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Draft Indian Standard

Caustic Soda — Code of Safety
(*First Revision*)

भारतीय मानक मसौदा

कॉस्टिक सोडा- सुरक्षा संहिता
(*पहला पुनरीक्षण*)

(ICS 13.300; 71.060.40)

Chemical Hazards Sectional Committee, CHD 07

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FOREWORD

(Formal clause to be added later)

Caustic soda is an important basic chemical having large-volume use in industries such as rayon, paper and soap in addition to its use in a very large number of industries as an auxiliary process chemical. Caustic soda is a corrosive chemical and handling of it presents various hazards which are better prevented than cured. A sound code of practice will reduce the frequency of hazards and also, in many cases, the amount of damage caused by an accident.

The elimination of accidents is vital to public interest. Accidents produce social and economic loss and impair individual or group productivity. Realization of this loss has led the authorities to devote a good deal of attention to safety education. Apart from general precautions, some typical precautions are required to be taken during manufacture, storage and handling of caustic soda. The standard also prescribes safety measures for controlling hazards and essential information on symptoms of poisoning, first-aid, medical treatment, storage, handling, labelling and employee safety. This standard is intended to guide the users in the recognition of these hazards and in establishing safe handling procedures.

This standard was originally published in 1967. With a view to update the standard based on the experience of last five decades and on the currently available data the Committee felt a need to revise the standard. In this revision general properties have been incorporated and modifications have been made to update safety measures for controlling hazards and essential information on symptoms of poisoning, first-aid, medical treatment, storage, handling, labelling and employee safety based on the currently available data and last five decades experience.

The properties of caustic soda listed in clause 4 have been taken from literature and have been included for information only. Moreover, these properties pertain to pure caustic soda. BIS has published a separate standard IS 252: 2013 on the requirements, methods of sampling, and test for caustic soda suitable for use in rayon, cosmetic, textile, soap, paper and other similar industries. It covers the material in the solid and lye form.

The various clauses of the standard have been aligned with the format being applied for all Indian Standards on Code of safety of chemicals.

In the preparation of this code of safety assistance have been derived from the following publications:

- a) Chemical safety data sheets – SD-16, Manufacturing Chemists Association, 1825 Connecticut Avenue, Washington D.C. 20009.
- b) Sax's Dangerous Properties of Industrial Materials, Volume three, 12th Edition, Richard J. Lewis Sr., Wiley-Interscience Publication, 2012.
- c) NIOSH, Pocket Guide to Chemical Hazards, U.S. Department of Health and Human Services Centres for Disease Control, 1990 (National Institute for Occupational Safety and Health).
- d) IPCS-International Program on Chemical Safety, 2004 edition
- e) Nicky Bates, National Poisons Information Service (London Centre), Medical Toxicology Unit, Guy's & St Thomas' Hospital Trust, Avonley Road, London, SE14 5ER, UK.

1 SCOPE

This standard prescribes a code of safety concerning hazards relating to caustic soda. It describes the properties and essential information for the safe handling and use of caustic soda.

This code does not, however, deal with specifications for design of buildings, chemical engineering plants, method and ingredients used in the manufacture, equipment for waste disposal and operation control.

2. REFERENCES

The Indian Standards listed below contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revisions, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards:

<i>IS No.</i>	<i>Title</i>
1260 (Part 1): 1973	Pictorial Marking for Handling and Labelling of Goods: Part 1 Dangerous Goods
4155: 1966	Glossary of terms relating to chemical and radiation hazards and hazardous chemicals
4167: 2020	Glossary of items relating to air pollution (<i>second revision</i>)
8519: 1977	Guide for selection of industrial safety equipment for body protection
8520: 1977	Guide for selection of industrial safety equipment for eye, face and ear protection
8807: 1978	Guide for selection of industrial safety equipment for protection of arms and hands

3. TERMINOLOGY

For the purpose of this standard the definitions given in IS 4155 shall apply.

4. PROPERTIES

4.1 General Information

4.1.1 *Chemical Name* – Sodium hydroxide

4.1.2 *Common Name & Synonyms* – Caustic soda, Lye, Soda Lye, Sodium hydrate

4.1.3 *Uses*

Sodium hydroxide is used in bar soaps and detergents. Sodium Hydroxide is also used as a drain cleaner to unclog pipes. Around 56 percent of sodium hydroxide produced is used by industry, with 25 percent of NaOH used in the paper industry. Some other uses include fuel cell production, to cure food, bleach, drain cleaner, oven cleaner, soaps, detergent, paper making, paper recycling, aluminum ore processing, oxide coating, processing cotton fabric, pickling, pain relievers, anticoagulants to prevent blood clots, cholesterol reducing medications, and water treatment.

4.2 Identification

4.2.1 Formula — *NaOH*

4.2.2 CAS Number — 1310-73-2

4.2.3 UN Number — 1823 (solid)
1824 (solution)

4.2.4 UN Class — UN Hazard Class 8, UN Subsidiary Risks: NA UN Pack Group: II

4.2.5 Hazchem Code — 2W

4.3 Physical Properties

4.3.1 General— hygroscopic and deliquescent salt

4.3.2 Molecular Mass — 39.997 gm/mol

4.3.3 Physical State — Solid/Liquid

4.3.4 Color — colorless liquid/colorless solid/for lye colorless to semi turbid

4.3.5 Odor — Odorless

4.3.6 Boiling Point — 1390 °C

4.3.7 Melting Point — 318 °C

4.3.8 Vapor Density (Air=1) — 2.3

4.3.9 Specific Gravity — 2.13 at 20 °C

4.3.10 Viscosity — Not applicable

4.3.11 Vapor Pressure at 76.6°C — < 2 KPa at 20 °C

4.3.12 Heat of Combustion — Not applicable

4.3.13 Refractive Index at 589.4 nm — 1.433 at 320 °C; 1.421 at 420 °C

4.3.14 Solubility in Water – Miscible, 111 g/100 ml at 20 °C

4.3.15 Solubility in other solvents — Soluble in chloroform, miscible with ethanol ether.

4.4 Chemical Properties

4.4.1 Reactivity

Caustic soda destroys living tissues. Considerable heat is generated on adding water to solid caustic soda or its strong solutions and this may cause boiling and spattering of hot solution. It react with mineral acids to form corresponding salts. All organic acids also react with sodium hydroxide to form soluble salts. Another common reaction of caustic soda is dehydrochlorination.

4.4.2 Polymerization — Not applicable

4.4.3 Allotrope Formation — Not applicable

4.4.4 Corrosion Properties

Caustic soda corrodes clothing and a few metals, such as aluminium, tin, lead, zinc and alloys containing these metals; slowly corrodes iron, copper and Monet metal.

4.5 Fire and Explosion Hazard Properties

4.5.1 Ignition Temperature — There is no ignition temperature.

4.5.2 Auto Ignition Temperature — Not flammable

4.5.3 Flash Point — Not applicable

4.5.6 Fire Risk — Not applicable

5 HEALTH HAZARD & TOXICITY INFORMATION

5.1 General Information

Caustic soda is dangerous when carelessly handled. Solid caustic soda or its solutions have marked corrosive action on all tissues of body. Signs and symptoms of irritation do not immediately become evident after contact with caustic soda, as a result, the worker may suffer injury before he realizes that the chemical is in contact with his body.

5.2 Routes of entry

5.2.1 Skin

Direct contact to skin produces severe pain, chemical burns and cause wounds, lesions or abrasions. It shall not be in contact with open cuts or irritated skin. Repeated exposure to skin causes dermatitis.

5.2.2 Eyes

Direct contact to eye causes pain and burns. This results in severe damage of eye such as clouding of cornea, inflammation of iris, epithelium destruction, cataracts, eyes glued to eyelids and blindness.

5.2.3 Ingestion

Ingestion of Lye produce burns around the mouth, throat, and stomach. It increase in saliva production and inability to speak or swallow. It causes ulcerations and swellings of mucous membrane. May experience nausea, vomiting and diarrhea.

5.2.4 Inhalation

Lye on inhalation irritates the respiratory tract and can cause lung damage. Mild symptoms include cough, choking and damage of mucous membrane. While when sudden inhalation of dust can also result fatal symptoms with severe lung and throat inflammation.

5.2.5 Long term effects

Prolonged exposure results in erosion of teeth, inflammatory and ulcerative changes in mouth, necrosis of jaw, bronchial irritation followed by bronchial pneumonia. High exposure of dust could lead to pneumoconiosis.

5.3 Toxicity information

- a) *Threshold Limit Value (TLV) (Time Weighted Average (TWA))* — 2 mg/m³
- b) *Short Term Exposure Limit (STEL)* — Not Available
- c) *Immediately Dangerous to Life or Health (IDLH)* — 10 mg/m³
- d) *Lethal Dose (LD₅₀) (rat, oral), (median dose)* — 325 mg/Kg
- e) *Lethal Concentration (LC_{Lo}) (human) Oral* — Not Available
- f) *Inhalation (Rat) LC₅₀* — Not Available

5.4 Antidote

There is no antidote for sodium hydroxide toxicity.

5.5 Health Effects

5.5.1 Signs and Symptoms

Causes severe irritation or burns to the eyes, skin, gastrointestinal tract, and respiratory system.

Incompatibility: Acids and Halogenated compounds.

5.5.2 Acute Toxicity

5.5.2.1 Systemic effects

No general or systemic effects are noted except those resulting from shock or those secondary to tissue damage.

5.5.2.2 *Local effects*

Caustic soda is dangerous to live tissue. Contact with it causes burns, frequently deep ulceration and ultimate scarring. Severe burns result not only from the solid alkali but also from solutions of this compound. Even dilute solutions on prolonged contact exert a destructive effect on tissues. Caustic soda is a strong primary irritant. Multiple small burns may result from exposure to dust or mist of the material. Contact with eyes either of solid caustic soda or its solutions may rapidly cause severe damage to the delicate eye tissues. Molten caustic causes severe injury both by reason of high temperature (above 320°C) and corrosive nature of the compound. Ingestion either of the solid caustic soda or its solution results in damage to mucous membranes or deeper tissues. As a result, perforation may follow or subsequent extensive scar formation may occur. Death may occur if vital areas are penetrated into. Scarring may so constrict the damaged tissues that extensive corrective surgery may be required. Inhalation of the dust or concentrated mist may cause damage to upper respiratory tract and even to the lung tissue proper. The effects of irritation may vary from mild irritation of nasal membranes to severe pneumonitis depending on the severity of the exposure.

5.5.3 *Chronic Toxicity*

It could lead to bronchial pneumonia or pneumoconiosis.

5.5.3.1 *Systemic effects*

There are none except those secondary to tissue damage.

5.5.3.2 *Local effects*

Repeated contact with dilute solutions may cause superficial destruction of skin in multiple areas and primary irritant dermatitis may result. Repeated inhalation may similarly cause varying degrees of irritation to the tissues of the respiratory passage including lungs.

6 PERSONAL PROTECTIVE EQUIPMENT

6.1 Availability and Use

While personal protective equipment is not an adequate substitute for good, safe working conditions, adequate ventilation, and intelligent conduct on the part of employees working with caustic soda, it is, in many instances, the only practical means of protecting the worker, particularly in emergency situations. One should keep firmly in mind that personal protective equipment protects only the worker wearing it, and other unprotected workers in the area maybe exposed to danger.

The correct usage of personal protective equipment requires the education of the workers in proper employment of the equipment available to him. Under conditions which are sufficiently hazardous to require personal protective equipment, its use should be supervised and the type of protective equipment selected should be capable of control over any potential hazards.

6.2 Non-Respiratory Equipment

6.2.1 Eye and Face Protection

Safety glasses or chemical goggles should be used to protect eye and skin, wherever required. Face shield shall be used while handling bulk quantities. Immediate work area must be well equipped with facilities such as eye wash fountain and quick drench shower (*see* IS 8520).

6.2.2 Head Protection

Class C Hard hats should be worn where there is danger of falling objects. If hard hats are not considered necessary, soft-brimmed hats or caps may be worn to give protection against splashes.

6.2.4 Body, Skin and Hand Protection

Wear protective clothing to minimize skin contact. Wear chemical resistant clothing and rubber boots when potential for contact with the material exists. Always place pants legs over boots. Contaminated clothing should be removed, then discarded or laundered. Discard contaminated leather goods. Handling bulk quantities a PVC suit and PVC gloves be used (*see* IS 8519 and IS 8807).

6.3 Respiratory Equipment

6.3.1 Respirator selection based on assigned protection factor (APF) for concentration up to 10 mg/m³

- a) (APF = 25) Any supplied-air respirator operated in a continuous-flow mode;
- b) (APF = 25) Any powered, air-purifying respirator with a high-efficiency particulate filter;
- c) (APF = 50) Any self-contained breathing apparatus with a full facepiece; and
- d) (APF = 50) Any supplied-air respirator with a full facepiece.

6.3.2 Emergency or planned entry into unknown concentrations or IDLH conditions:

- a) (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode; and
- b) (APF = 10,000) Any 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.

7 STORAGE, HANDLING, LABELLING AND TRANSPORT

7.1 General

This material is inorganic and not subject to biodegradation. Because of the high pH of this product, it is harmful to aquatic life. The washings should be collected in an impervious container and recovered or neutralized with acid and disposed without harming the nearby eco-system.

7.2 Storage

7.2.1 Drum containers should be stored in dry locations to prevent rusting. They should be periodically inspected and spills, etc, attended to. Rusted containers become weak, and they should be handled with extra care.

7.2.2 For stationary storage, mild steel tank or any other properly designed tank with alkali resistant lining should be used. They should be provided with manholes of at least 60 cm diameter protected with grills and cover. Top of the tank should be vented to atmosphere.

7.2.3 All tanks should be capable of being completely isolated from other tanks and processes by suitable valves. Where possible small portions of pipe lines should be removed or blanks should be inserted for additional safety. The tanks should be capable of being drained off completely.

7.2.4 Before repairs or cleaning, tanks should be completely drained and thoroughly washed.

7.2.5 Persons required to enter a tank should first make sure that the tank is empty, has been washed free of alkali and certified so by a competent authorized inspector or inspecting authority. They should wear adequate personal protective equipment including a safety belt securely attached to a rope the free end of which is held by a person standing outside the confined space. Supply of fresh breathable air to persons inside the tank should be ensured by proper means.

7.2.6 High density polyethylene (HDPE) bags used for storage of caustic flakes/solids should be of proper strength (denier). The bags should be lined internally. Caustic should be filled in suitable size liners kept in HDPE outer bags. Care to be taken that the outer bag is not soiled with caustic. The temperature of caustic, while filling should be 45 to 50 °C. After filling, the liner should be tied at mouth immediately to avoid ingress of moisture. The outer HDPE bag should be double stitched. The bags should be stored in well ventilated and covered storage. Hooks should not be used for transfer of filled bags. There should not be ingress of water during rain. Preferably the bags may be stored on platform raised to a height to prevent contact with water in case of some water enters storage yard due to any circumstances. The storage of bags should not go beyond a height of 5ft.

7.2.7 Storage and Precautions with Tankers

7.2.7.1 Before allowing persons to carry out jobs inside a tank, proper safety work permit for confined space entry to be taken. It should be ensured that the tank is isolated from the supply line and lockout tagout (LOTO) to be followed.

7.2.7.2 The following points are to be carefully remembered:

- a) Water should be freely available and used in case of spillage.

- b) When empty, all openings and valves should be properly closed, and the tanker returned promptly.
- c) Tankers, unless they are specifically meant for storage and transport of caustic soda solution, should be thoroughly cleaned of all extraneous matter before use.
- d) During loading and unloading, the tanker should be braked and isolated against any movement.
- e) While loading and unloading spurting should be avoided and as an additional precaution anti-splash screens should be used.
- f) Work on tankers should be supervised by foremen and only workers using approved type of personal protective equipment should be allowed to work.
- g) Compressed air should not be used for loading or unloading the tank wagons, but pumps or gravity method should be used.
- h) All valves should be closed before disconnection.
- i) Safety instructions should be stenciled on both sides of the tanker.

7.3 Handling

7.3.1 In handling caustic soda solution care should be taken to avoid solidification in the pipelines and equipment. The strength of the solution may be easily determined from its density. All equipment should be kept clean by washing of the accumulation of solidified caustic and sodium carbonate that forms around small leakages. When disconnecting equipment or pipelines, make sure that they are empty of caustic soda, and they are washed. At such times, a hose with running water should always be available. Glandless pumps should preferably be used, otherwise packing glands of pumps should be shielded to prevent spraying of caustic solution. When spillage has occurred of solid or flakes it should be swept carefully with a broom and the area hosed down. In case of spillage of solution, the floor should be washed with water from a hose rather than swept.

7.3.2 Molten caustic has a temperature range of 320 to 400°C. Extreme care should be taken to avoid spurting of molten caustic in the caustic filling yard. The yard should be always kept clean. Any overflow or spillage of molten caustic should be allowed to solidify and then immediately washed away, otherwise a dangerous slippery surface will be left on the floor. Handling filled drums of molten caustic is a dangerous practice which should not be followed unless the operator is well guarded. If hot caustic is to be run into a container the latter should be absolutely dry and free of acid to guard against explosion. When liquid enters a container, extreme caution should be exercised to prevent splashing.

7.3.3 Accidents frequently occur while taking samples of molten caustic soda. A long-handled nickel or steel ladle of small capacity should be used to scoop out the sample. It is not advisable to take samples of flowing molten caustic as there is always danger of spurting. Goggles, gloves, gum boots, aprons and safety helmets should be invariably worn whenever handling molten caustic soda. The supervisory staff should constantly bear in mind that all safety equipment should be properly and constantly used. The most common hazard is to the eye and should always be protected by suitable goggles. Use of transparent face shield is recommended in addition to safety goggles.

7.3.4 Solid caustic should be ground and flaked in a separate well-ventilated room remote from other work rooms. Each man in the grinding room should be provided with adequate type of personal protective equipment.

The persons carrying/ lifting the caustic drums/bags should have undergone training on ergonomic lifting methods.

The joint flanges must be covered to avoid spray, in case of leakage or gasket failure.

Pipelines exposed to cold temperatures should be insulated and when exposed extreme cold, concentric pipes with steam jacket may be provided to keep the caustic flowing without getting solidified and causing increase in pressure in the pipelines.

The tank should have proper venting arrangement for venting out the steam and vapours. The people engaged in this activity should wear all protective equipment and should be at a suitable distance from the tank.

They have to avoid contact with strong acids, acid chlorides, acid anhydrides, chloroformates, copper, aluminum and their alloys.

7.3.5 *Equipment for Handling*

7.3.5.1 Pots containing boiling caustic soda should be provided with exhaust hood to carry off the mists and sprays.

7.3.5.2 Evaporators and similar vessels used in handling liquid caustic soda under pressure should be tested periodically with cold water according to the standards laid down in the relevant pressure vessels code.

7.3.5.3 Tanks should be provided with overflow arrangements in such a way that the liquid is conveyed to a safe place without causing harm to workers nearby.

7.3.5.4 Stuffing boxes are sources of leaks. With modern materials of construction and gland packing or seals, this leakage may be well controlled.

7.3.5.5 To prevent leaks, pipelines should be of seamless type and have welded flange joints. Depending on temperature and pressure, the gaskets may be of soft rubber or compressed asbestos.

7.3.5.6 Pipelines exposed to low temperatures should be so arranged that they can be heated to prevent crystallization of the solution.

7.3.5.7 All equipment used for manufacture, handling, storage, or use of caustic soda should be regularly inspected and maintained in good condition.

7.3.5.8 During maintenance work when pipes are to be disconnected, workers should operate from above. Before breaking the point, they should ensure that there is no pressure inside and that the line has been thoroughly drained, and if necessary, thoroughly rinsed with water. Flanges should always be opened from the far end. The valve which controls the line should be closed and locked and a 'MAN AT WORK' sign should be hung on it until the repairs are complete.

7.3.6 Dissolve solid caustic soda in one of the following ways:

7.3.6.1 Strip the drum and immerse the cake of solid caustic in the dissolving tank of water.

7.3.6.2 Perforate the drum suitably and suspend it above the dissolving tank and pump a stream of water into the drum allowing the solution to flow into the dissolving tank.

7.3.6.3 To avoid iron contamination, peel off the steel drum from solid cake of caustic before dissolving. In bulk addition rapid generation of heat is obtained and there is likelihood of local boiling and spurting of the solution. Dissolve flakes by addition to a well-agitated tank of water. Accidents frequently occur during the handling of caustic soda for making solutions and it is imperative that all safety equipment is properly used in this dissolving department.

7.4 Labelling

7.4.1 Each container (including tankers) should carry an identifying label or stencil as depicted in **Fig. 7** in IS 1260 (Part 1). The storage containers shall be labelled or marked to identify as follows:

a) Contents of the container;

b) Name and address of the manufacturer or importer of the hazardous chemical; and

c) Physical, chemical and toxicological data as per the criteria given in the relevant schedule of the Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989. While referring to the statutes, the stipulations given in the subsequent amendments of those statutes shall be taken into account.

Manufacturers name with label warnings required by regulations or ordinances form part of the label or placard.

7.4.2 Each drum shall be labelled as follows:

‘SODIUM HYDROXIDE (CAUSTIC SODA)

Danger — Do not get in eyes, on skin or clothing. Do not take internally. In case of contact, flush with water copiously; in case of eyes flush with water for 15 min and see the doctor. Use goggles, face-shield, rubber aprons, gloves, gum boots and helmets while handling.

7.4.3 Solid

Solid caustic soda should be packed in mild steel drums. The container should be securely closed, the lid being tack-welded or expanded to a tight fit. If the closure is not air-tight, moisture and carbon dioxide will be absorbed by caustic soda. Over the lid, a printed sealing foil of tin should be affixed. On this label, it should be clearly stated that the container is carrying a corrosive and caustic chemical. Precautions regarding the handling and the corrosive nature of chemical should be clearly written on the container. It should also be marked with paint with the name of the manufacturer, grade and weight of caustic soda material, and the year and month of manufacture. The container used for solid caustic soda is generally not corrugated.

7.4.4 Flakes

The mild steel drums used for flakes should be usually of black sheets and should be corrugated for greater strength. The lid should be expanded into position or should be tack-welded. All the other markings should be as for the solid drums. Both solid and flake drums should be black painted. The flakes can also be packed in lined HDPE bags with a suitable strength inner liner.

Handling care including use of PPEs and emergency precautions should have been printed on the outer HDPE bag.

7.4.5 Lye

Lye of different strength should be transported in tankers. The tankers should be generally painted in light grey or white with an alkali-resistant paint. The words 'caustic soda 32 and its strength' should be painted in large block letters horizontally across the tankers, on both sides. Precautions regarding the handling of the corrosive chemical shall be written on the label or on the printed tin-plate attached to the tanker and should be prominently displayed. The words 'CORROSIVE CHEMICAL' should in addition be stenciled on both sides of the tanker.

7.5 Transport

7.5.1 Unloading Tankers/drums

Waste containing alkali is harmful to bacterial growth necessary for degradation of organic waste. Such wastes should be properly treated and neutralized before it is led into sewers, rivers, ponds or open fields.

7.5.2 Driver

The persons carrying/ lifting the caustic drums/bags should have undergone training on ergonomic lifting methods.

K. The valves should be covered by a strong protection system to prevent accidental breakage and spray.

L. The tankers driver should be trained with hazardous chemical transport guidelines and provided with the transport emergency (TREM) card and material safety data sheet (MSDS) for each consignment.

M. In case of solid transport, no incompatible chemicals should be transported with caustic soda.

NOTE — If transport of the hazardous chemical is involved it shall be carried out in accordance with the Central Motor Vehicles Rules, 1989. While referring to the statutes, the stipulations given in the subsequent amendments of those statutes shall be taken into account.

8 SPILLAGE, LEAKAGE AND WASTE DISPOSAL

8.1 General

All personal attending to spill/leak should use proper personal protective equipment and fire-fighting equipment while handling caustic soda.

8.2 Spillage

In case of spillage, do not repack the spilled material. Do not bring the spilled material in contact with acid, acid chlorides or other combustible materials

8.2.1 General Information

8.2.2 *Land Spill (Spill on land)*

The area shall be removed with all ignition sources and clean up all spill immediately using protective equipment.

8.2.2.1 *Containment*

The spill drain area should have retention basins for pH adjustments and dilution of spill before disposal. As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 m for liquids and at least 25 m for solids.

8.2.3 *Water Spill (Spill in Water)*

The area shall be cleared with personal and alert fire brigade about the nature of hazard.

8.2.3.1 *Containment* — Prevent it from entering into drains

8.3 Leakages

8.3.1 *General Information* — In case of a spill or leak, stop the leak as soon as possible.

8.3.2 *Leak from the Tanker/Tank* — The leaking tanker should be emptied out to another empty tanker or to a storage tank.

8.3.3 *Caution* — Persons handling leaking caustic soda tankers should wear proper personal protective equipment.

8.4 Accidental Release Measures

Wear appropriate personal protective equipment recommended in **6**. Completely contain spilled material with dikes, sandbags, etc. Shovel dry material into suitable container. Liquid material may be removed with a vacuum truck. Remaining material may be diluted with water and neutralized with dilute acid, then absorbed and collected. Flush spill area with water, if appropriate. Keep product and flush water out of water supplies and sewers. This material is alkaline and may raise the pH of surface waters with low buffering capacity. Releases should be reported, if required, to appropriate agencies.

8.5 Disposal of Empty Containers

8.5.1 The empty containers (including drums, HDPE bags, liners, etc.) and the wastes are hazardous wastes and should be disposed with all precautions or to be sold to authorized recyclers only.

8.5.2 Empty flake drums should be thoroughly washed with water by filling to the brim, agitating and pouring out the water at least six times. Before washing, the drum should be visually examined to see that no appreciable quantities of caustic flakes are sticking inside.

8.5.3 Solid drums are usually cut open, so the drum sheets should be washed profusely with water before disposal. In case the solid caustic is dissolved out of the uncut drum, the empty drum should be treated like the empty flake drum before disposal.

8.5.4 In the case of returnable flake drums, care should be taken to tightly close and reseal the lid before returning the empty drums.

9 FIRE PREVENTION AND FIRE FIGHTING

9.1 Extinguishing Media

This material is not combustible. Use extinguishing media appropriate for surrounding fire.

9.2 Special Fire Fighting Procedures

Keep run-off water out of sewers and water sources. Dike for water control. Cool containers exposed to flames with water until well after the fire is out. Move container from fire area if it can be done without risk. If risk of water pollution occurs, notify appropriate authorities.

9.3 Unusual Fire & Explosion Hazards

May develop highly toxic or corrosive fumes if heated. In contact with some metals and water/humid air, hydrogen gas is formed, which may form explosive mixture with air. Contact with some organic chemicals can produce a violent or explosive reaction.

9.4 Protective Measures in Fire

Self-contained breathing apparatus and suitable protective clothing must be worn in fire conditions.

10 TRAINING

10.1 Workers required to handle caustic soda in any form should be instructed about the hazards involved and safe methods of work. They should be provided with adequate and appropriate personal protective equipment and its correct use should be ensured. They should be instructed about basic first-aid measures against alkali and the steps to be taken in the event of spillage of caustic soda. They should be instructed about the location and

use of showers, eye fountains, hose lines, etc. Food should not be stored or eaten in a work-area where caustic soda is handled.

10.2 They should have provided with MSDS of the above chemical, site safety regulations and trained with emergency response procedures, use of protective clothing, fire-fighting and first aid.

11 HEALTH MANAGEMENT, FIRST-AID AND MEDICAL TREATMENT

11.1 Health Management

11.1.1 *Physical Examination*

11.1.1.1 *Pre-placement physical examinations*

All new entrants should be given a pre-placement medical examination before they are engaged in the manufacture of caustic soda. All workers should be regularly checked up by a physician with particular reference to dermatitis.

11.1.1.2 *Periodic examination*

The respiratory stress and skin irritation can be periodically examined

11.2 First Aid

11.2.1 *General Principles*

11.2.1.1 Speed in removing caustic soda from the affected parts is of primary importance. Whether a full-time physician is employed or not, industrial first-aid kits should be kept at all places where caustic soda is handled.

11.2.1.2 Copious and prolonged application of water to affected part is of foremost importance. The irrigation should be continued for as long as 1 to 2 h. The contaminated clothing should be removed promptly. In case of severe burns and those involving extensive areas of body shock may ensue, and in this case, patient should be laid in a supine position and kept reasonably warm until the physician, who should be called in attendance at once, arrives. No oil or ointment of any kind should be applied within first 24 h after exposure or subsequently without orders from the physician.

11.2.1.3 Neutralization with acid or other chemicals should be postponed until thorough washing has been done. One-percent ammonium chloride or 4-percent boric acid solution is suitable for eye washing. 10 percent ammonium chloride or 2-percent acetic acid solution is suitable for application to skin.

11.2.2 *Contact with Skin*

Remove contaminated clothes. Rinse skin with plenty of water or shower for at least 15 min. Refer immediately for medical attention.

11.2.3 *Contact with Eyes*

Even if minute quantities of caustic soda either in solid or liquid form enter the eyes, they should be irrigated immediately with copious amounts of water for at least 15 min. Eyelids should be held apart during washing. A physician preferably an eye specialist should be called at once and if necessary, eye washing may be continued for another 15 min until he arrives. After the first washing, few drops of 3.5-percent pontocaine solution or an equally effective aqueous topical anaesthetic may be instilled into the eyes. No oil or oily ointment should be used.

11.2.4 *Ingestion*

Do not attempt to induce vomiting. Patient should be encouraged to drink a large quantity of water. Dilute vinegar or a 5-percent solution of ammonium chloride may be administered freely if available. After dilution or neutralization of the alkali, whites of egg or paraffin oil may be taken for soothing effect. Stomach tubes or emetics should not be used unless ordered by the physician.

11.2.5 *Inhalation*

Patient shall be laid down and keep warm and rested. Inhalation of vapors as aerosol could cause ling oedema and shall be transported to hospital immediately.

11.2.6 *First-Aid Kit*

The first-aid kit should have Paraffin oil, pontocaine solution and ammonium chloride solution. No additional requirement in first aid kit. Flushing of skin or rinsing of mouth is only first aid in case of acetone poisoning.

11.3 Medical treatment

Washing of skin or eyes using large amount of water.

12 ADDITIONAL INFORMATION

All the accidents occurring in a caustic soda plant should be thoroughly investigated to find out the causes of the accidents and to suggest remedial measures and the detailed report should be recorded properly for future reference. All the accidents occurring in a caustic soda plant should be thoroughly investigated to find out the causes of the accidents and to suggest remedial measures and the detailed report should be recorded properly for future reference.