Safe Storage of Chemicals

Policy Document

Policy Document: Safe Storage of Chemicals (including chemical compatibility)

Table of Contents

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1 Introduction

The safe storage of chemicals is essential in order to provide for the effective management of chemicals, lessen the risk of fire, prevent accidental mixing in emergencies, and to minimise exposure to corrosive and toxic chemicals. Safe storage begins with identification of the chemicals to be stored and their intrinsic hazardous properties.

- The first principle of safe storage - Separate and isolate your most serious hazards. Never store chemicals alphabetically outside their segregation group. Segregate and store chemicals according to their compatibility and hazard category. It is essential to segregate antagonistic substances to prevent dangerous interactions. All newly purchased chemicals should now have a label on them identifying their hazard category *viz*. corrosive, flammable, oxidising, toxic etc.

- The second principle of safe storage - Store minimum quantities. The less you have—the smaller your risk.

Store the minimum stock levels of hazardous chemicals in the laboratory. When large quantities of hazardous chemicals are bought they should be stored in departmental chemical store.

2 Purpose

2.1 To reduce the risks to health for University members, property and environment that could potentially be exposed to hazardous chemical substances, by:

- ensuring that all hazardous chemicals be stored in safe facilities that are standardised throughout the University of Cape Town
- All chemicals are on University grounds are recorded as to what they are, where they are stored and the quantities stored.

2.2 To assure compliance with the requirements of South African law

3 Objectives of this Management Guide

3.1 To ensure the protection of University members, property and the environment.

3.2 To give guidelines on how store chemicals in the safest possible way.

3.3 To work in conjunction with the University of Cape Town Hazardous Substance Policy, Hazardous Substance Programme (notably the keeping of chemical inventories); the Management Guides – Categorizing, Control Banding and Toxicological Scoring of Hazardous Substances; and The Control of Hazardous Substances

3.4 This document does not deal with the storage of Hazardous Biological Agents (HBA's) or Radionuclides. Each of these has their own dedicated advice sheets

4 Scope and Standards

This management guide applies to all facilities on University grounds and to all members of the University.

The University of Cape Town Safe Storage of Chemicals Management Guide shall be complied with as a minimum standard wherever practicable.

This Policy will be reviewed annually from the date of implementation or when deemed necessary.

5 Acknowledgements

Thanks for all their assistance goes to Dr Gregory Kew – Occupational Health Practioner; Dr Laura Roden – Department of Molecular and Cell Biology, University of Cape Town; Lillian Nsomi-Campbell, Physical Planning Unit, University of Cape Town: Sue Aspinall – Department of Plant Sciences, University of Cambridge; Margaret Cooper – Institute of Child Health, University of Cape Town and Barry Platen – Health and Safety Department, University of Cape Town.

6 Important Notes on Storage

- In line with the University of Cape Town Policy (see Management Guides – Categorizing, Control Banding and Toxicological Scoring of Hazardous Substances; and The Control of Hazardous Substances) before storage all chemicals have to be hazard assessed, dated and labelled accordingly.
- Since many chemicals have several hazards, which may vary in degree of severity depending on quantity and concentration, it is often difficult to determine what protection is needed for safe storage and where best to store a particular chemical. If the chemical exhibits more than one hazard then segregate by the characteristic of its primary hazard.

  Separation, segregation or isolation is recommended depending upon the severity of hazard, total quantities stored, and the size and break resistance of individual containers. It is important to note that chemical compatibility must take preference when storing chemicals. Material and size of storage containers will also affect the need for special storage practices and safety procedures.

  Never store chemicals alphabetically outside their segregation group

- As always with chemicals, follow the University *Policies on Hazardous Substances* and *Basic Laboratory Code of Conduct.* Always use Personal Protective Equipment appropriate to the hazard. Never eat, drink or smoke when handling chemical substances, always wash your hands after contact with chemical substances etc.
- Always keep copies of Material Safety Data Sheets for each chemical in each store. Relevant safety information must be kept available with each Safety Representative and or each laboratory manager.
- All chemicals should be regularly inspected for any signs of deterioration in the quality of their labels and containers. If there is any damage to the label then it should be repaired or replaced immediately. This will avoid the possibility of a chemical becoming an 'unknown' with the expense of waste disposal that would bring (see *Policy Document- Hazardous Waste*, and *Management Guide – The Control of Hazardous Waste*).
- Ventilation is needed for chemicals and containers that may release dangerous or damaging quantities of vapours or gases that are flammable, corrosive, irritating or toxic. Ventilation may also be needed for containers and chemicals that may produce annoying odours
- Do not store chemicals in direct sunlight and near heat sources such as ovens, autoclaves and hot pipes.
- Keep Containers closed at all times. Ensure the lids are intact, if not replace
- Ensure chemical containers are intact, if not replace.

- Do not store any chemicals in glass containers on the floor
- Do not place cabinets that are used for chemical storage near an exit or on an escape route.
- Do not store chemicals above eye level. If a storage container were to break, its contents may spill into face and upper body.
- Do not store liquids and solids together as contamination may occur in case of spillages.
- Do not overcrowd shelves
- Chain compressed gas cylinders
- Store chemicals preferably in their original containers
- Do not store chemicals permanently on the open bench. This is an environment where chemicals may get knocked over; where incompatible chemicals can easily get stored alongside one another; and where there is little fire protection. Chemicals stored at the bench or other work areas should be those that are used frequently. Quantities should be limited to only the minimum amount that is required for the day's work.
- With the exception of particularly odorous chemicals, do not store chemicals permanently in fume hoods. Storing chemicals in a fume hood is bad laboratory practice, it can lead to a cluttered work area (a cluttered fume hood may not extract adequately leading to chemical vapours to enter the general work area. Along with storing chemicals on the laboratory bench, the fume hood is also an environment where chemicals may get knocked over; where incompatible chemicals can easily get stored alongside one another; where there is little fire protection.
- Chemicals requiring low temperature storage such as at +4ºC must be sealed with tight-fitting caps and stored in spark-proof lab-safe refrigerators and at lower temperatures in lab-safe freezers.
- All waste materials, used and out of date chemicals, empty containers etc should be treated according to see *Policy Document- Hazardous Waste*, and *Management Guide – The Control of Hazardous Waste*

7 Secondary Containment

Hazardous chemicals or other chemicals whose containers have been opened must be stored in unbreakable secondary containers (for example containers of concentrated acids and bases can be placed into plastic tubs to contain any leakage).

Secondary containment simply means that when a chemical spill develops the spill will be contained and controlled in a secondary area (i.e. specially designed safety storage cabinet) which will reduce the risk of chemical exposure, fire, explosion, etc. Several regulatory agencies have stated that "secondary containment" must be provided and that spill control procedures be adopted for hazardous chemicals. The containment system should have sufficient capacity to contain the volume of containers plus 10% or the volume of the largest container whichever is greater.

8 General rules for building and equipping a chemicals store

- All storerooms must have adequate security. Only authorised personnel may have access to these facilities.
- A chemical substance store should be physically separated from any building or room that maybe be affected by what is housed within the store, this should be by means of fire resistant material rated to at least two hours
- It should be constructed with material with a minimum fire resistance of two hours
- Will be constructed with secondary containment as defined in section 9
- Will have adequate ventilation so that vapour cannot accumulate within. This includes mechanical ventilation from floor to ceiling, exhausted above roof level and ventilated to open air.
- Should have adequate shelving that is non-porous and non-combustible and preferably avoiding metal, adjustable shelf supports. The shelving should have anti-roll lips. Shelves should be firmly attached to walls. Preferably avoid island shelving.
- The chemical store should be properly labelled as such, and also carry the hazard labels for the hazard group store within. It should also be labelled with the quantity of substances stored within.
- The store should be equipped with personal protective equipment (PPE) and facilities for storing PPE to be used within where contamination can be prevented.
- The store should also have washing facilities appropriate to the hazard, available.
- The store should be equipped with smoke detectors. With fire extinguishers and chemical spill kits appropriate to the hazard and approved eye/face wash and shower readily available.
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9 Chemical Storage in the laboratory/Work Area

Laboratories and work areas are not store rooms. This applies to chemicals, solvents and equipment.

- Only hold small quantities, do not stockpile.

10 Dangerous Chemicals / Hazardous Chemical Substances (HCS), including rules for building and equipping specialist storage facilities

'Dangerous chemicals are chemicals which due to their intrinsic properties may cause damage to health, the environment or property. They are classified pursuant to the nature of the hazard and the method of handling.'

From Chemicals Act, *European Union Occupational Safety and Health Research, 6 May 1998*

If it is necessary to store dangerous chemicals at low temperatures the fridge or freezer used should be fitted with a lock.

One would need to 'hazard classify' the chemical in question to ascertain if the chemical should be treated as 'dangerous'. The MSDS related to the chemical in question should give the relevant information to be able to classify the chemical. Hazardous/dangerous chemicals includes those that are classified as harmful; corrosive; irritant; oxidizing; harmful to the environment; flammable; highly flammable; extremely flammable; explosive; sensitizing; toxic; very toxic; mutagenic; and toxic to reproduction. The R or Risk values that are attributed to a substance are a handy guide to hazard classification (see Guidance Note *EU Risk Phrases*)

Policy Document: Safe Storage of Chemicals (including chemical compatibility)

According to SABS 0265:1999 'Dangerous substances and preparations shall be identified and classified in terms of the hazard they pose to humans, animals, and the environment. In the hazard identification and hazard classification the following properties and potentially adverse effects of these substances and preparations shall be taken into account.

a) explosiveness; b) oxidizing potential; c) flammability; d) toxicity; e) harmful to health; f) corrosiveness; g) irritation; h) sensitization; i) carcinogenicity; j) mutagenicity; k) toxic to reproduction; and l) danger to the environment'

One can find a large proportion of substances normally offered for sale and handling have already been hazard classified and are listed in different annexes in SABS 0265:1999 (Clause 2 Annex C; Annex D); SANS 10228:2003 (Clause B.2 and Annex C) and the Occupational Health and Safety Act, 1993 (Tables 1, 2, and 3). These lists are not definitive and are to be used as a guide. SABS 0265:1999 5.1.4 States "a substance not listed in clause C.2 of annex C, or listed without concentration limits, can be hazard classified on the basis of

a) the physiological properties of the substance, or
b) available results obtained from animal tests"

Poisonous Fumes: SABS 0400-1990 mentions that if one has a store and the contents are "liable, in the event of a fire, to cause combustion with extreme rapidity or give rise to poisonous fumes, or cause explosions" then it will fall into the J1 occupancy definition. One will then have to build the store to conform to J1 rules. It can be read that if the contents are not going to cause combustion with extreme rapidity then the store will not have to follow the flammable store rules. However, it will have to still be built with a 120min fire resistance (wall, floor, ceiling and door), with extraction etc. (Please refer to SABS 0400-1990 for requirements for J1 Occupancy)

There are groups of dangerous chemicals that will need their own specialized storage, these are listed below

10.1 Acids: Small quantities can be stored safely inside a vented cabinet so long as they are in a containment tray to contain any spillages. According to ISO 15189, acids and alkalis or other hazardous liquids should be stored below eye level and large containers should be stored near the floor, but at a height that allows for safe ergonomic handling.

Large quantities can be stored safely inside a secure room with a mechanical exhaust ventilation system designed to provide at least six air changes per hour. Contaminated air should not be circulated or allowed to re-enter into another makeup air unit intake. Acid chlorides and other materials which liberate acid fumes can also be stored in a similar way. Alkalis are incompatible materials which must be stored separately. All inorganic acids (except nitric acid), and all regulated organic acids should be stored in a cabinet constructed of corrosion resistant material. Acids may be stored with bases, but fumes from acids and bases may produce a coating of salt crystals on the outside of reagent containers. Steel cabinets are not recommended for phenol, nitric or sulphuric acids. Nitric acid should be stored separately from acetic acid, either in an isolated portion of the acid cabinet, or in the polystyrene container in which it was shipped. Fuming nitric acid should never be used.

10.2 Alkalis: Even although these materials are marked with a corrosive label, as are acids, they must be stored separately from acids since any accidental mixing of the concentrated materials will generate large quantities of heat and fumes.

10.3 Bases: All strong bases, such as high molar concentrations of sodium hydroxide, potassium hydroxide, or ammonium hydroxide should be stored in a dedicated corrosive chemicals cabinet that is coated with corrosion-resistant material. However solids can be stored on the shelf with the other dry chemicals.

10.4 Carcinogens, Mutagens and Substances Toxic to Reproduction : must be stored in closed containers, clearly labelled with visible warning signs and University category labels (Z4 or Z5 – see management guide: Categorizing, Control Banding and Toxicological Scoring of Hazardous Substances).

All containers must be kept segregated from other chemicals on a lockable and preferably ventilated cupboard. This cupboard will need to be fitted with trays for secondary containment to contain spillages. The cupboard will need to be clearly labelled 'Carcinogens'. Access will need to be restricted to the designated members of staff.

10.5 Chlorinated solvents: are best stored in ventilated rooms separately from flammable solvents, because there are violent reactions when certain flammable solvents and chlorinated solvents are allowed to mix. Also, when chlorinated solvents are involved in a fire they can generate toxic gases such as phosgene. They should not be stored with alkali metals such as lithium, potassium or sodium, since any mixing may cause an explosion. They can be stored in metal bins if ventilated storage is not available.

10.6 Oxidisers: are best stored separately from other materials. Ideally, they should be stored in a bin or cabinet made from metal or other non-organic material. They should not be stored where they can come in contact with wooden shelves or paper

10.7 Poisons: must be stored in a well identified locked cupboard in a controlled store room and a list kept of the contents. Local exhaust ventilation must also be provided. Any poison removed must be signed for. It would be good practice to take the same care in the storage of other highly toxic substances. Chemical suppliers should indicate whether a substance is a poison at the time of purchase and will normally have a special order procedure for such materials.

Volatile toxic substances should be stored in ventilated storage cabinets. When lower temperatures are necessary then explosion proof refrigerators and freezers designed for this purpose must be used.

10.8 Flammable chemicals: Quantities over 40L with a closed cup flash point <40°C (definition of flammable by SABS 0400-1990, Code of practice for The application of the National Building Regulations) would be deemed as a J1* Occupancy requirement (as defined by the same regulations) and therefore should be stored in a specialised flammable store.

As defined by the *Occupational Health and Safety Act*, *General Safety Regulations*, *Section 4: Use and Storage of Flammable Liquids (*Please also refer to *Appendix 2; 11257 Western Province By-Law Relating to Community Fire Safety* for additional requirements), every flammable liquid store should be:

1. separated by means of fire resisting material with a fire-resistance of two hours from any room, cabinet or enclosure.
2. constructed of fire-resisting materials with a fire resistance of two hours
3. constructed in such a way that, in case of spillage, a volume of the flammable in question equal to the quantity of flammable liquid ordinarily kept in store plus 10% of that quantity, can be contained
4. ventilated to the open air in such a manner that vapour cannot accumulate inside the store
5. clearly marked with a sign indicating that it is such a store and also indicating the amount of flammable liquid which may be stored therein.

In addition the store should be fitted with spark proof light fittings (see SABS 0400 building reg's), and that the secondary containment (by way of recessing the floor below the door threshold or providing a sill) floor being made of concrete or suitable impervious material.

The store room should be properly labelled e.g. "Store for flammables" or "Flammables Store" – "Bewaarplek vir vlambare stowwe" in 100mm block letters, and "No Smoking – Rook verbode" signs.

Flammable chemicals must not be stored in ventilated rooms where the airflow will fan any fire and may also spread the fire to other parts of the building via the ventilation ducting. Where natural ventilation is not practicable or when the well is greater than 300mm in depth then mechanical ventilation will be necessary. Ventilation should be directly to the outside, and provide 30 air changes per hour, through vertical metal ducting that reaches at least to 1 metre above roof height or 3.65 metres above the ground level. The ducting should also have a 2 hour fire rating if in contact with the building. The exhaust should be operated by means of a courtesy switch so that it will only operate when the door is opened. This should stop a fire spreading due to airflow from an operating exhaust fanning the spread of fire when the room is unmanned/closed.

A fume cupboard should be provided in the store room to be used when noxious chemicals are supplied in bulk to the University, and then decanted into smaller containers.

For quantities less than 40L a purpose built flammables cabinet incorporating the steps 1-5 mentioned above can be used within the work area.

J1 Occupancy – High risk storage, Occupancy where material is stored and where the stored material in liable, in the event of a fire, to cause combustion with extreme rapidity or give rise to poisonous fumes, or cause explosions. SABS 0400-1990, Code of practice for the application of the National Building Regulations)

11 Segregation and chemical compatibility

11.1 General Information

- Many organic and inorganic materials are combustible. Some have such a high degree of combustibility that they are designated flammable.
- Organic acids (see also the section on acids) are combustible materials and many of them are combustible liquids. Organic acids can safely be stored with flammable and combustible liquids, but they should generally not be stored with mineral acids, which are oxidising and could react more or less violently with organic acids.
- Oxidisers (except ammonium nitrate) must be stored to avoid contact with incompatible materials such as flammable and combustible liquids, greases, ordinary combustibles and other materials that could react with the oxidiser or catalyse its decomposition, including other oxidisers. Oxidizers include such chemicals as: nitrates, nitrites, permanganates, chromates, dichromates, chlorates, perchlorates, and peroxides..
- Ammonium nitrate: Ammonium nitrate should be stored in isolation from all other chemicals.
- Mineral acids (see also the section on acids), including those recognised as strong oxidisers, such as nitric acid, perchloric acid and sulphuric acid should be separated from flammable and combustible materials.
- In addition to the oxidisers that are corrosive or irritating, alkalis/bases are corrosive or irritating. Those that are liquid in large glass containers, such as ammonium hydroxide, should be stored in a separate cabinet or area.
- Toxic chemicals that are acid-sensitive, such as cyanides and sulfides, should be stored in a separate location from acids or protected from contact with acids.
- Dry chemicals can be stored together but organic and inorganic chemicals should be kept separately.
- Metals: All metals, except mercury can be stored together. Metals should be stored separate from all oxidizers, halogens, organic compounds and moisture.

11.2 Chemical Compatibility Table

(updated reference guide from Dept of Molecular and Cellular Biology, University of Cape Town)

Chemical Name	Incompatible with
Acetic acid	chromic acid, nitric acid, alcohols, ethylene glycol, perchloric acid, peroxides, permanganates
Acetic anhydride	Hydroxyl-containing compounds such as ethylene glycol, perchloric acid
Acetylene	Chlorine, bromine, copper, silver, fluorine, mercury
Activated charcoal	Calcium hypochlorite, oxidizing agents
Alkali and alkali earth metals, such as sodium, potassium, lithium, magnesium, calcium, powdered aluminium	Carbon dioxide, carbon tetrachloride, other chlorinated hydrocarbons (also prohibit the use of water, foam, and dry chemical extinguishers on fires involving theses metals- dry sand should be employed)
Aluminium alkyls	Water
Ammonia (anhydrous)	Mercury, chlorine, calcium hypochlorite, iodine, bromine, hydrogen fluoride
Ammonium nitrate	Acids, metal powders, flammable liquids, chlorates, nitrates, sulphur, fine particulate organics, combustible materials
Aniline	Nitric acid, hydrogen peroxide
Bromine	Ammonia, acetylene, butadiene, butane, other petroleum gases, sodium carbide, turpentine, benzene, finely divided metals
Calcium oxide	Water
Carbon, activated	Calcium hypochlorite, other oxidants
Chlorates	Ammonium salts, acids, metal powders, sulphur, fine particulate organics, combustible materials
Chromic acid and chromium trioxide	Acetic acid, naphthalene, camphor, glycerol, petroleum spirit (turpentine), alcohol, other flammable liquids
Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane, hydrogen, petroleum benzene, sodium carbide, turpentine, benzene, powdered metals
Chlorine dioxide	Ammonia, methane, phosphine, hydrogen sulphide
Copper	Acetylene, hydrogen peroxide
Cumene hydro-peroxide	Acids, organic and inorganic
Cyanides	Acids
Fluorine	Isolate from everything
Hydrazine	Hydrogen peroxide, nitric acid, any other oxidant

Hydrocarbons (benzene, butane, propane, gasoline, turpentine etc)	Fluorine, chlorine, bromine, chromic acid, peroxides
Hydrocyanic acid	Nitric acid, alkalis
Hydrofluoric acid (anhydrous), hydrogen fluoride	Ammonia (aqueous or anhydrous)
Hydrogen peroxide	Copper, chromium, iron, most metals or their salts, any flammable liquid, combustible materials, aniline, nitromethane
Hydrogen sulphide	Fuming nitric acid, oxidizing gases
Iodine	Acetylene, ammonia (aqueous or anhydrous)
Mercury	Acetylene, fulminic acid, ammonia
Nitric acid (conc.)	Acetic acid, acetone, alcohol, aniline, chromic acid, hydrocyanic acid, hydrogen sulphide, flammable liquids, flammable gases, nitratable substances
Nitroparaffins	Inorganic bases, amines
Oxalic acid	Silver and mercury and their salts
Oxygen	Oils, grease, hydrogen, flammable liquids, solids, and gases
Perchloric acid	Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, grease, oils (all organics)
Peroxides, organic	Acids (organic or mineral), also avoid friction, store cold
Phosphorus	Sulphur, oxygen containing compounds such as chlorates
Phosphorus (white)	Air, oxygen
Phosphorus pentoxide	Alcohols, strong bases, water
Potassium	See alkali metals
Potassium chlorate	Acids (see also chlorates)
Potassium perchlorate	Acids (see also perchloric acid)
Potassium permanganate	Glycerol, ethylene glycol, benzaldehyde, sulphuric acid
Silver and silver salts	Acetylene, oxalic acid, tartaric acid, fulminic acid, ammonium compounds
Sodium	See alkali metals (above)
Sodium nitrate	Ammonium nitrate and other ammonium salts
Sodium peroxide	Any oxidizable substance, such as ethanol, methanol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerol, ethylene glycol, ethyl acetate, methyl acetate, furfural
Sulphuric acid	Chlorates, perchlorates, permanganates

11.3 Compatible Inorganic Groups

Compatible Inorganic Groups

1. Metals, Hydrides (store flammable solids in flammables cabinet)

2. Acetates, Halides, Iodides, Sulphates, Sulphites, Thiosulfates, Phosphates, Halogens

3. Amides, Nitrates (except ammonium nitrate), Nitrites, Azides (ammonium nitrate is separated and stored by itself)

4. Hydroxides, Oxides, Silicates, Carbonates, Carbon

5. Sulfides, Selenides, Phosphatides, Carbides, Nitrides

6. Bromates, Chlorates, Perchlorates, Perchloric Acid, Chlorites, Hypochlorites, Peroxides, Hydrogen Peroxide

7. Arsenates, Cyanides, Cyanates

8. Borates, Chromates, Manganates, Permanganates

9. Acids *(except Nitric) (Nitric Acid is isolated and stored by itself)

10. Sulphur, Phosphorus, Arsenic, Phosphorus Pentoxide* Store acids in approved acid cabinet

(Flinn Scientific, Inc., P.O. Box 219, Batavia IL 60510. Phone: 1-800-452-1261; Fax: 630-879-6962.)

11.4 Compatible Organic Groups

1.Acids *(except acetic and formic),** Anhydrides, Peracids

2.Alcohols, Glycols, Amines, Amides, Imines, Imides***

3.Hydrocarbons, Esters, Aldehydes***

4.Ethers, Ketones, Ketenes, Halogenated Hydrocarbons, Ethylene Oxide***

5.Epoxy Compounds, Isocyanates

6.Peroxides, Hydroperoxides, Azides

7.Sulphides, Polysulphides, Sulphoxides, Nitriles

8.Phenols, Cresols

* Store acids in approved acid cabinet
** Acetic acid is separated and stored by itself, formic acid is stored in flammables cabinet
*** Store flammables in approved flammables cabinet

(Flinn Scientific, Inc., P.O. Box 219, Batavia IL 60510. Phone: 1-800-452-1261; Fax: 630-879-6962.)

Policy Document: Safe Storage of Chemicals (including chemical compatibility)

11.5 Acids: (guide from Arizona State University)

Acids are generally divided into two categories: *inorganic* or *mineral acids*, which consist of molecules having atoms of hydrogen, an identifying non-metal (such as chlorine, sulphur, or phosphorous) and maybe oxygen, and *organic acids* which consist only of carbon, hydrogen, and oxygen atoms, and always contain a carboxyl group. Both mineral and organic acids corrode metals and cause permanent damage to body tissues, including the eyes.

The degree to which an acid corrodes depends on whether the acid is an oxidizing agent. Perchloric, sulphuric, and nitric acids are strong oxidizers and special considerations should be taken to safely store these materials.

Ventilation of acid storage cabinets is not required; however, if the elimination of corrosive vapours is desired, acid storage cabinets can be connected to the duct work of the existing laboratory fume-hoods. This will dilute the concentration of the acid vapours and will not harm the fume-hoods exhaust system since it is designed to handle corrosive vapours.

PERCHLORIC ACID: When perchloric acid vaporizes, it may condense into perchloric crystals or salts which become an explosion risk if allowed to accumulate. Water wash-down fumehoods made of non combustible material must be used to prevent perchlorate accumulation in the exhaust system of the hood. It is recommended that metal safety cabinets not be used for storage because they may foster environments for perchloric salts to collect. Wooden cabinets also pose a risk because perchloric, when in contact with cellulose material, can spontaneously ignite. So what is the solution? Perchloric acid bottles should be stored in plastic (high density polyethylene) storage cabinets on glass or ceramic trays large enough to contain a spill.

SULPHURIC ACID: Sulphuric acid is a strong oxidizer and is chemically incompatible with a large group of substances. Chemical reactions involving sulphuric acid that occur in an uncontrolled fashion are likely to form products that are toxic, flammable, or explosive. For example, a mixture of sulphuric acid and perchloric acid results in a violent explosion; hence, these two acids should never be stored side by side. Sulphuric also has a tremendous affinity for water and has the ability to extract water from certain materials, making it incompatible with organic materials. Special note should also be given to reactions between sulphuric acid and other oxidizing agents like metallic permanganate, dichromates, and chlorates. These reactions form unstable acids, which subsequently dehydrate into the corresponding anhydride, sometimes explosively. Ideally, sulphuric acid should be stored in isolation from all other chemicals in an approved acid or corrosives safety cabinet. Isolation compartments are available through general laboratory safety supply companies.

NITRIC ACID: Nitric acid causes the spontaneous ignition of wood, excelsior, and other cellulose material and oxidizes many organic compounds, sometimes explosively. Turpentine, acetic acid, acetone, ethyl alcohol, nitrobenzene, and aniline are just some of the substances that react explosively and burn when mixed with concentrated nitric acid. Some finely divided metals also react explosively with concentrated nitric acid. Ideally, nitric acid should be stored in isolation from all other chemicals or in a specific isolation compartment within an approved acid or corrosives cabinet.

HYDROCHLORIC ACID: Hydrochloric acid, whether concentrated or diluted, is a strong acid that has a detectable pungent odour. It is not an oxidizing acid and is chemically incompatible with oxidizing agents like metallic permanganates, dichromates, chlorates, and the materials listed above. Hydrochloric acid should be stored separately from other oxidizing acids and materials.

HYDROFLUORIC ACID: Chemically, hydrofluoric acid is a weak, non oxidizing acid and is the only common acid that corrodes glass. Hydrofluoric acid, including waste acid, should always be stored in plastic containers and physically separated from ammonia.

ACETIC ACID: Acetic acid is an organic acid, and a reducing agent, which will burn when ignited. However, storing acetic acid on a flammable storage cabinet is not recommended because the acid vapours corrode the metal components in flammable storage cabinets and possibly the metal containers that many flammable liquids are shipped in. Because acetic acid is an organic acid, it is chemically incompatible with strong oxidizing agents and should be stored separately.

12 Appendix 1 11257 BY-LAW RELATING TO COMMUNITY FIRE SAFETY

Province of Western Cape: Provincial Gazette 5832 of 2002

LOCAL AUTHORITIES

11257 BY-LAW RELATING TO COMMUNITY FIRE SAFETY

12.1 Flammable stores

49. (1) The construction of a flammable store must be in accordance with the National Building Regulations (T1) read in conjunction with SABS 0400.

(2) The floor must be of concrete construction or other impermeable material and must be recessed below the door level or incorporate a sill.

(3) The recess or sill must be of such a depth or height that in the case of spillage it will be capable of containing the quantity of flammable liquid, as indicated on the flammable substance certificate and an additional 10% of the quantity mentioned on the certificate.

(4) Notwithstanding the National Building Regulations (T1) read in conjunction with SABS 0400:—

(a) the roof assembly of a flammable store must be constructed of a concrete slab capable of providing a two-hour fire resistance when it forms part of another building;

(b) the ventilation of a flammable store must be achieved by the use of air bricks located in the external walls at the ratio of one air brick nominally above the sill level and one air brick located in the top third of the wall per 5 m2 of wall area or part thereof, so that vapour cannot accumulate inside the store;

(c) the air bricks must be covered both internally and externally with closely-woven, non-corrodible wire gauze of at least 1 100 meshes per metre, and

(d) the wire gauze must be held in position by metal straps, a metal frame or cement.

(5) When required by the controlling authority, the flammable store must be ventilated by a mechanical ventilation system approved by the Municipality and must comply with the following requirements:—

(a) the ventilation system is to be intrinsically safe, provide 30 air changes per hour and must operate continuously;

(b) the fan extraction point must be nominally above sill level and must discharge through a vertical metal duct terminating at least 1 metre above roof height or at least 3,6 metres above ground level, whichever is the greater;

(c) ducting material that is external to the store, but communicates with the remainder of the building, must be fitted with a fire damper of two-hour fire resistance at the point of exit from a flammable store, and

(d) the ducting must be as short as possible and must not have sharp bends.

(6) Notwithstanding the National Building Regulations (T1) read in conjunction with SABS 0400, a flammable store door must be constructed of material with a fire resistance of two hours, provided that all relevant safety distances are complied with, and the door must open outwards.

(7) When required by the controlling authority, a flammable store door must be a D-class fire door, which complies with SABS 1253.

(8) Notwithstanding the National Building Regulations (T1) read in conjunction with SABS 0400, artificial lighting in the flammable store must be by electric light having vapour-proof fittings wired through seamless steel conduit and the switches operating the lights must be located outside the store.

(9) No other electrical apparatus may be installed in the flammable store.

(10) A flammable store must be provided with a foam inlet consisting of a 65 millimetre male instantaneous coupling and mild steel pipe work leading to the inside thereof and the foam inlet must be identified by means of a sign displaying the words ‘‘**Foam Inlet**’’ in 100 millimetre block letters.

(11) Racking or shelving erected in the flammable store must be of non-combustible material.

(12) The flammable store must be identified by the words, ‘‘**Flammable Store—Bewaarplek vir Vlambare Vloeistowwe—Isitoro Indawo Yokugcina Izixhobo Ezithatha Lula Umlilo**’’, and the permissible quantity allowed within the flammable store, indicated in 100 millimetre block letters on both the inside and outside of all doors communicating directly with the store.

(13) The owner or person in charge of a flammable store must ensure that the flammable store doors are kept locked when the store is not in use.

(14) A person shall not enter a flammable store or cause or permit it to be entered without the permission of the owner or person in charge of the premises.

(15) Sufficient fire extinguishers, as determined by the controlling authority, must be mounted on the external wall of the flammable store in a conspicuous and easily accessible position.

(16) Any hand tool used in the flammable store must be intrinsically safe.

(17) A person may not use or permit a flammable store to be used for any purpose other than that indicated on the flammable substance certificate, unless the store is not in use as a flammable store and the controlling authority has been notified in terms of the following procedure:—

(a) within seven days of the cessation, notify the controlling authority in writing thereof;

(b) within 30 days of the cessation, remove the flammable substance from the flammable store and render it safe, and

(c) within 30 days of the cessation, remove all signage.

(18) Subject to the provisions in this section, the controlling authority may call for additional requirements to improve the fire safety of a flammable store.

12.2 Container handling and storage

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(1) All flammable substance containers must be kept closed when not in use.

(2) A person may not extract flammable liquids from a container of a capacity exceeding 20 litres, unless the container is fitted with an adequately sealed pump or tap.

(3) Flammable liquid containers must be labelled and marked with words and decals, which indicate the flammable liquids contained therein as well as the hazard of the liquids.

(4) Flammable substance containers must be declared gas or vapour-free by a competent person before any modification or repairs are undertaken.

(5) All flammable substance containers must be manufactured and maintained in such a condition as to be reasonably safe from damage and to prevent leakage of flammable substances or vapours there from.

(6) An empty flammable liquid container must be placed in a flammable store.

(7) Where a flammable store is not available for the storage of empty flammable liquid containers, the controlling authority may permit such storage in the open; provided that:—

(a) the storage area must be in a position and of sufficient size which in the opinion of the controlling authority will not cause a fire hazard or other threatening danger;

(b) the storage area is well ventilated and enclosed by a wire mesh fence and:—

(i) the fence supports are of steel or reinforced concrete;

(ii) has an outward opening gate that is kept locked when not in use, and

(iii) when the floor area exceeds 10 m2 an additional escape gate is installed, fitted with a sliding bolt or other similar locking device that can be opened from the inside without the use of a key;

(c) the storage area is free of vegetation and has a non-combustible firm level base;

(d) a two metre distance around the perimeter of the fenced area is clear of grass, weeds and similar combustible materials;

(e) when the storage area has a roof, the construction of the roof and supporting structure must be of non-combustible material;

(f) open flames, welding, cutting operations and smoking is prohibited in or near the storage area and signage is prominently displayed on the fence and complies with SABS 1186: Part 1, and

(g) fire-fighting equipment is installed as determined by the controlling authority.

(8) An empty flammable liquid container must be securely closed with a bung or other suitable stopper.

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