified

2.2 Label elements, including precautionary statements
o Pictogram and symbol:

o Signal word: Danger
o Hazard statements:
H220 Extremely flammable gas
H280 Contains gas under pressure; may explode if heated
H341 Suspected of causing genetic defects.
H350 May cause cancer.
o Precautionary statements:
- Prevention:
P201 Obtain, special instructions before use.
P202 Do not handle until all safety precautions have been read and understood.
P210 Keep away from heat,/sparks/open flames/hot surfaces. - No smoking.
P280 Wear protective gloves/protective clothing/eye protection/face protection/hearing protection.
P281 Use personal protective equipment as required.
- Treatment:
P308+P313 IF exposed or concerned: Get medical advice/attention.
P377 Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
P381 Eliminate all ignition sources if safe to do so.
- Storage:
P403 Store in a well-ventilated place.
P405 Store locked up.
P410+P403 Protect from sunlight. Store in a well-ventilated place.
- Disposal:
P501 Dispose of 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)



o Health: 0
o Flammability: 4
o Reactivity: Not available

3. Composition/information on ingredients

Component	Common name and synonyms	CAS No.	Conc. / %
Vinyl chloride	(Mono)chloroethene;	75-01-4	99.9

4. First aid measures

4.1 Description of first aid measures

Eye contact

- Call emergency medical service.
- In case of contact with substance, flush eyes with large amounts of water for at least 15 minutes.

Skin contact

- Remove and isolate contaminated clothing and shoes.
- In case of contact with substance, immediately flush skin or eyes with soap and water for at least 15

minutes.
- 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 contaminated clothing and shoes and isolate contaminated area.
- In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.
- For minor skin contact, avoid spreading material on unaffected skin.
- In case of contact with liquefied gas, thaw frosted parts with lukewarm water.

Inhalation
- Move victim to fresh air.
- If exposed or concerned: Get medical advice/ attention.
- Keep victim warm and quiet.
- 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.

Ingestion
- Rinse mouth immediately with water.
- If exposed or concerned: Get medical advice/ attention.
- 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.

4.2 Most important symptoms and effects, both acute and delayed effects
- Not known

4.3 Indication of immediate medical attention and notes for physician
- Exposures require specialized first aid with contact and medical follow-up.
- Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves .

5. Fire-fighting measures

5.1 Extinguishing media
- Suitable extinguishing media: alcohol foam, carbon dioxide, or water spray
- Use dry sand or earth to smother fire.
- Unsuitable extinguishing media: straight streams

5.2 Specific hazards arising from the chemical
- Extremely flammable gas
- Contains gas under pressure; may explode if heated.
- May decompose at high temperatures into forming toxic gases.
- May violently polymerize and result in fire and explosion.
- Containers may explode when heated.
- May form explosive mixtures with air.
- Will be easily ignited by heat, sparks or flames
- Vapors may travel to source of ignition and flash back.
- Cylinders exposed to fire may release flammable gas.
- Some of these materials, if spilled, may leave a flammable residue after evaporation.

5.3 Special protective equipment and precautions for fire-fighters
- Protective equipment to be worn in case of fire-fighters: fire protection clothing, heat protection clothing, oxygen mask
- Leaking gas fire: Do not extinguish, unless leak can be stopped safely.

- Eliminate all ignition sources if safe to do so.
- Rescuers should put on appropriate protective gear.
- Evacuate area and fight fire from a safe distance.
- Vapors from liquefied gas are initially heavier than air and spread along ground.
- Substance may be transported in a molten form.
- Ruptured cylinders may rocket.
- Do not extinguish leaking gas fires unless leak stops.
- Dike fire-control water for later disposal; do not scatter the material.
- 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.
- Damaged cylinders should be handled only by specialists.
- Use extinguishing agent suitable for type of surrounding fire.

6. Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

- Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
- The very fine particles may cause a fire or explosion, eliminate all ignition sources.
- Clean up spills immediately, observing precautions in Protective Equipment section.
- Keep unnecessary and unprotected personnel from entering.
- If possible, turn leaking containers so that gas escapes rather than liquid.
- Isolate area until gas has dispersed.
- Do not direct water at spill or source of leak.
- Eliminate all ignition sources.
- Use water spray to reduce vapors or divert vapor cloud drift. Avoid allowing water runoff to contact spilled material.
- All equipment used when handling the product must be grounded.
- Ventilate the area.
- Stop leak if you can do it without risk.
- Some of these materials, if spilled, may leave a flammable residue after evaporation.
- Do not touch damaged containers or spilled material unless wearing appropriate protective clothing.
- Cover with plastic sheet to prevent spreading.
- Please note that there are materials and conditions to avoid.

6.2 Environmental precautions

- Prevent entry into waterways, sewers, basements or confined areas.
- Prevent spreading of vapors through sewers, ventilation systems and confined areas.

6.3 Methods and materials for containment and cleaning up

- Dike and collect water used to fight fire.
- 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.

7. Handling and storage

7.1 Precautions for safe handling

- Handle only in a well-ventilated area.
- Do not handle until all safety precautions have been read and understood.
- Do not take contaminated clothing out of work area.

- Please work with reference to engineering controls and personal protective equipment.
- Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, static electricity, or other sources of ignition.
- 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.
- Take precautions against static electricity.
- Do not enter storage area unless adequately ventilated.
- All equipment used when handling the product must be grounded.
- Please note that there are materials and conditions to avoid.

7.2 Conditions for safe storage, including any incompatibilities

- Protect from sunlight. Store in a well-ventilated place and closed container
- Keep away from heat/sparks/open flames/hot surfaces. - No smoking
- Do not apply heat directly.
- Take precautions against static electricity.
- Store locked up
- Empty drums should be completely drained, properly bunged, and promptly returned to a drum reconditioner, or properly disposed of.
- Containers can build up pressure if exposed to heat (fire).

8. Exposure controls/personal protection

8.1 Occupational Exposure limits

o ACGIH regulation: TWA 1 ppm
o OSHA regulation: TWA 1 ppm (Final PELs), STEL 5 ppm (Final PELs)
o NIOSH regulation: Not available
o Biological exposure index: Not available
o EU regulation: TWA 1 ppm; 2.6 mg/m^3
o Other:
- Korea : TWA 1 ppm
- China : TWA 10 mg/m^3
- Australia : TWA 5 ppm; 13 mg/m^3
- Belgium : TWA 3 ppm; 7.77 mg/m^3
- Demark : TWA 1 ppm; 2.6 mg/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.

Individual protection measures, such as personal protective equipment

Respiratory protection

- Wear NIOSH approved full or half face piece (with goggles) respiratory protective equipment when necessary.
- In case exposured to gaseous/liquid material, the respiratory protective equipments as follow are recommended.
- In lack of oxygen(< 19.5%), wear the supplied-air respiratior or self-contained breathing apparatus oxygen.

Eye protection

- Wear enclosed safety goggles to protect from gaseous state organic material causing eye irritation or other disorder.
- An eyewash unit and safety shower station should be available nearby work place.

Hand protection

- Wear appropriate protective gloves by considering physical and chemical properties of chemicals.

Body protection
- Wear appropriate protective clothing by considering physical and chemical properties of chemicals.

9. Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance	
Description:	Gas
Color:	Colorless
Odor:	Sweet odor
Odor threshold:	250ppm
pH:	Not available
Melting point/freezing point:	-153.8°C (1013hPa)
Initial boiling point and boiling range:	-14°C (1013hPa)
Flash point:	-78°C (open-cup)
Evaporation rate:	Not available
Flammability (solid, gas):	Flammable gas
Upper/lower flammability or explosive limits:	UEL 33% / LEL 3.6%
Vapor pressure:	2,980mmHg (25°C)
Vapor density:	2.15 (Air=1)
Relative density	0.9106(20°C)
Solubility:	9.15g/L(20°C)
Solubility in organic solvents:	Not available
Partition coefficient: n-octanol/water:	Log Kow=1.58(22°C)
Auto ignition temperature:	472°C (1013hPa)
Decomposition temperature:	450°C
Viscosity:	0.01072cP (20 °C)
Molecular weight:	62.5 g/mol
Particle Size (Polymer compound)	Not applicable
Self-accelerated decomposition temperature (Polymer compound)	Not applicable

"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:

- Material may produce irritating and highly toxic gases from decomposition by heat and combustion during burning.
- May violently polymerize and result in fire and explosion.
- May form explosive mixtures with air.
- Will be easily ignited by heat, sparks or flames
- Vapors may travel to source of ignition and flash back.
- Vapors may cause dizziness or suffocation without awareness.
- Extremely flammable gas
- Contains gas under pressure; may explode if heated.
- Containers may explode when heated.
- Cylinders exposed to fire may release flammable gas.

10.2 Conditions to avoid:

- Keep away from heat/sparks/open flames/hot surfaces. – No smoking
- Do not apply heat directly.

10.3 Incompatible materials:

- Combustibles, reducing agents

10.4 Hazardous decomposition products:

- Corrosive and/or toxic fume
- Irritating, corrosive and/or toxic gases

11. Toxicological information

Information on toxicological effects	
(a) Acute toxicity	
Oral	Not classified
	· LD_{50} (rat, female/male) > 4,000 mg/kg bw (OECD TG 401)
Dermal	Not available
Inhalation	Not classified
	· LC_{50} (rat) = 390 mg/L air/2h (Krakov's method)
(b) Skin Corrosion/ Irritation	Not available
(c) Serious Eye Damage/ Irritation	Not available
(d) Respiratory sensitization	Not available
(e) Skin Sensitization	Not available
(f) Carcinogenicity	Category 1A
	· IARC : Group 1 (Carcinogenic to Humans) · US EPA IRIS : A (Human carcinogen) · NTP : K (Known Human Carcinogen) · OSHA : applicable · ACGIH : A1 (Confirmed Human Carcinogen) · NIOSH : potential occupational carcinogen · EU CLP 1272/2008: Carc. 1A · Mortality through December 31, 1995 was followed in a cohort of 10,109 men who had been occupationally exposed to vinyl chloride between 1942 and 1972 at any one of 37 facilities (17 companies) in the United States or Canada. The incidence of cancer in the digestive system and brain was found to be significantly high. · As a result of a carcinogenicity (oral) test in rats (female/male) through oral route, the occurrence of hepatocellular carcinoma and angiosarcoma were reported. NOAEL = 0.13 mg/kg bw/day (OECD TG 453) · As a result of a carcinogenicity (inhalation) test in rats (female/male) through inhalation route, the occurrence of bronchoalveolar, mammary gland tumor, and lung and liver angiosarcoma was reported. · A cohort study of workers in the vinyl chloride industry in the United States and Europe that has been extensively studied over the past 25 years has found an

	increased incidence of angiosarcoma in occupationally exposed humans.
(g) Mutagenicity	Category 2
	· *In vitro*: Bacterial Reverse Mutation Assay : positive with/without metabolic activation (OECD TG 471) · *In vitro*: Mammalian Chromosome Aberration Test: positive with/without metabolic activation · *In vivo*: Micronucleus test : positive (OECD TG 474) · *In vivo*: Rodent Dominant Lethal Test : negative
(h) Reproductive toxicity	Not classified
	· No developmental or reproductive toxicity was observed even at the highest concentration tested in the two-generation reproductive toxicity test (OECD TG 416) and teratogenicity test (OECD TG 414) using rats. NOAEL (reproductive toxicity, inhalation) >= 1,100 ppm, NOAEL (developmental toxicity, inhalation) >= 2,500 ppm
(i) Specific target organ toxicity (single exposure)	Not classified
	· As a result of an acute inhalation toxicity test at a concentration of 225-500 mg/L in rats, contractions, convulsions, respiratory irritation, salivation, and lacrimation were observed, and hyperemia was observed in all organs. (Affected organs : lung, liver, kidney) (Krakov's method)
(j) Specific target organ toxicity (repeat exposure)	Not classified
	· As a result of subchronic oral administration test for 13 weeks at concentrations of 0, 30, 100, and 300 mg/kg using rats, decreased white blood cells and blood sugar, decreased GOT & GPT serum and GOT urine, increased liver and adrenal weight, liver Hypertrophy of the endoplasmic reticulum etc. was observed. (OECD TG 408)
(k) Aspiration Hazard	Not available

12. Ecological information

12.1 Toxicity	
Acute toxicity	Not classified
	· Fish: 96h-LC_{50} (*Brachydanio rerio*)= 210 mg/L (semi-static) (OECD TG 203) · Invertebrate: 48h-LC_{50} (Daphnia magna) = 196 mg/L (static) (ECOSAR 2001) · Algae: 48h-EC_{50} (Anacystis aeruginosa) = 118 mg/L (static) (ECOSAR modeling)
Chronic toxicity	Not classified
	· Vinyl chloride has high water solubility but is a highly volatile gas, and it is highly unlikely to exist in aquatic concentrations at high concentrations, and all acute toxicity values exceed 100 mg/L. Therefore, further evaluation of chronic aquatic toxicity is not required.
12.2 Persistence and degradability	· As a result of testing on microorganisms adapted to vinyl chloride, it was confirmed to be readily biodegradable. (93% degradable (measured value)) (Measure the amount of vinyl chloride entering and exiting the closed bottle) · Vinyl chloride exists in the atmosphere more than 99% when exposed to the environment as a gas at room temperature and is removed from the atmosphere through photooxidation. (DT50 = 2.2-2.7 day)

12.3 Bio-accumulative potential	· log P_{ow} = 1.58 (22 °C) · BCF = 5.471 L/kg (estimated) (EPISUITE)
12.4 Mobility in soil	· K_{oc} = 56 -
12.5 Results of PBT and vPvB assessment	· The subsance is not PBT / vPvB.
12.6 Hazardous to the ozone layer	Not classified
12.7 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.: 1086

14.2 UN Proper shipping name: VINYL CHLORIDE, STABILIZED

14.3 Transport Hazard class:

· ADR: 2.1
· IMDG: 2.1
· ICAO/IATA: 2.1
· RID: 2.1

14.4 Packing group: Not applicable

14.5 Environmental hazards: Not applicable

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

14.7 Special precautions for user

in case of fire: F-D
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): Section8 (b) inventory: Present (ACTIVE)
Proposition 65: carcinogen, 2/27/1987
OSHA Regulation: Regulated
CERCLA Regulation: 1 lb final RQ; 0.454 kg final RQ
SARA 302 Regulation: Not regulated
SARA 304 Regulation: Not regulated

SARA 313 Regulation: 0.1 % de minimis concentration

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-05651)
  Phase-in substance subject of registration (26)
  Toxic chemical (2001-1-519) (Vinyl chloride and mixtures containing 0.1% or more thereof)
  Accident precaution chemicals (9) (Vinyl chloride and mixtures containing 0.1% or more thereof)
- European Inventory of Existing Commercial chemical Substances (EINECS): Present (200-831-0)
- Canada management information: Domestic Substances List (DSL): Present
- China management information: Inventory of Existing Chemical Substances (IECSC): Present (24724)
- Japan management information: Existing and New Chemical Substances (ENCS): Present ((2)-102)
- Australia management information: Inventory of Chemical Substances (AICS): Present
- New Zealand management information: Inventory of Chemicals (NZIoC): Present
  (HSNO Approval: HSR001016)
- Philippines management information: Inventory of Chemicals and Chemical Substances (PICCS): Present
- Taiwan management information: Taiwan Chemical Substance Inventory (TCSI): Present

16. OTHER INFORMATION

16.1 Indication of changes:

Preparation date: June 20, 2016
Version: 5
Revision date: January 20, 2022

16.2 Key literature reference and sources for data:

- TSCA; http://iaspub.epa.gov/sor_internet/registry/substreg/searchandretrieve/searchbylist/search.do
- EU Regulation 1272/2008
- TOMES;LOLI ; http://csi.micromedex.com/fraMain.asp?Mnu=0
- UN Recommendations on the transport of dangerous goods 17th
- IARC Monographs on the Evaluation of Carcinogenic Risks to Humans; http://monographs.iarc.fr
- ECHA CHEM; http://echa.europa.eu/web/guest/information-on-chemicals/registered-substances
- OECD SIDS; http://webnet.oecd.org/
- HSDB; https://pubchem.ncbi.nlm.nih.gov/
- EPA; http://www.epa.gov/iris
- EPISUITE Program ver.4.1
- NIOSH(The National Institute for Occupational Safety and Health)
- ACGIH(American Conference of Governmental Industrial Hygienists)
- National chemicals information systems; http://ncis.nier.go.kr
- National Emergency Management Agency-Korea dangerous material inventory management system; http://hazmat.mpss.kfi.or.kr/material.do
- K-REACH; K-REACH/registration-dossier

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.