Qualitative risk assessment

The following areas are covered under Qualitative Risk Analysis.

FOLLOWING ARE MSDS OF MAJOR CHEMICALS WHICH WILL BE HANDLED AT THE PLANT SITE.

1.1.1 AMMONIA

SECTION 1. PRODUCT IDENTIFICATION
PRODUCT NAME: Ammonia
CHEMICAL NAME: Ammonia **FORMULA:** NH3
SYNONYMS: Ammonia, Anhydrous

SECTION 2. COMPOSITION / INFORMATION ON INGREDIENTS
Ammonia is sold as pure product (>99%).
CAS NUMBER: 7664-41-7
EXPOSURE LIMITS:
OSHA: PEL = 50 ppm **ACGIH:** TLV/TWA = 25 ppm **NIOSH:** IDLH = 300 ppm
TLV-STEL = 35 ppm

SECTION 3. HAZARD IDENTIFICATION
EMERGENCY OVERVIEW
Anhydrous Ammonia is an irritating, flammable, and colorless liquefied compressed gas packaged in cylinders under its own vapor pressure of 114 psig at 70 _F. Ammonia can cause severe eye, skin and respiratory tract burns. It poses an immediate fire and explosion hazard when concentrations exceed 15%; therefore, area must be ventilated before entering. Wear self-contained breathing apparatus (SCBA) when entering release area if concentrations exceed allowable exposure limits. Fully protective suits are required in large releases. Always be aware of fire and explosion potential in the case of large releases.
ACUTE POTENTIAL HEALTH EFFECTS:
ROUTES OF EXPOSURE:
EYE CONTACT: Exposure to Ammonia can cause moderate to severe eye irritation.
INGESTION: Ingestion is not a likely route of exposure for Ammonia.
INHALATION: Ammonia is severely irritating to nose, throat, and lungs. Symptoms may include burning sensations, coughing, wheezing, shortness of breath, headache and nausea. Overexposure may also cause central nervous system effects including unconsciousness and convulsions. Upper irway damage is more likely and can result in bronchospasm (closing of the airway). Vocal chords are particularly vulnerable to corrosive effects of high

concentrations. Lower airway damage may result in fluid build up and hemorrhage. Death has occurred following a 5 minute exposure to 5000 ppm.

SKIN CONTACT: Vapor contact may cause irritation and burns. Contact with liquid may cause freezing of the tissue accompanied by corrosive caustic action and dehydration.

POTENTIAL HEALTH EFFECTS OF REPEATED EXPOSURE:

ROUTE OF ENTRY: Inhalation, eye or skin contact

SYMPTOMS: Repeated or prolonged skin exposure may cause dermatitis.

TARGET ORGANS: Eyes, skin, central nervous and respiratory systems.

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: Conditions generally aggravated by exposure include asthma, chronic respiratory disease (e.g., emphysema), dermatitis and eye disease.

CARCINOGENICITY: Ammonia is not listed as a carcinogen or potential carcinogen by NTP, IARC, or OSHA.

SECTION 4. FIRST AID MEASURES

EYE CONTACT: Flush eyes with large quantities of water. Seek medical attention immediately.

INGESTION: Ingestion is not a likely route of exposure for Ammonia.

INHALATION: Remove person to fresh air. If not breathing, administer artificial respiration. If breathing is difficult, administer oxygen. Obtain prompt medical attention.

SKIN CONTACT: Flush affected area with large quantities of water. Remove contaminated clothing immediately. If liquid comes in contact with skin, remove contaminated clothing and flush with plenty of lukewarm water for several minutes. Seek medical attention immediately.

NOTE TO PHYSICIAN: Bronchospasm may be treated with the use of a bronchodialator such as albuterol and an anticholinergic inhalant such as Atrovent.

SECTION 5. FIRE FIGHTING MEASURES

FLASH POINT: AUTOIGNITION: FLAMMABLE RANGE:

Not applicable 1204 °F (651 _C) 16% - 25%

EXTINGUISHING MEDIA: Dry chemical, carbon dioxide or water.

SPECIAL FIRE FIGHTING INSTRUCTIONS: Evacuate all personnel from area. If possible without risk, stop the flow of Ammonia, then fight fire according to types of materials that are burning. Extinguish fire only if gas flow can be stopped. This will avoid possible accumulation and re-ignition of a flammable gas mixture. If possible, move adjacent cylinders away from fire area. Keep adjacent cylinders cool by spraying with large amounts of water until the fire burns itself out. Self-contained breathing apparatus (SCBA) may be required.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Most cylinders are designed to vent contents when exposed to elevated temperatures. Pressure in a cylinder can build up due to heat and it may rupture if pressure relief devices should fail to function. Runoff from firefighting may be contaminated; check pH. Ammonia can form explosive compounds when combined with mercury.

HAZARDOUS COMBUSTION PRODUCTS: Oxides of nitrogen

SECTION 6. ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED: Evacuate immediate area. Eliminate any possible sources of ignition, and provide maximum explosion-proof ventilation. Shut off source of leak if possible. Isolate any leaking cylinder. If leak is from container, pressure relief device or its valve, contact your supplier. If the leak is in the user's system, close the cylinder valve, safely vent the pressure, and purge with an inert gas before attempting repairs. Ammonia vapors can be controlled with water spray, however; runoff may be contaminated. Releases that exceed 100 lbs (45.4 kgs) during a 24- hour period must be reported. All responders must be adequately protected from exposure. Levels of Ammonia should be below levels listed in Section 2 (Composition / Information on Ingredients) and the atmosphere must have at least 19.5% oxygen before personnel can be allowed in the area without self-contained breathing apparatus (SCBA).

SECTION 7. HANDLING AND STORAGE

STORAGE: Store cylinders in a well-ventilated, secure area, protected from the weather. Cylinders should be stored upright with valve outlet seals and valve protection caps in place. There should be no sources of ignition. All electrical equipment should be explosion-proof in the storage areas. Storage areas must meet National Electrical Codes for class 1 hazardous areas. Flammable storage areas should be separated from oxygen and other oxidizers by a minimum distance of 20 ft. or by a barrier of noncombustible material at least 5 ft. high having a fire resistance rating of at least ½ hour. Ammonia cylinders should not be stored near acids or acid-forming gases. Post "No Smoking or Open Flames" signs in the storage or use areas. Do not allow storage temperature to exceed 125 _F (52 _C). Storage should be away from heavily traveled areas and emergency exits. Full and empty cylinders should be segregated. Use a first-in first-out inventory system to prevent full containers from being stored for long periods of time. Caution: Ammonia cylinders are subject to theft and misuse. Cylinders should be stored and used in controlled areas.

HANDLING: Do not drag, roll, slide or drop cylinder. Use a suitable hand truck designed for cylinder movement. Never attempt to lift a cylinder by its cap. Secure cylinders at all times while in use. Use a pressure reducing regulator or separate control valve to safely discharge gas from cylinder. Use a check valve to prevent reverse flow into cylinder. Never apply flame or localized heat directly to any part of the cylinder. Do not allow any part of the cylinder to exceed 125 _F (52 _C). Once cylinder has been connected to properly purged and inerted process, open cylinder valve slowly and carefully. If user experiences any difficulty operating cylinder valve, discontinue use and contact supplier. Never insert an object (e.g., wrench, screwdriver, etc.) into valve cap openings. Doing so may damage valve causing a leak to occur. Use an adjustable strap-wrench to remove over-tight or rusted caps. All piped systems and associated equipment must be grounded. Electrical equipment should be non-sparking or explosion-proof. Only a recommended CGA connection should be used. Adapters should not be used. Use piping and equipment adequately designed to withstand pressures to be encountered. If liquid product is being used, ensure steps have been taken to prevent entrapment of liquid in closed systems. The use of pressure relief devices may be necessary. Dedicated inert gas cylinders with in line back-flow protection should be used for purging.

SPECIAL REQUIREMENTS: Always store and handle compressed gases in accordance with Compressed Gas Association, Inc. (ph.703-979-0900) pamphlet CGA P-1, *Safe Handling of Compressed Gases in Containers.* Local regulations may require specific equipment for storage or use.

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS:

VENTILATION: Provide adequate natural or mechanical ventilation to maintain Ammonia concentrations below exposure limits.

RESPIRATORY PROTECTION:

Emergency Use: Self-contained breathing apparatus (SCBA) or positive pressure airline with full face mask with escape pack should be worn in areas of a large release or unknown concentration.

EYE PROTECTION: Safety glasses for handling cylinders. Chemical goggles with full faceshield for connecting, disconnecting or opening cylinders.

SKIN PROTECTION: Leather gloves for handling cylinders. Rubber or Neoprene gloves, and chemical resistant outergarment should be worn when connecting or disconnecting cylinders. Total encapsulating chemical suit may be necessary in large release area. Fire resistant suit and gloves in emergency situations.

OTHER PROTECTIVE EQUIPMENT: Safety shoes are recommended when handling cylinders. Safety shower and eyewash fountain should be readily available.

CAUTION: Contact with cold, evaporating liquid on gloves or clothing may cause cryogenic burns or frostbite. Cold temperatures may also cause embrittlement of PPE material resulting in breakage and exposure.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE, ODOR AND STATE: Colorless gas with a sharp, strong odor similar to "smelling salts" which is readily detectable at 20 ppm

MOLECULAR WEIGHT: 17.0

BOILING POINT (1 atm): -28.1 _F (-33.4 _C)

SPECIFIC GRAVITY (air=1): 0.59

FREEZING POINT / MELTING POINT: -107.9 _F (-77.7 _C)

VAPOR PRESSURE (At 70 _F (21.1 _C)): 114.4 psig

GAS DENSITY (At 70 _F (21.1 _C) and 1 atm): 0.045 lb/ft3

SOLUBILITY IN WATER (vol./vol. at 68 °F): 0.848

SECTION 10. STABILITY AND REACTIVITY

CHEMICAL STABILITY: Stable

CONDITIONS TO AVOID: High temperatures (greater than 800 °F (426 _C)). Cylinders should not be exposed to temperatures in excess of 125 _F (52 _C).

INCOMPATIBILITY (Materials to Avoid): Copper, silver, cadmium and zinc and their alloys; mercury, tin, acids, alcohols, aldehydes, halogens and oxidizers.

REACTIVITY:

A) HAZARDOUS DECOMPOSITION PRODUCTS: Hydrogen at high temperatures.

B) HAZARDOUS POLYMERIZATION: Will not occur

SECTION 11. TOXICOLOGICAL INFORMATION

LC50 (Inhalation): 7338 - 11590 ppm (rat, 1 hour); 2000 ppm (rat, 4 hours)

LD50 (Oral): Not applicable

LD50 (Dermal): Not applicable

SKIN CORROSIVITY: Ammonia is corrosive to the skin.

ADDITIONAL NOTES: Rats exposed continuously to 180 ppm Ammonia for 90 days did not show any abnormalities of organs or tissues. Mild nasal irritation was observed in 12 out of 49 rats exposed to 380 ppm Ammonia. At 655 ppm Ammonia, 32 out of 51 rats died by day 25 of exposure and 50 out of 51 rats had died after 65 days of exposure.

SECTION 12. ECOLOGICAL INFORMATION
AQUATIC TOXICITY: Currently, the following aquatic toxicity data are available for Ammonia: Daphnia magna (48 hour) LC50 = 189 mg/l
Rainbow trout (24 hour) LC50 = 0.97 mg/l
Fathead minnow (96 hour) LC50 = 8.2 mg/l
MOBILITY: Not available
PERSISTENCE AND BIODEGRADABILITY: Not available
POTENTIAL TO BIOACCUMULATE: Not available
REMARKS: Do not release large amounts of Ammonia to the atmosphere. It does not contain any Class I or Class II ozone depleting chemicals.

SECTION 13. DISPOSAL CONSIDERATIONS
UNUSED PRODUCT / EMPTY CYLINDER: Return cylinder and unused product to supplier. Do not attempt to dispose of unused product.
DISPOSAL: Small amounts of Ammonia may be disposed of by discharge into water. A ratio of ten parts water to one part Ammonia should be sufficient for disposal. The subsequent solution of ammonium hydroxide can be neutralized and should be properly disposed of in accordance with regulations.

1.1.2 Diethylene Amine

SECTION 1: Identification of the substance
1.1 Product identifiers
Product name : Ethylenediamine
CAS-No. : 107-15-3
1.2 Relevant identified uses of the substance or mixture and uses advised against
Identified uses : Laboratory chemicals, Manufacture of substances
1.3 Details of the supplier of the safety data sheet
Company : Sigma-Aldrich Chemical Pvt Limited
Industrial Area, Anekal Taluka
Plot No 12,
12 Bommasandra - Jigani Link Road
560100 BANGALORE
INDIA
1.4 Emergency telephone number
Emergency Phone # : +91 98802 05043
SECTION 2: Hazards identification
2.1 Classification of the substance or mixture
Classification according to Regulation (EC) No 1272/2008
Flammable liquids (Category 3), H226
Acute toxicity, Oral (Category 4), H302
Acute toxicity, Inhalation (Category 4), H332
Acute toxicity, Dermal (Category 3), H311
Skin corrosion (Category 1B), H314
Respiratory sensitisation (Category 1), H334
Skin sensitisation (Category 1), H317
Chronic aquatic toxicity (Category 3), H412
For the full text of the H-Statements mentioned in this Section, see Section 16.
2.2 Label elements

Labelling according Regulation (EC) No 1272/2008

Pictogram

Signal word Danger

Sigma-Aldrich **-** E26266 Page 2 of 8

Hazard statement(s)

H226 Flammable liquid and vapour.

H302 + H332 Harmful if swallowed or if inhaled

H311 Toxic in contact with skin.

H314 Causes severe skin burns and eye damage.

H317 May cause an allergic skin reaction.

H334 May cause allergy or asthma symptoms or breathing difficulties if inhaled.

H412 Harmful to aquatic life with long lasting effects.

Precautionary statement(s)

P261 Avoid breathing vapours.

P273 Avoid release to the environment.P280 Wear protective gloves/ protective clothing/ eye protection/ face protection.

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/doctor.

2.3 Other hazards

This substance/mixture contains no components considered to be either persistent, bioaccumulative and

toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

Rapidly absorbed through skin.

Lachrymator.

SECTION 3: Composition/information on ingredients

3.1 Substances

Synonyms : 1,2-Diaminoethane

Formula : C<SB>2</>H<SB>8</>N<SB>2</>

Molecular weight : 60.10 g/mol

CAS-No. : 107-15-3

EC-No. : 203-468-6

Index-No. : 612-006-00-6

Hazardous ingredients according to Regulation (EC) No 1272/2008

SECTION 4: First aid measures

4.1 Description of first aid measures

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Take off contaminated clothing and shoes immediately. Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed

No data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture

Carbon oxides, Nitrogen oxides (NOx)

Flash back possible over considerable distance., Container explosion may occur under fire conditions., Vapours may form explosive mixture with air.

5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information

Use water spray to cool unopened containers.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Wear respiratory protection. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist. Keep away from sources of ignition - No smoking.Take measures to prevent the build up of electrostatic charge.

7.2 Conditions for safe storage, including any incompatibilities

Store in cool place. Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage. Air and moisture sensitive. Handle and store under inert gas.

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

8.2 Exposure controls

Appropriate engineering controls

Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

Personal protective equipment

Eye/face protection

Tightly fitting safety goggles. Faceshield (8-inch minimum). Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands. The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.

Body Protection

Complete suit protecting against chemicals, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use (US) or type ABEK (EN 14387) respirator cartridges as a backup to enginee protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a) Appearance Form: liquid
b) Odour No data available
c) Odour Threshold No data available
d) pH 12.2 at 110 g/l at 20 °C
e) Melting point/freezing point
Melting point/range: 8.5 °C
f) Initial boiling point and
boiling range 118 °C
g) Flash point 38 °C - closed cup
h) Evaporation rate No data available
i) Flammability (solid, gas) No data available
j) Upper/lower flammability or explosive limits
Upper explosion limit: 16 %(V)
Lower explosion limit: 2.7 %(V)
k) Vapour pressure 10 mmHg at 20 °C
l) Vapour density 2.07 - (Air = 1.0)
m) Relative density 0.899 g/mL at 25 °C
n) Water solubility soluble
o) Partition coefficient: noctanol/water
p)

9.2 Other safety information

Relative vapour density 2.07 - (Air = 1.0)

SECTION 10: Stability and reactivity

10.1 Reactivity No data available

10.2 Chemical stability

Absorbs carbon dioxide (CO2) from air. Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions

No data available

10.4 Conditions to avoid

Air Exposure to moisture Heat, flames and sparks.

10.5 Incompatible materials

Oxidizing agents, Phosphorus halides, Aldehydes, Organic halides

10.6 Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Carbon oxides, Nitrogen oxides (NOx) Other decomposition products - No data available

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity LD50 Oral - Rat - 1,200 mg/kg(Ethylenediamine)
Remarks: Behavioral:Ataxia. LC50 Inhalation - Rat - 4 h - 14.7 mg/l(Ethylenediamine)
LD50 Dermal Dermal - Rabbit - 560 mg/kg(Ethylenediamine)

Skin corrosion/irritation

Skin - Rabbit(Ethylenediamine) Result: Causes burns.

Serious eye damage/eye irritation

Eyes - Rabbit(Ethylenediamine)
Result: Corrosive

Respiratory or skin sensitisation

Maximisation Test - Guinea pig(Ethylenediamine)
Result: Causes sensitisation.
May cause allergic respiratory and skin reactions

Germ cell mutagenicity

No data available(Ethylenediamine)

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

Reproductive toxicity

No data available(Ethylenediamine)

Specific target organ toxicity - single exposure

No data available(Ethylenediamine)

Specific target organ toxicity - repeated exposure

No data available

Aspiration hazard

No data available(Ethylenediamine)

Additional Information

RTECS: KH8575000
Vomiting, Diarrhoea, Abdominal pain, To the best of our knowledge, the chemical, physical, and
toxicological properties have not been thoroughly investigated.(Ethylenediamine)
Liver - Irregularities - Based on Human Evidence(Ethylenediamine)

SECTION 12: Ecological information

12.1 Toxicity

Toxicity to fish LC50 - Pimephales promelas (fathead minnow) - 115.7 mg/l - 96 h(Ethylenediamine)
Toxicity to daphnia and other aquatic invertebrates
EC50 - Daphnia magna (Water flea) - 3 mg/l - 48 h(Ethylenediamine)
NOEC - Daphnia magna (Water flea) - 0.16 mg/l - 21 d(Ethylenediamine)
Toxicity to algae EC50 - Pseudokirchneriella subcapitata (green algae) - 151 mg/l - 96 h(Ethylenediamine)

12.2 Persistence and degradability

Biodegradability Biotic/Aerobic - Exposure time 28 d(Ethylenediamine)
Result: 94 % - Readily biodegradable

12.3 Bioaccumulative potential

No data available

12.4 Mobility in soil

No data available(Ethylenediamine)

12.5 Results of PBT and vPvB assessment

This substance/mixture contains no components considered to be either persistent, bioaccumulative and
toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

12.6 Other adverse effects

Toxic to aquatic life. Avoid release to the environment.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product

Burn in a chemical incinerator equipped with an afterburner and scrubber b highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company.

Contaminated packaging

Dispose of as unused product.

1.1.3 FURNACE OIL

Material Safety Data Sheet : FURNACE OIL

1. Product and company identification

Product name Fuel oil, residual Fuel oil

Product use Fuel for industrial, marine and commercial boilers and furnaces; fuel for low and medium speed diesel engines. For specific application advice see appropriate Technical Data Sheet or consult our company representative.

2. Hazards identification

Physical state color Dark Brown. / Black.

Emergency overview WARNING !

COMBUSTIBLE LIQUID AND VAPOR.

HARMFUL IF SWALLOWED. INHALATION CAUSES HEADACHES, DIZZINESS, DROWSINESS AND NAUSEA AND MAY LEAD TO UNCONSCIOUSNESS. HARMFUL ON PROLONGED OR REPEATED INHALATION. VAPOR MAY CONTAIN HYDROGEN SULFIDE (H2S) GAS WHICH CAN BE HARMFUL OR FATAL IF INHALED. MAY CAUSE RESPIRATORY TRACT, EYE AND SKIN IRRITATION. CONTAINS MATERIAL THAT

CAN CAUSE TARGET ORGAN DAMAGE. SUSPECT CANCER HAZARD - CONTAINS MATERIAL WHICH MAY CAUSE CANCER. HEATED MATERIAL CAN CAUSE THERMAL BURNS.

Combustible liquid. Harmful if swallowed. Prolonged or repeated contact can defat the skin and lead to irritation and/or dermatitis. Keep away from heat, sparks and flame. Avoid exposure - obtain special instructions before use. Do not breathe vapor or mist. Do not ingest. Avoid contact with eyes, skin and clothing. Contains material that can cause target organ damage. Contains material which may cause cancer. Risk of cancer depends on duration and level of exposure. Use only with adequate ventilation. Keep container tightly closed and sealed until ready for use. Wash thoroughly after handling.

Routes of entry Dermal contact. Eye contact. Inhalation.
Potential health effects Eyes May cause eye irritation. Heated material can cause thermal burns.
Skin May cause skin irritation. Harmful in contact with skin. Prolonged or repeated contact can defat the skin and lead to irritation and/or dermatitis. Possible cancer hazard based on skin painting studies in laboratory animals. Heated material can cause thermal burns.
Inhalation Vapors may cause drowsiness and dizziness. Can cause central nervous system (CNS) depression. May cause respiratory tract irritation. Vapor may contain hydrogen sulfide (H_2S) gas which can be harmful or fatal if inhaled.
Ingestion Harmful if swallowed.

3. Composition/information on ingredients
Ingredient name CAS # % Fuel oil, residual 68476-33-5 100
Contains: Sulfur 7704-34-9 0 - 4
Naphthalene 91-20-3 0.1 - 3
Ethylbenzene 100-41-4 0.1 - 0.5
Polycyclic aromatic hydrocarbons (PAHs) mixture 0 - 0.1
Hydrogen Sulfide 7783-06-4 Trace
The liquid product from various refinery streams, usually residues. The composition is complex and varies with the source of the crude oil.

4. First aid measures
Eye contact Cold product - Wash eye thoroughly with copious quantities of water, ensuring eyelids are held open. Obtain medical advice if any pain or redness develops or persists. Hot product - Flood with water to dissipate heat. In the event of any product remaining, do not try to remove it other than by continued irrigation with water. Obtain medical attention immediately.
Skin contact Cold Product - Wash contaminated skin with soap and water. Remove contaminated clothing and wash underlying skin as soon as reasonably practicable.

Hot Product - Flood skin with cold water to dissipate heat, cover with clean cotton or gauze, obtain medical advice immediately.

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

EXPOSURE TO HYDROGEN SULFIDE: Casualties suffering ill effects as a result of xposure to hydrogen sulfide should be immediately removed to fresh air and medical assistance obtained without delay.

Ingestion Do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Notes to physician Treatment should in general be symptomatic and directed to relieving any effects. Inhalation of hydrogen sulfide may cause central respiratory depression leading to coma and death. It is irritant to the respiratory tract causing chemical pneumonitis and pulmonary edema. The onset of pulmonary edema may be delayed for 24 to 48 hours. Treat with oxygen and ventilate as appropriate. Administer broncho-dilators if indicated and consider administration of corticosteroids. Keep casualty under surveillance for 48 hours in case pulmonary edema develops.

5. Fire-fighting measures

Auto-ignition temperature 250 to 537°C (482 to 998.6°F)

Explosion limits Lower: 0.5% Upper: 5%

Flammability of the product

Combustible liquid.

Flash point Closed cup: >=60°C (>=140°F) [Pensky-Martens.]

Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. Fire water contaminated with this material must be contained and prevented from being discharged to any waterway, sewer or drain.

Protective clothing (fire) Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Fire-fighting procedures Hazardous combustion products

Combustion products may include the following:

carbon oxides (CO, CO_2) (carbon monoxide, carbon dioxide) sulfur oxides (SO_2, SO_3 etc.) Hydrogen Sulfide (H_2S) In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion. Vapors can form explosive mixtures with air. Vapors are heavier than air and can spread along the ground or float on water surfaces to remote ignition sources. Vapors may accumulate in low or confined areas or travel a considerable distance to a source of ignition and flash back. Runoff to sewer may create fire or explosion hazard. Avoid spraying directly into storage containers because of the danger of boil-over. Boil-over is the rapid increase in volume caused by the presence of water in hot product and the subsequent overflow from a tank.

Fire/explosion hazards
Extinguishing media Suitable Use dry chemical, CO2, water spray (fog) or foam.
Not suitable Do not use water jet.

6. Accidental release measures Environmental precautions
Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air). Water polluting material. May be harmful to the environment if released in large quantities. Depending upon its temperature the product may be liquid, semi-solid or solid. Protect drains from spills and prevent entry of product, since this may result in blockage on cooling. Should blockage occur, notify the appropriate authority immediately.

Spillages in water or at sea: Product less dense than water: In case of small spillages in closed waters (i.e. ports), contain product with floating barriers or other equipment. Collect spilled product by absorbing with specific floating absorbents. If possible, before working in the combustion/exhaust spaces of engines/boilers or before handling ash/dust produced by the combustion of product, the work area should be thoroughly dampened with water. This will help to minimize the amount of airborne contamination produced by the work activity. However, because of the risk of explosion, do not allow water to come into contact with hot ash/dust. The use of dispersants should be advised by an expert, and, if required, approved by local authorities. Collect recovered product and other contaminated materials in suitable tanks or containers for recycle, recovery or safe disposal. Product which is denser than water will sink to the bottom, and usually no intervention will be feasible. If possible, collect the product and contaminated materials with mechanical means, and store/dispose of according to relevant regulations. In special situations (to be assessed on caseby- case basis, according to expert judgment and local conditions), excavations of trenches on the bottom to collect the product with sand may be a feasible option.

Methods for cleaning up Personal protection in case of a large spill
Chemical splash goggles. Chemical-resistant protective suit. Boots. Chemical-resistant gloves. Self-contained breathing apparatus (SCBA) should be used to avoid inhalation of the product. Suggested protective clothing might not be adequate. Consult a specialist before handling this product. CAUTION: The protection provided by air-purifying respirators is limited. Use a positive pressure air-supplied respirator if there is any potential for an uncontrolled release, if exposure levels are not known, or if concentrations exceed the protection limits of air-purifying respirator. This

material can contain hydrogen sulfide (H2S), a very toxic and extremely flammable gas. Entry into a confined space or poorly ventilated area contaminated with vapor, mist or fume is extremely hazardous without the correct respiratory protective equipment and a safe system of work. Wear self-contained positive pressure breathing apparatus (SCBA). Eliminate all ignition sources. Stop leak if without risk. Move containers from spill area. Approach release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see section 13). Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilled product. Note: see section 1 for emergency contact information and section 13 for waste disposal. Depending upon its temperature the product may be liquid, semi-solid or solid. Protect drains from spills and prevent entry of product, since this may result in blockage on cooling. Should blockage occur, notify the appropriate authority immediately.

Large spill Eliminate all ignition sources. Stop leak if without risk. Move containers from spill area. Absorb with an inert material and place in an appropriate waste disposal container. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor.

7. Handling and storage Handling Put on appropriate personal protective equipment (see Section 8). Workers should wash hands and face before eating, drinking and smoking. Do not get in eyes or on skin or clothing. Do not breathe vapor or mist. Do not ingest. Avoid release to the environment. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use non-sparking tools. Take precautionary measures against electrostatic discharges. To avoid fire or explosion, dissipate static electricity during transfer by grounding and bonding containers and equipment before transferring material. **Storage** Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see section 10). Eliminate all ignition sources. Separate from oxidizing materials. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination. This material can contain hydrogen sulfide (H2S), a very toxic and extremely flammable gas. Vapors containing hydrogen sulfide may accumulate during storage or transport and may also be vented during filling of tanks. Hydrogen sulfide has a typical "bad egg" smell but at high concentrations the sense of smell is rapidly lost, therefore do not rely on sense of smell for detecting hydrogen sulfide. Use specially designed measuring instruments for determining its concentration. Light hydrocarbon vapors can build up in the headspace of tanks. These can cause flammability/explosion hazards even at temperatures below the normal flash point (note: flash point must not be regarded as a reliable indicator of the potential flammability of vapor in tank headspaces). Tank headspaces should always be regarded as potentially flammable and care should be taken to avoid static electrical discharge and all ignition sources during filling, ullaging and sampling from storage tanks. Do not enter storage tanks. If entry to vessels is necessary, follow permit to work procedures. Entry to any tanks or other confined space requires a full risk assessment and appropriate control measures to be put in place in conformance with appropriate regulations and industry practice on confined space entry. When the product is pumped (e.g. during filling, discharge or ullaging) and when sampling, there is a risk of static discharge. Ensure equipment used is properly earthed or bonded to the tank structure. Electrical equipment should not be used unless it is intrinsically safe (i.e. will not produce sparks). Explosive air/vapor mixtures may form at ambient temperature. If product comes into contact with hot surfaces, or leaks occur from pressurized fuel pipes, the vapor or mists generated will create a flammability or explosion hazard. Product contaminated rags, paper or material used to absorb spillages, represent a fire hazard, and should not be allowed to accumulate. Dispose of safely immediately after use.

8. Exposure controls/personal protection
Occupational exposure limits
Fuel oil, residual **ACGIH TLV (United States).**
TWA: 0.2 mg/m^3, (Benzene-soluble)
Naphthalene **ACGIH TLV (United States).**
STEL: 79 mg/m^3 15 minute(s). Issued/Revised: 5/1996
STEL: 15 ppm 15 minute(s). Issued/Revised: 5/1996
TWA: 52 mg/m^3 8 hour(s). Issued/Revised: 5/1996
TWA: 10 ppm 8 hour(s). Issued/Revised: 5/1996
Ingredient name Occupational exposure limits
OSHA PEL (United States).
TWA: 50 mg/m^3 8 hour(s). Issued/Revised: 6/1993
TWA: 10 ppm 8 hour(s). Issued/Revised: 6/1993
Hydrogen Sulfide **ACGIH TLV (United States).**
STEL: 5 ppm 15 minute(s). Issued/Revised: 11/2009
TWA: 1 ppm 8 hour(s). Issued/Revised: 11/2009
OSHA PEL Z2 (United States).
AMP: 50 ppm 10 minute(s). Issued/Revised: 6/1993
CEIL: 20 ppm Issued/Revised: 6/1993
Ethylbenzene **ACGIH TLV (United States).**
STEL: 125 ppm 15 minute(s). Issued/Revised: 1/2002
TWA: 100 ppm 8 hour(s). Issued/Revised: 1/2002

OSHA PEL (United States).
TWA: 435 mg/m^3 8 hour(s). Issued/Revised: 6/1993
TWA: 100 ppm 8 hour(s). Issued/Revised: 6/1993
Polycyclic aromatic hydrocarbons (PAHs) **ACGIH TLV (United States).**
TWA: 0.2 mg/m^3 8 hour(s). Form: Benzene-soluble
OSHA PEL (United States).
TWA: 0.2 mg/m^3 8 hour(s). Form: Benzene-soluble
Some states may enforce more stringent exposure limits. While specific OELs for certain components may be shown in this section, other components may be present in any mist, vapor or dust produced. Therefore, the specific OELs may not be applicable to the product as a whole and are provided for guidance only.

Control Measures Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Hygiene measures Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing.

Personal protection
Eyes Chemical splash goggles.
Skin and body Avoid contact with skin and clothing. Wear clothing and footwear that cannot be penetrated by chemicals or oil. When handling hot material, wear heat resistant protective gloves, clothing and face shield that are able to withstand the temperature of the heated product.

Respiratory Use adequate ventilation. Do not breathe vapor or mist. If ventilation is inadequate, use respirator that will protect against organic vapor and dust/mist. Air supplied respiratory protection should be worn whenever it is required for the worker's face to be within 3 feet of an open hatch. If operating conditions cause high vapor concentrations or the TLV is exceeded, use supplied-air respirator.

Hands Cold material: Wear chemical resistant gloves. Recommended: nitrile gloves.
Hot material: to prevent thermal burns wear heat resistant and impervious gauntlets/gloves. The correct choice of protective gloves depends upon the chemicals being handled, the conditions of work and use, and the condition of the gloves (even the best chemically resistant glove will break down after repeated chemical exposures). Most gloves provide only a short time of protection before they must be discarded and replaced. Because specific work environments and material handling practices vary, safety procedures should be developed for each intended application.

Gloves should therefore be chosen in consultation with the supplier/manufacturer and with a full assessment of the working conditions. Consult your supervisor or Standard Operating Procedure (S.O.P) for special handling instructions.

9. Physical and chemical properties

Physical state Liquid.
Color Dark Brown. / Black.
Odor Oily
Explosion limits Lower: 0.5% Upper: 5%
Auto-ignition temperature 250 to 537°C (482 to 998.6°F)
Flash point Closed cup: >=60°C (>=140°F) [Pensky-Martens.]
Boiling point / Range 164 to 750°C (327.2 to 1382°F)
Melting point / Range <30°C (<86°F)
Density 1010 kg/m3 (1.01 g/cm3) at 15°C
Viscosity Kinematic: 663.2 mm2/s (663.2 cSt) at 40°C
Kinematic: 180 to 700 mm2/s (180 to 700 cSt) at 50°C
Vapor density >0.9 [Air = 1]
Vapor pressure <0.133 kPa (<1 mm Hg) at 20°C

10. Stability and reactivity

The product is stable. Reactive or incompatible with the following materials: oxidizing materials. Under normal conditions of storage and use, hazardous decomposition products should not be produced. Avoid all possible sources of ignition (spark or flame). Avoid excessive heat.