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Draft Indian Standard

ACETIC ACID - CODE OF SAFETY
(First Revision)

भारतीय मानक मसौदा

एसीटिक अम्ल- सुरक्षा संहिता
(पहला पुनरीक्षण)

(ICS 71.080.80;13.300)

Chemical Hazards Sectional Committee, CHD 07

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FOREWORD

(Formal Clause to be added later)

Acetic acid, also termed ethanoic acid in chemical literature, is represented by the formula CH_3COOH . It is an important organic-acid used in many industrial processes, such as manufacture of rubber, plastics, pharmaceuticals, dyes, insecticides, photographic chemicals and textiles. It is the primary raw material for the manufacture of acetic anhydride and acetates including acetate fibres.

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 acetic acid. This code describes the properties of acetic acid and nature of hazards associated with it. 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.

The properties of acetaldehyde listed in clause 4 have been taken from literature and have been included for information only. Moreover, these properties pertain to pure acetaldehyde. BIS has published a separate standard IS 695: 2020 on the requirements, methods of sampling, and test for acetaldehyde intended for industrial purposes.

This standard was first published in 1969. 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, safety measures for controlling hazards, and essential information on symptoms of asphyxiation, first-aid, medical treatment, storage, handling, labelling and employee safety have been incorporated.

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:

1. AF1225000:2019 Pocket guide to chemical hazards

1 SCOPE

1.1 This code describes the properties of acetic acid, the nature of hazards associated with it and the essential information on storage, handling, packing, labelling, and disposal of waste, cleaning and repair of containers, selection and training of personnel, personal protective equipment and first aid.

1.2 This code does not deal with the specifications for design of buildings, chemical engineering plants, storage vessels and equipment for operations control and waste disposal.

2 REFERENCES

The Indian Standards given 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>
IS 1260 (Part 1): 1973	Pictorial marking for handling and labelling of goods: Part 1 Dangerous Goods
IS 2925: 1984	Specification for industrial safety helmets (<i>second revision</i>)
IS 4155: 2023	Glossary of terms relating to chemical and radiation hazards and hazardous chemicals (<i>first revision</i>)
IS 4167: 2020	Glossary of items relating to air pollution (<i>second revision</i>).
IS 5572: 1994	Classification of hazardous areas (other than mines) having flammable gases and vapours for electrical installation (<i>second revision</i>)

IS 8519: 1977	Guide for selection of industrial safety equipment for body protection
IS 8520: 2023	Guide for selection of industrial safety equipment for eye, face and ear protection
IS 8807: 1978	Guide for selection of industrial safety equipment for protection of arms and hands
IS 10592: 2018	Industrial emergency showers, eye and face fountains and combination units - Specification (<i>first revision</i>)
IS 10667: 1983	Guide for selection of industrial safety equipment for protection of foot and leg

3. TERMINOLOGY

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

4. PROPERTIES

4.1 General information

Acetic acid is a colourless liquid with a vinegar-like odour. Acetic acid is a simple monocarboxylic acid containing two carbons. It has a role as a protic solvent, a food acidity regulator and an antimicrobial food preservative. Acetic acid hazards depend on the concentration of the acid. Acetic acid vapours inhalation may cause irritation of the nose, throat, eyes and cough. Exposure to concentrated acetic acid can cause corrosive damage. Acetic acid (100 percent) is called glacial acetic acid.

4.1.1 Chemical Name/IUPAC Name – Ethanoic acid

4.1.2 Common Name & Synonyms – Acetic acid (aqueous), Glacial acetic acid, Methanecarboxylic acid, Ethylic acid and 5 percent to 8 percent concentration found in vinegar.

4.1.3 Uses

Acetic acid is used in many industrial processes, such as manufacture of rubber, plastics, pharmaceuticals, dyes, insecticides, photographic chemicals and textiles. It is most simply used as table vinegar. It is the primary raw material for the manufacture of acetic anhydride and acetates including acetate fibres, and industrial preparation of dimethyl terephthalate (DMT).

4.2 Identification

4.2.1 Formula – CH_3COOH ($\text{CH}_3\text{CO}_2\text{H}$, $\text{C}_2\text{H}_4\text{O}_2$, or $\text{HC}_2\text{H}_3\text{O}_2$)

4.2.2 CAS Number -64-19-7

4.2.3 UN Number – 2789

4.2.4 UN Class – 8, UN Subsidiary risk-3, UN Pack Group: II

4.3 Physical Properties

4.3.1 General- Colourless liquid.

4.3.2 Molecular Mass – 60.1g/mol.

4.3.3 Physical State – Liquid.

4.3.4 Colour – Colourless.

4.3.5 Odour – Heavily vinegar like.

4.3.6 Boiling Point – 118 °C to 119 °C.

4.3.7 Melting Point – 16 °C to 17 °C..

4.3.8 Vapour pressure – 11 mmHg.

4.3.9 Specific Gravity / Density – 1 040 kg/m³ (25 °C).

4.3.10 Viscosity – 1.168 mm²/s.

4.3.11 Vapour Pressure (20°C) - 11.4 mm Hg.

4.3.12 Heat Of Combustion - 209.5 Kcal/mole.

4.3.13 Refractive Index at 25° C ~ 1.37 to 1.39.

4.3.14 Solubility In Water – Miscible in water.

4.3.15 Solubility In Other Solvents – Ethanol, Ether, Acetone, Tetrachloromethane, Glycerol.

4.3.16 Light Sensitivity – Protect material from direct sunlight.

4.4 Chemical Properties

4.4.1 Reactivity

4.4.1.1 Acetic acid undergoes the typical chemical reactions of a carboxylic acid. Upon treatment with a standard base, it converts to metal acetate and water. Reduction of acetic acid gives ethanol. The OH group is the main site of reaction of acetic acid. Other substitution derivatives include

acetic anhydride and this anhydride is produced by loss of water from two molecules of acetic acid. When heated above 440 °C, acetic acid decomposes to produce carbon dioxide and methane, or to produce ketene and water.

4.4.1.2 Acetic acid is mildly corrosive to metals including iron, magnesium, zinc, chromic acid, sodium peroxide, nitric acid, strong caustics, soluble carbonates, phosphates, hydroxides, peroxides, permanganates, potassium permanganate, amines, alcohols, strong bases, strong oxidizers, forming hydrogen gas, and salts called acetates. Reacts violently with strong oxidants this generates fire and explosion hazards.

4.4.1.3 Acetic acid should be stored away from sources of moisture in a cold, dry, well-ventilated environment.

4.4.1.4 To be stored in aluminium, duriron, hastelloy, stoneware, stainless steel or glass-lined containers types 316 or 318.

4.4.2 *Corrosion Properties* – Mildly corrosive in nature.

4.5 Fire and Explosion Hazard Properties

4.5.1 *Ignition Temperature* – 485 °C.

4.5.2 *Auto Ignition Temperature* - 427 °C.

4.5.3 *Flash Point* - 103 °F.

4.5.4 *Upper Explosive Limit* -19.9 percent.

4.5.5 *Lower Explosive Limit* - 4 percent.

4.5.6 *Fire Risk*

These types of hazards are not normally associated with acetic acid. However, leakage from containers may come in contact with metals and generate hydrogen. This, in confined spaces may cause explosion or fire. Although not classed as a flammable liquid, acetic acid, if ignited, will burn in air. Acetic acid is highly flammable and its vapour may cause a flash fire or ignite explosively. Vapours may travel considerable distance to a source of ignition and flash back. Heat may cause sealed containers to explode.

5. HEALTH HAZARD & TOXICITY INFORMATION

5.1 General Information

Hazards result from both contact with skin or eyes and inhalation of vapours. The threshold limit of acetic acid accepted at present is 10 parts per million in air or 25 mg/m³ of air. They can be dermal, respiratory, eye injury and skeletal. Fatal exposure can also occur by routes such as exposure of skin, inhalation, or ingestion. Appropriate precaution in handling is essential to prevent exposure.

5.2 Routes of entry

5.2.1 Skin

Acetic acid is corrosive and may produce severe burns. Acetic acid may be harmful if absorbed through skin.

5.2.2 Ingestion

Acetic acid is corrosive and may produce burns to the lips, oral cavity, upper airway, esophagus and digestive tract.

5.2.3 Inhalation

Acetic acid is corrosive and may cause damage to mucous membranes in nose, throat, lungs and bronchia system.

5.2.4 Long Term Effects

Repeated or prolonged contact with skin may cause dermatitis. Lungs may be affected by repeated or prolonged exposure to an aerosol of this substance. Risk of tooth erosion upon repeated or prolonged exposure to an aerosol of this substance. .

5.3 Toxicity information

Acetic acid emits highly toxic fumes if inhaled. Available toxicity values are given below:

5.3.1 Threshold Limit Value (TLV) — 25 mg/m³.

5.3.2 Short Term Exposure Limit (STEL) — 37 mg/m³.

5.3.3 Immediately Dangerous to Life or Health (IDLH) — 15 ppm.

5.3.4 Lethal Dose 50 (LD50) (median dose) — 3 310 mg/kg (rat, oral).

5.3.5 Inhalation (Acute toxicity) — LC50 (rat) 11.4 mg/l.

5.4 Antidote

There is no antidote for acetic acid poisoning.

5.5 Health Effect

5.5.1. Signs and Symptoms

Concentrated acetic acid is corrosive in nature and can cause severe burns, irritation of eyes, nose, and throat, and can damage mucous membrane in nose, throat and lungs.

5.5.2 Acute Toxicity

5.5.2.1 Systemic effect

Inhalation of concentrated vapour or a mist from hot acid may cause damage to the upper respiratory tract and even to the lung tissues. Repeated inhalation of the mist may cause a chronic inflammation of the upper respiratory tract and chronic bronchitis.

5.5.2.2 Local effects

Acetic acid is dangerous when improperly handled. Concentrated solution of acetic acid (30 percent or more) may be destructive to any body tissues which come in its contact. Contact with the eyes very rapidly causes severe damage which may result in total loss of sight. Repeated contact with diluted solutions may cause dermatitis, severe injury or death.

5.5.3 Chronic Toxicity

5.5.3.1 Systemic effects

Long continued absorption of acetic acid cause a severe skin condition like burns and skin irritation .A long term absorption of acetic acid cause chronic disease of the upper respiratory tract and lungs which may damage the tissue of the lungs. Long term use of acetic acid vapours may cause a problem in eyes and cause a uncorrected highly fault vision.

5.5.3.2 Local effects

There are no usual chronic local effect if properly handled.

6. PERSONAL PROTECTIVE EQUIPMENT

6.1 Availability and Use

6.1.1 General-Safety in handling acetic acid depends mainly upon the effectiveness of the adequate instructions on approved and safe methods of handling to the workers so engaged. Prior to assignment to processes involving the handling of acetic acid, all individuals should have a physical examination to properly protect their health, those who have the medial conditions should be excluded from assignment to such processes. Employees should be instructed primarily in regard to the corrosive properties of acetic acid and safe handling procedures. Employees should be thoroughly familiar with the location and operation of safety showers, eye-washing fountains and other protective service installations.

6.1.2 Employees should be instructed to check vents frequently which may become plugged due to the solidification of acetic acid at low ambient temperatures. This may lead to the rupture or collapse of tanks or pipelines, particularly if fabricated from aluminium, due to pressure differentials built up in loading or unloading. It is desirable to design out this danger as far as possible. Instructions should be given regarding when, how and where to use the personal protective equipment. They should be aware of the places where they are kept. All employees who are constantly engaged in processes involving the handling of acetic acid should have a careful physical examination at least once each year.

6.2 Non-Respiratory Equipment

6.2.1 Eye and face Protection

Wear face shield or eye protection in combination with breathing protection *see* IS 8520..

6.2.2 Head Protection

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 liquid leaks and splashes.

6.2.3 Foot and leg Protection

Leather safety shoes with built-in steel toecaps are recommended for workers handling drums and cans of acetic acid *see* IS 10667. Alternately rubber gumboots must be used while handling acetic acid. Leather leg guard is recommended. Shoes should be thoroughly cleaned and ventilated after contamination.

6.2.4 Body, Skin and Hand Protection

Protective clothing, aprons, shoes, gloves and hats, made of rubber or an equivalent impermeable material, synthetic resins which may be soluble in acetic acid shall not be used *see* IS 8519. Chemical safety goggles for protection against splashes or irritating concentrations of vapour. Respirators, if the vapour concentrations are sufficiently high. Safety showers *see* IS 10592 shall be provided in readily accessible areas where acetic acid is being handled. These should be inspected and tested regularly and maintained in the working condition at all times. A special eye washing fountain, a ready source of running tap water or a hose with gentle flow of drinking water shall be provided for eye irrigation. It should be frequently inspected and maintained in good working condition at all times.

6.3 Respiratory Equipment

6.3.1 Respirator Selection (*Upper Limit Devices*)

6.3.1.1 Up to 50 ppm:

- a) (APF=25) Any supplied –air respirator operated in a continuous –flow mode.
- b) (APF=25) Any powered, air –purifying respirator with organic vapor cartridge(s)
- c) (APF=50) Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s)
- d) (APF=50) Any air-purifying, full –facepiece respirators (gas mask) with a chin –style, front-or back-mounted organic vapor canister
- e) (APF=50) Any self-contained breathing apparatus with a full facepiece
- f) (APF=50) Any supplied –air respirator with a full facepiece

6.3.1.2 *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

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

6.3.1.3 *Escape*

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister

6.3.2 Any appropriate escape-type, self-contained breathing apparatus

7. STORAGE, HANDLING, LABELLING AND TRANSPORT

7.1 General

All personal handling acetic acid should use proper personal protective equipment. Appropriate fire fighting equipment should be available in the vicinity while handling acetic acid. Persons handling acetic acid should have adequate training in use of fire fighting equipment.

7.2 Storage

7.2.1 *Corrosion of Containers*

Acetic acid is very corrosive, particularly when dilute. It attacks most common metals and is best stored in aluminium, duriron, hastelloy, stoneware, stainless steel or glass-lined containers. All types of stainless steel are not sufficiently resistant and it is recommended that types 316 or 318 be used. Organic linings, such as synthetic resins or rubber are not satisfactory for prolonged contact and should be carefully selected after testing their suitability for the duration of contact. Dilute acid will corrode aluminium.

7.2.2 *Tanks*

Storage tanks may be constructed of aluminium or stainless steel. Aluminium, in contact with acetic acid, is slowly attacked with the consequent formation of a layer of aluminium oxide over the surface. This prevents further corrosion, but the oxide may also be suspended in the acid giving it a cloudy appearance. Continued formation of aluminium oxide shall result in the formation of a layer of sludge at the bottom of the tank which should be cleaned out at regular intervals. Vents for the tanks should be properly sized and, if necessary, steam-traced to prevent plugging with solid acetic acid.

7.2.3 Where low ambient temperatures might be expected, tanks for storing glacial acetic acid should be provided with heating arrangement to prevent the contents from freezing. Care should be taken not to heat the acid to boil.

7.2.4 Outdoor storage tanks should preferably be liked as a precaution against tank failure.

7.2.5 Gauge glasses should be guarded.

7.2.6 Tanks should be located at a safe distance away from possible sources of ignition.

7.2.7 *Drums and Carboys*

Where drums and carboys are stored, natural ventilation is normally adequate. If vapours are present in sufficient concentrations to cause irritation, forced ventilation is required. Glass carboys used for storage of acetic acid should be of sound construction and kept in strong individual wooden or metal crates. Care shall be taken to see that the ambient temperature does not fall to or below the freezing point of acetic acid.

7.2.8 Filled boxed carboys of acetic acid should not be tiered more than three carboys high. Empty boxed carboys should be stored on their flat side, not over four tiers high, in such a manner that the necks will not protrude into aisles or passageways.

7.3 Handling

7.3.1 Since the vapours of acetic acid are irritating to the eyes, they should be adequately protected whenever it is present in any considerable amount.

7.3.2 The carboys shall not be carried on shoulders. Suitable devices, like tipple and siphon pump, should be used for removing contents. Care should be taken in cold weather to avoid sudden movement of glass carboys containing lumps of solidified acid.

7.3.3 Be sure that the closures are securely fastened -before moving either filled or empty carboys.

7.3.4 Place a cap or boot over the neck of the carboy before moving it.

7.3.5 Use specially designed hand-trucks for transporting individually boxed carboys about the plant. Do not use hooks.

7.3.6 Never handle carboys by the closure or the neck.

7.3.7 Never 'walk' a carboy on the edge of the box.

7.3.8 When removing full or empty boxed carboys from storage tiers, trucks or cars and when stacking full or empty carboys, the neck of the bottle shall never be tilted towards the workman.

Spills and Leakage-An unusually strong odour of acetic acid is a good indication of spillage or leakage. Material may be flushed with water or neutralized by readily available basic compounds, such as soda- ash. Neutralization is preferable since this minimizes the corrosion of sewer lines.

Fire and Explosion - In case of fire, water, carbon dioxide and dry chemical extinguishers are recommended.

7.4 Labelling

7.4.1 Each container (including tankers) should carry an identifying label or stencil depicted 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 must be labelled "FLAMMABLE LIQUID".

7.4.3 Each tanker and each railroad car carrying one or more containers of acetaldehyde must bear the "DANGEROUS" placard in addition.

7.4.4 The lower half of the label shall have the following information printed in red letters. Any other label, warning or statement required by statutes, regulations or ordinance may also be used in combination or separately.

<p>ACETIC ACID DANGER ! Causes severe burns. Don't get liquid or vapour into eyes or on skin or clothing. Keep away from heat and open flame. In case of contact, immediately flush skin or eyes with plenty of water for at least 15 min. Get medical attention.</p>
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7.5 Transport

7.5.1 Containers generally used for transport of acetic acid are:-

- a) Tank cars
- b) Drums
- c) Carboys

7.5.1.1 Tank Cars

Tank cars should be spotted accurately on level track at unloading station. Brakes should be set and wheels blocked. In cold weather, the contents may freeze and in that case the contents shall be thawed by steam heat. Vents of tank cars shall be opened to avoid pressure built-up before heat is applied. The bottom end of the tank, opposite the steam inlet, will be the last part to thaw. When this section of the tank is warm to the touch, heating may be discontinued. The time required for heating will vary depending upon temperature and weather conditions. Care shall be taken that the acid is not heated to a boil.

7.5.1.2 Tank cars may be emptied through a dome education pipe or through the bottom outlet, using air pressure or pump. If air is used, the pressure shall not exceed the maximum stencilled on the car since excess pressure may seriously damage aluminium cars. If the safety disk is ruptured, it shall be replaced by a disk furnished by the supplier. Do not use a substitute disk under any circumstances.

7.5.1.3 Before unloading through bottom outlet, heat valve leg thoroughly with live steam to melt any solid acetic acid present. Before removing bottom outlet cap, open and close valve to make sure that it is working freely.

7.5.1.4 Make sure that vents are working properly when emptying through a pump. It is possible that the tank may collapse due to decrease in the internal pressure as the contents are removed. To ensure against such collapse, the dome cover should be left slightly open.

7.5.1.5 After making sure that the valve is closed, cautiously remove cap from outlet and connect to unloading line. Empty tank car completely before disconnecting.

7.5.1.6 Replace all covers, caps, etc, and blow out heater coil with compressed air until free from condensate. Do not replace plugs in inlet and outlet connections of heater coil during cold weather. The ends shall be left open to permit any residual moisture to drain out freely and prevent freezing in the coil.

7.5.1.7 In the event of any difficulty in unloading, contact supplier at once for instructions. Report any damage or defects in car when returning it. Do not attempt to wash out.

7.5.2 Drums

Drums are preferably emptied through a stainless steel valve and nipple assembly which fits the bung on the end of the drum. Never apply air pressure to aluminium drums in order to transfer contents. The drum may be seriously damaged, if not ruptured.

7.5.3 Carboys

When opening carboys, always keep the hands and face to the side of the carboy neck never over it. In the case of big carboys, the recommended method of removing the wire holding the stopper in place is to use a wire cutter, preferably the face type. Never attempt to remove the wire by twisting or prying. To do so will frequently break the neck of the bottle and injure the workman. Never use air pressure to empty carboys. Use a tilter especially designed for the ‘purpose, or a safety siphon fabricated of material resistant to acetic acid. Make sure that the solid acetic acid, if any, is completely thawed. The shifting of masses of solid acid may result in breakage of carboys.

7.5.4 Driver

Only driver trained in acetic acid handling should be employed for transportation of acetic acid. Driver should carry TREM card when vehicle is on road.

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.

7.6 Cleaning and Repairs of Tanks

7.6.1 Periodic cleaning of equipment is necessary and frequency of cleaning will be determined by experience. Aluminium equipment requires cleaning due to accumulation of aluminium oxide sludge. Cleaning crew shall be thoroughly instructed in the job and its hazards.

7.6.2 Disconnect tank completely and, if possible, blank-off openings.

7.6.3 Tanks and equipment shall be thoroughly purged, before cleaning and repairs, by steaming and washing with water. Before workmen enter the tank, a competent person shall check the effectiveness of the purging and any possible oxygen deficiency.

7.6.4 Protective equipment shall be provided as necessary (see 6).

7.6.5 A safety belt and life line for a man entering the storage tank shall be provided. A man on the outside of the tank shall keep the men in the tank under constant observation and at least two other men shall be available to help those in the tank in case of trouble.

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 acetic acid.

8.2 Spills and Leakage

An unusually strong odour of acetic acid is a good indication of spillage or leakage. Material may be flushed with water or neutralized by readily available basic compounds, such as soda ash. Neutralization is preferable since this minimizes the corrosion of sewer lines.

8.3 Waste disposal

Waste acetic acid may be flushed away with water with due regard to local, state and central laws regulating the health and pollution. As a safeguard against corrosion of sewer lines, the waste acid should first be neutralized with any readily available basic compounds, such as soda ash, acetate salts so formed are all water soluble and are easily flushed away.

9. FIRE PREVENTION AND FIRE FIGHTING

9.1 General

Leakage from containers may come in contact with metals and generate hydrogen. This, in confined spaces may cause explosion or fire. Although not classed as a flammable liquid, acetic acid, if ignited, will burn in air. In case of fire, water, carbon dioxide and dry chemical extinguishers are recommended. Vapours may cause a flash fire or ignite explosively. Vapours may travel considerable distance to a source of ignition and flash back. Heat may cause sealed containers to explode. As in any fire, wear self-contained positive pressure or pressure-demand breathing apparatus and full protective gear.

9.2 Prevention

9.2.1 Use water spray to cool unopened containers. Cool containers exposed to flames with flooding quantities of water until well after the fire is out. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire.

9.2.2 Move containers from fire area if you can do so without risk. Some of these materials, if spilled, may evaporate leaving a flammable residue. In the event of fire and/or explosion do not breathe fumes.

9.3 Fire fighting

Acetic acid is controlled with Water, dry powder, foam, carbon dioxide water.

10. TRAINING

10.1 Prior to assignment to processes involving the handling of acetic acid, all individuals should have a replacement physical examination and, in order to properly protect their health, those who have the following conditions should be excluded from assignment to such processes:

- a) Chronic skin conditions,
- b) Chronic diseases of the upper respiratory tract and the lungs,
- c) Only one eye and
- d) Uncorrected highly faulty vision.

10.1.1 Employees should be instructed primarily in regard to the corrosive properties of acetic acid and safe handling procedures.

10.1.2 Employees should be thoroughly familiar with the location and operation of safety showers, eye-washing fountains and other protective service installations.

10.1.3 Employees should be instructed to check vents frequently which may become plugged due to the solidification of acetic acid at low ambient temperatures. This may lead to the rupture or collapse of tanks or pipelines, particularly if fabricated from aluminium, due to pressure differentials built up in loading or unloading. It is desirable to design out this danger as far as possible.

10.1.4 Instructions should be given regarding when, how and where to use the personal protective equipment. They should be aware of the places where they are kept.

10.1.5 All employees who are constantly engaged in processes involving the handling of acetic acid should have a careful physical examination at least once each year.

11. HEALTH MANAGEMENT, FIRST-AID AND MEDICAL TREATMENT

11.1 Health Monitoring

11.1.1 *Personal Hygiene*

11.1.1.1 Employees should bath daily after finishing work. They should report any abnormal condition of the mouth or skin to medical department.

11.1.1.2 Food should not be stored or eaten near the place where acetic acid is being handled.

11.1.2 *Physical Examination*

11.1.2.1 *Pre-placement physical examinations*

Pre-placement medical examination of all employees who are constantly engaged in processes involving the handling of acetic acid should have a careful physical examination at least once each year.

11.1.2.2 *Periodic examination*

The extent of medical or dental control depends upon the amount of exposure to acetic acid. Where there is a prolonged exposure to open acetic acid, the following procedures are recommended.

11.1.2.3 *Medical examination*

An annual physical examination should be conducted for each employee who is constantly exposed to acetic acid. He should be instructed to report any illness, or any disorder of skin that he experiences.

11.1.2.4 *Dental examination*

Periodical dental examinations may be conducted.

11.2 **First Aid**

11.2.1 *General principles*

First-aid treatment should be started at once in all cases of contact with acetic acid in any form otherwise serious injury may result. Refer all injured persons to a physician even when the injury appears to be slight. Give the physician a detailed account of the accident.

11.2.2 *Contact with Skin*

11.2.2.1 Remove contaminated clothes. Rinse and then wash skin with water and soap. Rinse skin with plenty of water or shower for at least 15 min. Refer immediately for medical attention. Whenever acetic acid comes in contact with skin, the speed in removing it is of primary importance. First aid shall be started immediately in cases of contact with acetic acid as delay in initiating treatment may result in injury.

11.2.2.2 Apply copious quantity of running water. This may best be accomplished while the man is under a safety shower. All contaminated clothing shall be removed immediately. No attempt should be made to neutralize the acetic acid with alkaline solution until all areas of contact have been thoroughly irrigated with running water.

11.2.2.3 In case of severe or extensive burns, shock symptoms, such as rapid pulse and sweating, may appear at any time. The patient should be kept in supine position and a physician should be called in.

11.2.2.4 No oil or ointment should be applied to the affected areas without specific direction from the physician.

Caution—In the case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves. Show this safety data sheet to the doctor in attention.

11.2.3 *Contact with Eyes*

Protect unexposed eyes. Rinse/Flush exposed eyes gently using water for 15 min to 20 min. Remove contact lenses if able to do so during rinsing. Seek medical attention if irritation persists or if concerned. The eyelids should be held apart during the irrigation to ensure contact of water with all the tissues of the surfaces of the eyes and lids. A physician, preferably an eye specialist, should be called in attendance at the first possible moment. After the first 15 min period of irrigation is completed, it is permissible as a first measure to instil two or three drops of 0.5 percent solution of pontocaine or an equally effective aqueous topical anesthesia. No oils or oily ointments should be instilled unless ordered by the physician.

11.2.4 *Ingestion*

Rinse mouth thoroughly. Do not induce vomiting. Have exposed individual drink sips of water. Seek medical attention if irritation, discomfort or vomiting persisted. Ingestion of concentrated acetic acid causes burns of the mucous membrane of the mouth, throat, oesophagus and stomach. Do not attempt to induce vomiting in patients who have swallowed strong solution of acetic acid. If the patient is conscious, encourage him to wash out his mouth with copious quantity of water, then have him drink milk, if available, mixed with the whites of eggs. If these are not immediately available, have him drink as much water as possible. be called in, as soon as possible. Do not give anything by mouth to an unconscious patient.

11.2.5 *Inhalation*

Move exposed individual to fresh air. Loosen clothing as a necessary and position individual in a comfortable position. Seek medical advice if discomfort or irritation persists. Give artificial respiration if necessary. If breathing is difficult, give oxygen. A worker who has been overcome by acetic acid vapours should be removed immediately from exposure to a fresh or uncontaminated atmosphere. If breathing is stopped, an effective means of artificial respiration should be initiated immediately. If oxygen inhalation apparatus is available oxygen should be administered, but only by a person authorized for such duty or by a physician. The patient should be kept comfortably warm, but not hot. A physician should be called in at once.