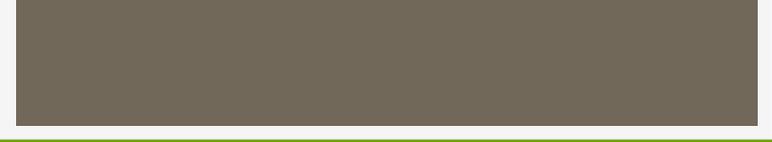


Ordering  
(arrangement)  
of chemical

- There are chemicals in the laboratory as well as a relatively large amount of equipment.
- a lot of chemicals can also cause a high risk of harm
- therefore the storage aspects of the laboratory, structuring management and maintenance of chemicals is an important part that must be considered



Common things that should be of concern in the storage and ordering (arrangement) of such chemicals include aspects of :

1. *segregation,*
2. *multiple hazards*
3. *Labeling*
4. *storage facilities*
5. *secondary containment*
6. *outdate chemicals*
7. *Inventory*
8. *hazard information*

# *segregation*

- Storage and arrangement of chemicals based on alphabetical order is inappropriate, that need is only required to make the administrative process.
- Sorting alphabetically would be more appropriate if the chemical is classified according to physical properties, and chemical properties, especially the hazard level of chemical

## *multiple hazards*

- Chemicals that should not be stored with other chemicals, must be stored in secondary containers that specifically isolated.
- This is meant to prevent mixing with other sources of danger such as fire, poisonous gases, explosions, or chemical degradation.
- Many chemicals that have properties more than one type of hazard levels.
- Storage of such chemicals should be based on the level of highest the danger of risk.

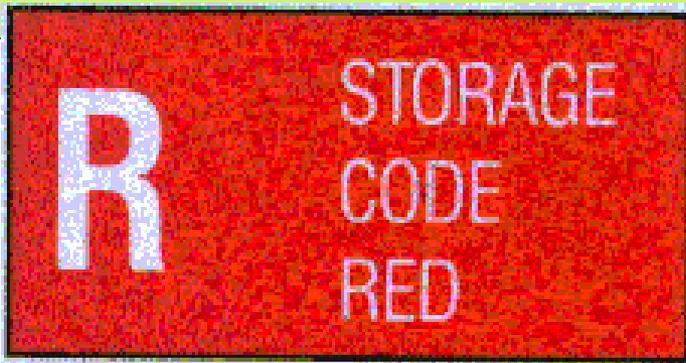
- For example,  
benzene has a flammable and toxic properties. Properties of burning at higher risk than the carcinogens.  
Therefore, benzene should be placed in storage cabinets to store flammable liquids stored in the cabinet rather than of toxic materials.

The following is a general guide to sort the hazard level of chemicals in relation to storage.

- Radioactive Materials > Materials pyrophoric > explosive > Flammable Liquids > acid / base Corrosive > Reactive Material of Water > Flammable solids > Materials Oxidizers > Combustible Material > Toxic Materials > Materials that do not require special separation

# Labeled

- Chemical containers and storage locations must be clearly labeled.
- Label the container must include the name of the material, the level of hazard, date received and adopted. |
- It would be nice if the storage place of each group of such materials be labeled with different colors. For example the color red for flammable materials, oxidizing materials for the yellow, blue for toxic materials, white for corrosive materials, and green for low dangerous materials.



Flammable material



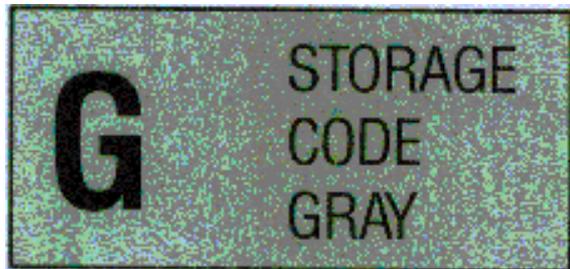
Oxidazer material



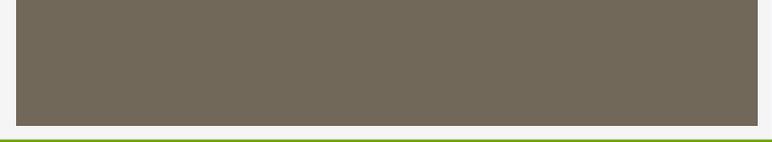
Toxic material



corrosive material



Low hazard  
material

- 
- To the labeling of the storage location, labeling the reagent bottle is much more important. Information to be included in the reagent bottles are:
    - Chemical name and formula
    - Concentration
    - The date of receipt
    - Date of manufacture
    - The name of the person making the reagents
    - Long life
    - The level of danger
    - Classification of storage location
    - Name and address of the manufacturer

## *storage facilities*

- Chemicals should be placed in storage facilities are closed as in cabinets, lockers, etc..
- Storage area must be clean, dry and away from sources of heat or contact with the sun.
- In addition, storage areas should be equipped with ventilation to the smoke room or out of the room.
- Hazardous liquid chemicals should be stored well in a secondary container such as a plastic tray to prevent accidents due to leakage or rupture.

## *secondary containment*

- Secondary container that is required should be based on the size of containers filled with chemicals directly, not on the basis of the volume of liquid material present in the container.
- Container size of primary materials that need to be provided by the secondary container that is:
  1. Radioactive liquid when the container size  $\geq 250$  ml
  2. All other hazardous liquids to the container  $\geq 2.5$  L

- To grouping the hazard material that need secondary container:

1. Flammable liquids , combustible material and halogenated

solvents such as alcohol, ether, trichloroethane, etc..

2. Concentrated mineral acids such as nitric acid, hydrochloric

acid, sulfuric acid, fluoride, phosphoric acid etc

3. Strong bases such as ammonium hydroxide, sodium

hydroxide, and potassium hydroxide.

4. Radioactive Materials

# *Outdate/ Expired chemicals*

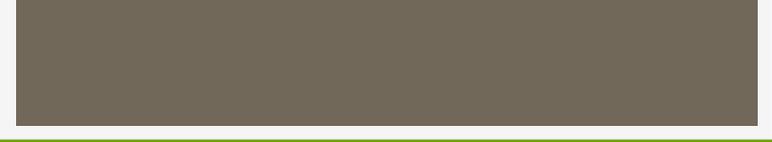
- Expired chemicals, chemicals that are not needed,
- chemicals are damaged should be discarded through the waste management unit
- Remember that a chemical disposal costs will increase if wait until a long time, therefore chemical waste should be cleaned every time.

# *Inventory*

- Inventory should be carried out on existing chemicals in the laboratory.
- Update the labels periodically damaged.
- Inventory should include the name of materilas, formulas, quantity, quality, storage location, and date of receipt, the name of industry, health hazards, physical hazards, long and short hazards to health.

# *hazard information*

- In a lab, the MSDS (Materials Safety Data Sheets) or other sources that provide information about the hazards of each materials must be present.
- In the MSDS typically includes information about products and industry name, material composition, level of hazard identification, first aid materials when exposed to it, how to deal accidents, handling and storage, the way of physical protection, stability and reactivity, toxicological information, transportation, disposal and government regulations are enforced.



**storage method and arrangement  
of chemicals for each group of  
materials according to the danger  
level.**

# 1. Storage and arrangement of radioactive chemicals

- No indiscriminate lab can buy, use, store and dispose of radioactive materials.
- Such materials can be held in a lab when obtain permission from the Ministry of Health, especially the radiation.
- Radioactive materials must be stored somewhere that supervised and gated from losing by a person who was responsible.
- At the storage place should be written the words "CAUTION RADIOACTIVE MATERIALS".
- Record the number of real and notice limit the amount of storage allowed.

## 2. Storage and arrangement of reactive chemical

- Categorized as a reactive material that reacts or polymerizes itself produce a fire or toxic gas when there are changes in pressure or temperature, friction, or contact with moisture.
- Reactive material typically has more than one kind of hazard materials group,
- for example, such materials including flammable solids as well as a reactive material to water, so it requires special handling and storage.

- Reactive chemicals are usually grouped into chemical pyrophoric, explosive, forming peroxide, and water reactive.
- 1. Pyrophoric materials are materials that can be burned when in contact with air at a temperature  $<54.44\text{ }^{\circ}\text{C}$ . Pyrophoric chemicals exist in the form of **solids** such as **phosphorus**, gases such as **silane**, liquids such as **tributylaluminum**.  
Pyrophoric materials shall be stored in flammable cabinet separately from flammable liquids and combustible liquids.

## 2. Explosive

- Explosive materials are materials that can cause an explosion.
- The explosion was caused by a breakdown of materials quickly and results in the release of energy in the form of heat, flame and high pressure changes.
- Factors that support the emergence of an explosion of chemicals in the laboratory include:
  - (1) The content of oxygen compounds.  
Some peroxide (benzoyl peroxide dry) and other strong oxidizer explosive,
  - (2) reactive group.  
several compounds such as hydrazine having oxidative and reductive groups, so it is very unstable. Some nitro compounds (eg Trinitrotoluen / TNT, azides, acid pikrat dry) are also explosive.

Be careful in reading chemical labels, and note the symbol that shows stability and easy explosion of such materials

- Some ethers and similar compounds tend to react with air and light to form an unstable peroxide compounds.
- The chemicals can form peroxides are among is p-dioxane, ethyl ether, tetrahydrofuran, aetaldehyd, and cyclohexene.
- To minimize the danger of these chemicals, then the way that must be considered in the storage is as follows:
  1. Store peroxide-forming chemicals in a sealed bottle (not in contact with air) or in containers that are not exposed to light.
  2. Give the label on the container on the date of receipt and opening of such materials.
  3. Test periodically (3 or 6 months) in the formation of peroxides. Dispose of peroxide which has been opened after 3-6 months (see Table-5).
  4. Dispose of containers of peroxide-forming chemicals has never been opened within the expiration of 12 months upon receipt.

- Materials reactive with water if contact with the moist air will produce compounds toxic, flammable, or explosive gases. For example, hypochlorite and metal hydrides. Therefore the storage of these chemicals should be kept away from sources of water (do not store it under or over the sink, etc..).
- Use fire extinguishers with dry chemical event on fire with this material. Store in a desiccator filled with silica gel.

### 3. Storage and arrangement of corrosive chemicals

- Corrosive chemicals consist of two kinds of acids and bases. Storage of corrosive chemicals should not react with the place of storage (cupboard shelves and cabinets).
- For the purposes of storage, the **acids** are intangible fluid again classified into three types: **organic acids** (eg, glacial acetic acid, formic acid, **mineral acids** (eg hydrochloric acid and phosphoric acid), and **oxidizing mineral acids** (eg chromic acid, acid fluoride, perchloric acid, and acids such as fuming nitric acid and sulfuric acid).

- Guidelines for the storage of these **acid groups** are:
  - a. Separate acids from bases and active metals such as sodium (Na), potassium (K), calcium (Ca), magnesium (Mg), etc..
  - b. Separate the organic acids from mineral acids and oxidizing mineral acids,
  - c. Storage of organic acids is usually allowed with flammable and combustible liquids.
  - d. Separate acids from chemicals which can produce toxic and flammable gases such as sodium cyanide (NaCN), iron sulfide (FeS), calcium carbide (CaC<sub>2</sub>) etc..
  - e. Use secondary containers to store the acid, and use the bottle when it was transferred to the lab.
  - f. Keep a bottle of acid in the place cold and dry, and away from sources of

heat or not exposed to direct sunlight

- o Storage **alkaline solids** or liquids such as ammonium hydroxide ( $\text{NH}_4\text{OH}$ ), calcium hydroxide,  $\text{Ca}(\text{OH})_2$ , potassium hydroxide ( $\text{KOH}$ ), sodium hydroxide ( $\text{NaOH}$ ) must be carried out as follows:
  - a. Separate the base from the acid, the active metals, explosives, organic peroxides, and flammable materials.
  - b. Save inorganic base solution in a polyethylene container (plastic).
  - c. Place the container base solution in a plastic tray to avoid rupture or keborocan.
  - d. Keep bottles of base solution in a closet shelf or cabinet that resists corrosive. Large bottles stored on the lower shelf than the smaller bottles.

## 4. Storage and arrangement of chemicals Flammable & Combustible

- Flammable liquids and combustible chemicals are classified according to the point of fuel / ignition (flash point) and boiling point (boiling point).
- Burning point is expressed as the minimum temperature of the liquid to produce enough steam so that it can burn when mixed with air.
- Combustible liquid has a burning point  $< 37.8$  °C
- Flammable liquids has a burning point  $> 37.8$  °C

- In general, flammable and Combustible liquid storage in the laboratory are as follows.
  - a. stored in containers and in the cabinet.
  - b. Containers of glass should not be used for storing flammable liquids. Solvents must be stored in metal containers.
  - c. Flammable liquids that require cooler conditions, only stored in the refrigerator that read "Lab-Safe" or "Flammable Storage Refrigerators". Never store flammable liquids in a typical refrigerator.
  - d. Keep flammable materials from oxidizing.
  - e. Avoid storing flammable liquids away from heat, direct sun, source of flame or fire.

- Chemical solids rapid fire by friction, heat, or reactive to water and called spontaneous burning flammable solids.
- For example pikrat acid, calcium carbide, phosphorus pentachloride, lithium, and potassium. The element lithium (Li), potassium (K), and sodium (Na) should be stored in kerosene (kerosene) or mineral oil.
- Flammable solids should be stored in cabinets and kept away from flammable liquids or combustible liquids.
- When reactive to water, do not be stored under the sink, etc..

## 5. Storage and arrangement of oxidizing chemicals

- Chemicals including oxidizing agents are chemicals that support the process of combustion by removing oxygen or material that can oxidize other compounds.
- For example, potassium permanganate ( $\text{KMnO}_4$ ), ferric chloride ( $\text{FeCl}_3$ ), sodium nitrate ( $\text{NaNO}_3$ ), hydrogen peroxide ( $\text{H}_2\text{O}_2$ ).
- Oxidizing chemicals must be separated from flammable materials and combustible and reducing chemicals

## 6. Storage and arrangement of toxic chemicals (toxic)

- These chemicals consist of a high toxic material (highly toxic)
- Write on this chemical containers with the words "toxic substances".
- Store in a container that is not easily broken, and closed

## 7. Storage and arrangement of light-sensitive chemicals

- Storage of light-sensitive chemicals should be separated on the basis of hazardouz level.
- For example with an oxidizing bromine, arsenic with toxic compounds.
- Example light-sensitive compounds include bromine ( $\text{Br}_2$ ), mercury salts, potassium ferosianida,  $\text{K}_4 [\text{Fe} (\text{CN})_6]$ , sodium iodide ( $\text{NaI}$ ), etc..
- To avoid decomposition, these chemicals should be protected from light.
- Keep these light-sensitive material in a brown bottle (amber bottle).
- If this chemical storage bottles should be wrapped in foil (paper silver / tin), then write the label on the outside of the bottle.

# 8. Compressed Gas Storage and arrangement (Compressed Gases)

- a. Separate and mark where the gas tube that contains and which are empty.
- b. Secure the top and bottom of the cylinder by using a chain and a metal rack.
- c. Set the regulator when the gas in cylinders used.
- d. Replace the cover cylinder valve when not in use.
- e. Keep cylinders from source of heat, smoke or corrosive materials flammable materials.
- f. Separate cylinder with one another if the gas from one cylinder can cause a reaction with gas from other cylinders.
- g. Use smoke cabinets for reacting gas taken from the cylinder.
- h. Use carts are equipped with chains when transferring large gas cylinders.
- i. Keep the valve plug when not to scrape off the cylinder, because the gas in the cylinder has high pressure.