

## CHAPTER 7. CHEMICAL STORAGE

### A. INVENTORY

#### I. PURPOSE

An annual inventory of hazardous materials is required. According to the WCB Health and Safety Regulation, Part 5, Section 5.98, "an inventory must be maintained which identifies all hazardous substances at the workplace in quantities that may endanger workers in an emergency including controlled products covered by WHMIS, explosives, pesticides, radioactive materials, hazardous wastes, and consumer products.

Annual inventories allow for the following:

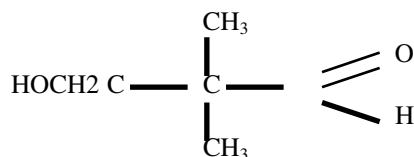
- Check chemicals with limited shelf life.
- Remove surplus and old chemicals.
- Correct incompatible storage.
- Know what you have.
- Cleanup containers & shelves.
- It's the Law!

#### II. CRITERIA

##### 1. BASED ON NAMES?

3-hydroxy-2,2-dimethylpropanal (IUPAC)  
 2,2-dimethyl-3-hydroxypropionaldehyde (Aldrich)  
 Propanal, 3-hydroxy-2,2-dimethyl (CAS)  
 Hydroxypivaldehyde (Common)

##### 2. BASED ON CHEMICAL FORMULA?



Sodium bicarbonate     $\text{NaHCO}_3$      $\text{CHNaO}_3$

### 3. UNIQUE IDENTIFIERS

(Manufacturer's Or Employer's Code)

|         |            |
|---------|------------|
| Aldrich | 26,918-2   |
| CAS     | 597-31-9   |
| SI      | OX-33450-1 |

### III. HOW TO LOCATE CHEMICALS

Develop system for finding information such as:

- Computer database system
- Cardex system

**A good system should:**

- *Direct you quickly to the chemical.*
- *Be easy to use.*
- *Be easy to maintain.*
- *Be updated annually.*

### B. CHEMICAL STORAGE

#### I. GENERAL

1. Store in central, properly ventilated area that includes forced ventilation from floor to ceiling and with exhaust above roof level.
2. Know the location of the master control shut-off valves for gas, water and electricity.
3. Smoke detector is required.
4. A communication system to the main office or emergency system is recommended.
5. Shelving should be accessible with chemicals at eye level or lower; no high shelf chemical storage.
6. Avoid floor chemical storage (even temporary).
7. Shelf assemblies are firmly secured to walls. Avoid island shelf assemblies.
8. Provide anti-roll lips on all shelves.
9. Shelving assemblies must be constructed of wood except for storing oxidizers.
10. Avoid metal, adjustable shelves supports and clips; use fixed, wooden supports.

11. For emergencies, have:

- Fire extinguishers of the approved type positioned near an escape route.
- Spill control and clean-up materials.
- Approved eye/face wash and shower.

## II. LABORATORY

Laboratories are not storerooms particularly as it applies to chemicals and solvents. Chemicals in laboratories should be stored in areas away from experimental activities, and limited to the requirements of 12 months or less. Excess stock should be kept in a proper chemical storage facility.

The following basic rules apply particularly to chemicals stored in laboratories.

### 1. SMALL AMOUNTS, NOT STOCKPILED

Ordering 1 kg because it is cheaper than the 100 g size is often false economy. The result:

- **It takes up more valuable space.**
- **It presents a greater potential hazard.**
- **It may eventually become a disposal problem.**

**Order only what you can use in 12 months.**

### 2. SECURE

- i) Do not overcrowd shelves.
- ii) Do not store too high; provide a proper kickstool or ladder where necessary.
- iii) Chain compressed gas cylinders.
- iv) Store lecture bottles upright and chain, or secure in a proper holder.
- v) Store solvents in a proper flammable liquid cabinet, and keep door closed.
- vi) Use appropriate containers for solvents and waste.
- vii) Store highly toxic or controlled materials in a secure cupboard.

### 3. SIGNED PROPERLY (LABELLED)

- i) Contents are labelled clearly.
- ii) Labels are intact and legible.
- iii) Labels are not overwritten; old labels are removed or completely covered.
- iv) Solvent stills are labelled.
- v) Regularly check and label peroxidizable materials with test results.

**Proper WHMIS labelling is used.**

### 4. SEALED

- i) Keep solvent containers closed.
- ii) Ensure chemical containers are intact.
- iii) Regularly vent materials capable of building up pressure; e.g. formic acid.

**Ensure container lids are intact and closed.**

### 5. SEGREGATED

- i) Be aware of *nomenclature* problems  
e.g. PHENOL is also known as:
  - Carboic acid
  - Hydroxybenzene
  - Oxybenzene
  - Phenic acid
  - Phenyl hydroxide
  - Phenylic acid or phenylic alcohol

The Merck Index can be a useful reference when checking confusing or equivalent names.

## III. METHODS

### 1. INTRODUCTION

Chemical storage, whether in a laboratory or central storeroom, should be under the supervision of a qualified person; storerooms must have adequate security.

Specialized cabinets should be used for specific groups of compatible substances.

## 2. ACIDS and BASES

- i) Store acids and bases separately.
- ii) Store acids in dedicated acid cabinet.
- iii) Store oxidizing acids (eg. nitric acid) away from organic acids (e.g. acetic acid).
- iv) Store hydrofluoric and perchloric acids in secondary containers made from compatible materials.
- v) Safety showers and eye wash facilities must be within easy access.
- vi) Protective equipment must be inspected regularly to insure proper working order, especially in corrosive atmospheres.

## 3. FLAMMABLE LIQUIDS

Flammable liquids should be stored in a dry, cool well-ventilated area, preferably a flammable materials storage cabinet or room.

### i) Laboratory Storage

Flammable liquids should be stored:

- According to the BC Fire Code and best management practices i.e.:

**Maximum size of container allowed in lab is 5 L.**

- In listed approved metal safety cans, which meet the fire code requirements, and are equipped with flash arrestor and self-closing lid.
- In glass containers greater than 1 litre only if purity of the material is affected by exposure to metal or in original containers.
- In appropriate 5 litre waste solvent containers that are capped when not in active use.

**Maximum volume of flammable containers in open laboratories at UBC is 25 L.**

### ii) Flammable Liquid Cabinets

An approved flammable liquid storage cabinet may be used when quantities of flammables are near or exceed 25 litres. An approved flammable liquid storage cabinet must be listed by an acceptable testing agency and approved by the local Fire Department.

Flammable Liquid Cabinet provide:

- A safe means of storage over a short period of time.
- A time-saving method of storage by locating cabinets in, or adjacent to work areas which reduces the frequency of trips to the drum storage or dispensing facility.

**Control flammables by eliminating careless open storage of small containers.**

Flammable liquids cabinets must:

- Be Underwriters Laboratories of Canada (ULC) listed and approved.
- Be closed at all times, with door latches operable.
- Have vents that are either plugged or vented directly to the outside.
- Be either wood (must meet specifications of fire code) or metal.
- Be suitably placed; ie. not located near an exit door or blocking access to an exit route.
- May have to be in a room which has a second exit depending on the quantity and hazards of flammable liquids in the room.
- Contain no more than 500 litres maximum of flammable and combustible liquids of which no more than 250 litres may be flammable.
- Be no more than one (1) per fire compartment, unless approved by the local Fire Department.

### iii) Flammable Liquid Storage Rooms

A properly designed flammable liquids room must satisfy many requirements, e.g. location, ventilation, electrical equipment, fire protection, etc. It must also meet the needs of the user, e.g. adequate size, conveniently located, etc.

The flammable liquids storage room should be easily accessible to fire fighting; i.e. located in corners of buildings over window openings and doors all providing sufficient entry. Explosion venting can then be incorporated into the exterior walls.

Specific guidelines for flammable liquid storage rooms include: the maximum number of litres per square metre of floor space; maximum room size with and without a sprinkler system (or other automatic extinguishing system); fire resistance rating of the interior walls.

Additional requirements include: a raised liquid tight sill of at least 102 mm in height (a sunken floor or open grated trench is also permissible); floor drains

which drain to a safe location; self-closing, listed, one and one-half hour Class B fire door (listed 3-hour Class A may be required for walls with a rating greater than 2 hours).

Rooms containing Class I flammables must have electrical equipment suitable for Class I, division 2; for Class II and Class III liquids, electrical fixtures must be approved for general use. The room must also have a gravity or mechanical exhaust ventilation (ICFM/sq.ft. of floor area) equipped with suitable interlocks.

#### *iv) Refrigerator Storage*

Refrigerators must be approved (ULC) for storage of flammable liquids (explosion-proof), or acceptably tested and approved. A number of refrigerators have exploded due to flammable vapours.

**If cold storage is required for flammables, explosion-proof units are required.**

#### *v) Flammable Compressed Gas Cylinders*

- Protected against mechanical damage.
- Stored in a secure area.
- Stored with protective caps on.
- Store separately from flammable, oxidizing and poison gases.
- If stored indoors, the room must have a 2-hour fire separation with entry from the exterior.
- Natural ventilation to outside wall must exist; room must have no other purpose.
- Compressed gases are normally heavier than air.
- Only 1 cylinder is allowed in any one room and must not be located below grade.

#### *vi) Toxic Compressed Gases*

See end of chapter 5 for "Use of Compressed Gas Cylinder in UBC Labs".

## 4. AIR-REACTIVE CHEMICALS

- Ensure container is stored in a secure location without danger of falling.
- Secondary containment is recommended.

**Use glove box or fill head space of the container with an inert gas before sealing the container.**

## 5. CHEMICAL STORAGE PATTERNS

*When it comes to chemical storage practices, the alphabet should be one of the last criteria used. Examples of compatibility problems arising from storing chemicals alphabetically include:*

- Alkanes and Ammonium Nitrate
- Hydrogen Peroxide and Hydrazine
- Ammonia and Bromine
- Nitric Acid and Phenol
- Aldehydes and Amines
- Sodium Cyanide and Sulfuric Acid
- Calcium Hypochlorite and Carbon

*Even apparently safe storage can be a potential problem. The following materials are often stored together even though there are hazards if the materials should mix:*

- Acetic Acid and Nitric Acid
- Perchloric Acid and Sulfuric Acid
- Concentrated Acids and Bases

### SEPARATE BY COMPATIBILITY

#### “COMPATIBILITY IS SYNONYMOUS WITH CHEMICAL FUNCTIONALITY”

Refer to:

- Material Safety Data Sheets
- Chemical Catalogues
- US School System Lab. Storage Guide
- Other Reference Materials

*The UBC Chemical Storage Guidelines are provided in at the end of this chapter.*

Contact the Health Safety and Environment Office @ 807-8621 for additional information and assistance regarding the safe storage of chemicals.

On the next page you will find a suggested arrangement of the compatible chemical families on the shelf areas of a chemical storage room. This arrangement is taken from the Flinn Chemical Catalogue Reference Manual.

## SUGGESTED SHELF STORAGE PATTERN - INORGANIC

|   |   |   |
|---|---|---|
| Sulfur, Phosphorus, Arsenic,<br>Phosphorus Pentoxide  | Arsenates, Cyanides,<br>Cyanates  | <p><b>INORGANIC ACIDS<br/>(EXCEPT NITRIC ACID)</b></p> <p><i>Store Nitric Acid away from other acids unless the acid cabinet provides a separate compartment for Nitric Acid.</i></p> <p><i>Acids are best stored in dedicated cabinets with corrosion resistant materials, paint and hardware</i></p> <p><b>ACID CABINET</b></p> |
| Halides, Sulfates, Sulfites,<br>Thiosulfates, Phosphates,<br>Halogens, Acetates                                     | Sulfides, Selenides,<br>Phosphides, Carbides,<br>Nitrides   |   |
| Amides, Nitrates ( <i>except ammonium nitrate</i> ), Nitrites,<br>Azides  | Borates, Chromates,<br>Manganates, Permanganates  |   |
| Metals, Hydrides<br>( <i>Store away from any water</i> ),<br>( <i>Store flammable solids in flammable cabinet</i> ) | Chlorates, Perchlorates,<br>Chlorites, Perchloric Acid,<br>Peroxides, Hypochlorites,<br>Hydrogen Peroxide |   |
| Hydroxides, Oxides, Silicates,<br>Carbonates, Carbon  | MISCELLANEOUS   |   |

## SUGGESTED SHELF STORAGE PATTERN - ORGANIC

|  |                                      |  |
|--|--------------------------------------|--|
| Alcohols, Glycols, Amines,<br>Amides, Imines, Imides                     | Phenol, Cresols                      | SEVERE POISONS<br><br>SECURE CABINET   |
| Hydrocarbons, Esters,<br>Aldehydes                                       | Peroxides, Azides,<br>Hydroperoxides | <p>Alcohols, Glycols, Etc.</p> <p>Hydrocarbons, Esters, Etc.</p> <p>Ethers, Ketones, Etc.</p> <p>Organic Liquids with<br/>Flash Point &lt; 37.8°C</p> <p><b>FLAMMABLES CABINET</b></p> |
| Ethers, Ketones, Ketenes,<br>Halogenated Hydrocarbons,<br>Ethylene Oxide | Acids, Anhydrides, Peracids          |  |
| Epoxy Compounds,<br>Isocyanates  | MISCELLANEOUS                        |  |
| Sulfides, Polysulfides, etc.   | MISCELLANEOUS                        |  |

**IF POSSIBLE, ALWAYS AVOID FLOOR STORAGE!**



# UBC CHEMICAL STORAGE

## I. SORT ACCORDING TO THE 6 WHMIS CATEGORIES DESCRIBED BELOW.

|  |   |
|--|---|
|  | <p><b>DANGEROUSLY REACTIVE</b><br/>Store as required according to the nature of their individual hazards<br/><i>e.g. metal hydrides; some hydrogenation catalysts; picric acid; dinitrophenol; trinitrotoluene</i></p>  |
|  | <p><b>OXIDIZING MATERIALS</b><br/><b>Store separate from flammable or combustible materials and reducing agents</b><br/><i>e.g. nitrates; chromates; permanganates; chlorates; peroxides</i></p>  |
|  | <p><b>FLAMMABLE &amp; COMBUSTIBLE MATERIALS</b><br/><b>Flammable liquids (flashpoint <math>\leq 37.8^\circ\text{C}</math>) should be stored in one of these ways:</b><br/> <ul style="list-style-type: none"> <li>◆ approved cabinet</li> <li>◆ approved fire safety can</li> <li>◆ explosion-proof refrigerator</li> <li>◆ approved room</li> </ul> <p><b>Note: 25 litres is the maximum total volume of all containers, which may be in the open lab, not including liquids stored in an approved flammable liquid cabinet or safety cans.</b></p> <p><b>Other flammable and combustible materials include:</b><br/> <ul style="list-style-type: none"> <li>◆ combustible liquids (flashpoint <math>&gt;37.8^\circ\text{C}</math>)</li> <li>◆ flammable gases &amp; aerosols</li> <li>◆ flammable solids (organic solids)</li> <li>◆ reactive flammables</li> </ul> </p> </p> |
|  | <p><b>CORROSIVE MATERIALS</b><br/><b>Separate concentrated acids and bases (caustics; alkalis; amines and anilines)</b><br/> <ul style="list-style-type: none"> <li>◆ oxidizing and flammable materials should be removed segregated as noted above</li> </ul> </p>   |
|  | <p><b>COMPRESSED GASES</b><br/>USE smallest, returnable size containers and quantities<br/> <ul style="list-style-type: none"> <li>◆ must be secured &amp; not by exit route &amp; door; long term storage in labs prohibited</li> </ul> </p>   |
|  | <p><b>HIGHLY TOXIC</b><br/>Store in secure area<br/>Includes cyanide, arsenic, antimony; other heavy metals and their compounds; carcinogens</p>  |

For large quantities of stock, use the following groupings for a final segregation of chemical classes:

### INORGANIC\*

- Sulfur, phosphorus\*\*, phosphorus pentoxide\*\*
- Halides, sulfates, sulfites, thiosulfates, phosphates oxide
- Amides, nitrates\*\* (except ammonium nitrate), nitrites\*\*
- Metals & metal hydrides
- Oxides, silicates, carbonates, carbon
- Arsenates, cyanates
- Sulfides, selenides, phosphides, carbides, nitrides

### ORGANIC\*

- Acids, anhydrides, peracids
  - Ethers\*\*, ketones, halogenated hydrocarbons, ethylene
  - Alcohols, glycols, amines, amides, imines, imides
  - Hydrocarbons, esters, aldehydes
  - Epoxy compounds, isocyanates
  - Peroxides, hydroperoxides, azides\*\*
  - Sulfides, polysulfides, sulfoxides, nitriles
  - Phenols, cresols
- \*\* dangerously reactive materials

\* Flinn Catalogue designations

**FOR ADDITIONAL INFORMATION, CALL THE HEALTH SAFETY & ENVIRONMENT OFFICE @ 807-8621.**