DRAFT TANZANIA STANDARD

TBS/CDC 7 (5813) P3 Sulphuric acid – Code of safety

TANZANIA BUREAU OF STANDARDS
Foreword

This Draft Tanzania Standard is being developed by the Industrial and Laboratory Chemicals Technical Committee under supervision of the Chemicals Divisional Standards Committee and it is in accordance with the procedures of the Tanzania Bureau of Standards.

This Draft Tanzania Standard is the first revision of TZS 89: 1980 *Sulfuric acid – code of safety*.

In the preparation of this standard assistance has been obtained from the following standards: IS 4262:2002 *Code of safety for sulphuric acid*, published by Indian Standards Institution.
Introduction

Sulphuric acid is an important industrial chemical principally used in the manufacture of fertilizers, chemicals, explosives, textiles, rayon, petroleum refining etc. It is unfortunate that coupled with the important and large volume use of sulphuric acid it is also one of the most corrosive and hazardous chemicals. Handling of sulphuric acid, therefore, presents various hazards which are better prevented than cured. Working according to a sound code of practice will reduce the frequency of hazards and also, in many cases, the amount of damage caused by an accident.

Sulphuric acid is also known by such name as 'oil of vitriol'. Sulphuric acid which has free sulphur trioxide dissolved in it is known as 'oleum' and 'fuming' sulphuric acid since it fumes copiously in contact with air.
Sulphuric acid – Code of safety

1 Scope

1.1 This Draft Tanzania standard prescribes code of safety concerning hazards relating to sulphuric acid. It describes properties and essential information for the safe handling and use of sulphuric acid.

1.2 Though this code does not deal with any specification for the design of building, chemical engineering plant, equipment for waste disposal, general precautionary measures in these aspects should be taken.

2. Normative references

<<<<<<Not applicable>>>>>

3. Terms and definitions

<<<<<<Not applicable>>>>>

4. Properties

4.1 Physical properties

Some of the important physical properties are:

a) Physical state – liquid,
b) Colour – colourless, clear to light brown
c) Odour – None (oleum has sharp penetrating fumes),
d) Flammability – Non-flammable,
e) Hygroscopicity – Very hygroscopic,
f) Relative density (99% acid) at 20°C – 1.834
g) Freezing point 10.5°C, and
h) Boiling Point (98% acid) 330°C.
4.2 Chemical and hazardous properties

Some of the important chemical and hazardous properties are:

a) Reactivity – The acid in its concentrated form is a strong oxidizing and sulphonating agent. It destroys organic matter with evolution of heat and attacks many metals with evolution of flammable hydrogen gas. Contact with such products as nitrates, carbides, chlorates, etc, may cause ignition. Dilution with water evolves considerable heat.

b) Corrosivity – highly corrosive to most metals, particularly at high concentrations with evolution of hydrogen gas.

5 Hazards associated with sulphuric acid

5.1 Health hazards

There are two types of health hazards, namely,

i. hazards having systemic effects and
ii. hazards having non-systemic effects on the skin and eyes

5.1.2 Systemic effects

Inhalation of concentrated vapour from hot acid or oleum may cause rapid loss of consciousness with serious damage to lung tissues. Individual sensitivity to such vapor is variable, 0.125 to 0.5 mg/kg may be mildly annoying, 1.5 to 2.5 mg/kg definitely unpleasant and 10 to 20 mg/kg are unbearable. Particles disseminated from sulphuric acid may cause cough, chronic inflammation, bronchitis through repeated exposures. Severe exposures may cause pneumonitis. Erosion of the teeth also occurs, particularly to those accustomed to mouth breathing. The threshold limit value for a mist of sulphuric acid is 1 mg/ m³ of air.

5.1.1 Non-systemic effects

Sulphuric acid is rapidly destructive to any tissue of the body with which it comes in contact, causing severe burns, which may be accompanied by shock and collapse. Contact with eyes very rapidly causes severe damage which may be followed by total loss of sight. Repeated contact with dilute solutions may cause dermatitis. Swallowing of the acid may cause severe injury or death.

5.2 Fire and explosion hazards

The acid is non-flammable but in higher concentration may cause ignition by contact with organic or combustible materials and such products as nitrates, carbides, chlorates and metallic powders. There is likelihood of highly flammable
hydrogen gas being generated inside a drum, tank car or a metal storage tank containing sulphuric acid. In as much as hydrogen gas will form explosive mixtures with air under certain conditions, smoking or open lights should not be permitted near the open drums or tank cars. The acid, in contact with metallic sulphides, may cause evolution of hydrogen sulphide and may become a source of ignition.

6 Storage and handling

6.1 Sulphuric acid is highly corrosive to most metals. For concentration from 93 to 99%, it may be stored satisfactorily in acid resistant tanks, drums and glass carboys. For concentration below 93%, it shall be stored in glass carboys, earthenware jars or other suitable containers lined with acid-resistant materials. Storage should be located in the open or in well-ventilated buildings or sheds. Natural ventilation is sufficient. Sulphuric acid stored in any type of metallic container would evolve hydrogen which is highly flammable and explosive. Pressure inside the container may build up on this account. Such pressure should be provided with safety vents.

6.2 Even small quantities of sulphuric acid should be stored away from other chemicals, especially organic materials, nitrates, chlorates, carbides, metal powders, oxidizing chemicals, peroxides and explosives.

6.3 Containers of sulphuric acid should be inspected regularly for leakages. Damage containers should be handled with special care.

6.4 Electrical wiring should be made of acid-resistant insulation and encased in rigid metal or polyvinyl chloride conduits. Smoking shall be strictly prohibited where sulphuric acid is stored.

6.5 Each storage tank should be provided with a vent of sufficient size. The vent should be of a type which will maintain the tank at atmospheric pressure and which is capable of being cleaned easily. For inspection, the top of the tank should be accessible by an independent metallic ladder without the use of the top of the tank which is likely to corrode due to action of acid mist.

6.6 All tanks should be placed squarely on good foundation and raised off the round by at least two layers of acid-proof bricks. The tanks should be mounted with a slight slope towards the sludge hole or outlet valve. A plug operated from the top of the tank should be provided over the outlet valve. Gauge glasses in acid tanks should be avoided.

6.7 Drums should be stored with the plugs up. Storage period of acid in drums should be kept to a minimum. They should be vented once a week or earlier in hot weather to release hydrogen build-up.
6.8 Glass carboys used for storage of sulphuric acid should be of sound construction and be kept in strong individual wooden crates. Suitable devices like tippler, siphon pump, etc, should be used for removing contents.

6.9 Glass carboys should be stored on a bed of limestone dust or calcareous sand.

6.10 Glass carboys continuing acid should not be stored more than half a metre high. After their contents have been removed attempt should be made to wash the carboys with water. They should be drained off as completely as possible and used either to refill with the same acid or returned to the supplier.

6.11 Floors of the storage area should be of acid-resistant material and should have adequate slope for easy draining of any spilled acid. Before the acid is allowed to enter the main sewer, it should be collected in a catch pit, sufficiently diluted and suitably neutralized. Water should be freely available to dilute such spillage.

7 Packaging and labelling

7.1 Packaging

Sulphuric acid is classified as a corrosive liquid. As such, it shall be packed in specified containers. Acid resistant barrels or lorry tankers may be safely used for transport of acid having a specific gravity higher than 1.8354 or 66°Be.

7.2 Labelling

Each container (including tank cars) shall carry an identifying label and containing the following information:

- a) Sulphuric acid (or oleum)
- b) Danger! Causes severe burns
- c) Avoid breathing vapour (oleum)
- d) Avoid contact with eyes, skin, or clothing. In case of contact, flush affected part with water for at least 15 minutes.
- e) Do not add water to contents. Do not store with explosives and metallic powders. Reacts with metal and gives off hydrogen which is flammable and explosive. Wash off any spillage of the acid with liberal quantities of water.
- f) Safety and Warning illustrations/signs such as
Poison/danger (sumu/hatari); followed by a skull and bones symbol.

Corrosive acid (inachoma) followed by the symbol.

8 Preventive measures

8.1 Handling of sulphuric acid presents various hazards, which may be avoided by observing the important precautions set below:

a) Avoid contact of sulphuric acid with eyes, skin and clothing,

b) Wear rubber gloves, goggles, acid-proof aprons and boots while handling sulphuric acid or oleum

c) Never add water or caustic solution to sulphuric acid. While diluting always add acid to water with constant stirring.

d) In the event of accidental contact, wash affected areas with plenty of water for at least 15 minutes. Irrespective of the degree of seriousness of an accident, first-aid or medical attention, or both, should be rendered at the earliest opportunity.

e) In case of spillage of sulphuric acid it should be first washed down with large quantities of water. Mild alkaline solution may be used afterwards to neutralize the last traces of the acid.

8.2 Spills and leakages

Spilled acid should not be left unattended. Wash with water or cover with dry sand, ash or gravel, if the use of water is impossible. Remaining traces of acid should be neutralized with soda ash or lime. Do not mop up the acid with cloth or rags.

8.3 Personal protection

8.3.1 General
Personal protection scheme depends upon the effectiveness of employee’s education, training and supervision. Personal protective equipment and pre-
placement physical examinations are precautionary measures to avoid accidents and not a substitute for safe working on the part of the personnel. Prior to assignment of processes involving the handling of sulphuric acid, all individuals should have a careful pre-placement physical examination.

8.3.2 Personal protective equipment

8.3.2.1 Employees handling sulphuric acid should be provided with the following equipment:

a) Safety helmets,

b) Rubber gloves (acid resistant),

c) Rubber high top safety boots and rubber aprons. A rubber acid suit is recommended for tanks wagon loading or unloading.

d) Suitable gas-tight chemical safety goggles and

e) Approved masks and breathing apparatus with full face pieces

8.3.2.2 Adequate personal protective equipment shall be available for emergency use throughout the plant or in area where sulphuric acid in stored or used. Personnel should be trained to appreciate the process hazards and the emergency and routine use of personal equipment. Personal protective equipment should be Eye fountains, emergency showers, and drench tubs covered with a thin sheet of polyethylene to keep the water clean, should be located in all areas where there is danger of acid splashing.

9 First-aid

9.1 Speed in removing sulphuric acid is of primary importance. First-aid should be given in all cases of contact with sulphuric acid in any form, as delay in initiating treatment may result in serious injury.

9.2 General first-aid

9.2.1 Apply copious quantity of running water. This is best provided for by situating readily accessible, well-marked, frequently-inspected, rapid action safety showers.

9.2.2 Do not neutralize the acid with alkali. The heat of neutralization actually accentuates the burn.

9.2.3 In case of excessive burns the patient may collapse or show shock symptoms, such as rapid pulse and sweating. Keep the patient in supine position (lying down on his back) and call the nearest physician.
9.2.4 No oil or ointment should be applied to affected areas without specific orders from the physician.

9.3 Contact with eyes

The following precautions should be observed even if minute quantities of strong or dilute solutions of sulphuric acid enter the eyes:

Immediately flush with copious quantity of running water for at least 15 minutes. A special eye-washing fountain, a ready source of running tap water or a hose with a soft gentle flow of drinking water should be available for eye flushing. The eyelids should be held apart during flushing to ensure contact with eye tissues. A physician preferably an eye specialist should be called in without delay. If pain persists, the eye flushing should be continued for a second period of 15 minutes. After the first phase or eye washing instill 2 or 3 drops of 0.5% solution of pinolcaine or any equally effective aqueous topical anesthetic. No oil or oily ointment should be applied unless prescribed by the physician.

9.4 Ingestion

Ingestion of even dilute solutions of the acid causes severe burns of the mucous membrane of the mouth, throat and stomach. Observe the following:

a) Do not attempt to induce vomiting.

b) Do not give anything oral to an unconscious patient.

c) If the patient is conscious, encourage to wash out mouth with water and give milk with egg-white to drink.

d) If these are not immediately available give as much water as possible for drinking.

e) Call on a physician as soon as possible.

9.5 Inhalation

A worker exposed to sulphuric acid mist or oleum vapour should be at once removed to an uncontaminated area and physician called at once. Oxygen may be administered by an authorized person only. If breathing has apparently ceased, artificial respiration should be started immediately.

10 Protection of maintenance crew

The hazardous nature of tank inspection, cleaning or repair requires that the maintenance crew be carefully trained for the purpose. All tank work should be done under the direct supervision of a foreman. The following precautions are recommended;
10.1 Pipelines in or out of the tank or other apparatus should be shut off or disconnected preferably by removing a complete small section and a black flange should be installed on the open end to protect against human error and unsuspected leak.

10.2 Before entering a tank, it should be tested whether further washing is necessary, and that no harmful gas or vapour is present.

10.3 Proper personal protective equipment should be worn by any one entering a tank for inspection, cleaning or repairs.

10.4 The tools used for working inside plants should be of no-sparking type.

10.5 A safety belt and life line for a person entering the storage tank should be used. A person outside the tank should observe those in the tank constantly and at least two other persons should be available to help in case of trouble.

11 Disposal of used containers and waste material

11.1 Disposal of empty containers

11.1.1 Before returning, completely drain the contents and tightly close all openings.

11.1.2 Do not use sulphuric acid containers for any other liquid.

11.1.3 Drums should be emptied by gravity only with the use of a faucet or safety siphon fabricated from the material resistant to sulphuric acid. Application of pressure to the drum for this purpose is extremely dangerous and should never be attempted.

11.2 Disposal of waste

Sulphuric acid waste should be diluted and neutralized before discharge into sewers. Limestone or soda ash may be used as neutralizing agents.