

HANDLING OF LABORATORY CHEMICALS

B. M. Ratnayake Bandara
(Professor of Organic Chemistry)
University of Peradeniya

A laboratory technical officer plays a key role in running a laboratory. He has to know and be familiar with a number of activities such as:

- a. Handling of laboratory chemicals, glassware, plastic-ware, and hardware
- b. Operation and maintenance of laboratory equipment.
- c. Housekeeping and maintenance of laboratory ("labkeeping")
- d. Cognitive skills
(technical instructions and procedures; terminology and nomenclature; literature searches)
- e. Computer and communication skills.

Handling of laboratory chemicals is an essential activity common to almost every laboratory. The degree of handling and the nature of chemicals depend on the laboratory type. We may consider the following aspects in handling chemicals:

1. Transport, storage, and transfer of chemicals
2. Preparation of solutions
3. Collection and storage of samples (analytical, biological, etc.)
4. Safety and toxicity
5. Clean-up of chemical spills and disposal of waste-chemicals.

Containers of Chemicals: Manufacturers pack chemicals in a variety of containers such as plastic bags, plastic bottles, glass bottles, plastic cans, tin cans, barrels, and drums, taking into consideration the acid, alkali, flammable, corrosive, or radioactive nature of chemicals. When transporting these containers, one has to be very cautious to avoid breakage. There are transport aids which make moving these containers safer and easier. These aids include *bottle carriers, carts, and trolleys*.

Transferring chemicals from big containers such as barrels and drums can be done safely, easily, and quickly by using *pouring spouts and hand pumps*. Remember to keep a tray of sand or suitable absorbent material beneath the tap.

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When storing chemicals, it is important to exercise preplanned *grouping and separation* of liquids and hazardous chemicals such as acids and alkali, volatile and flammable liquids, and radioactive materials. Pay attention to *incompatible chemicals*. Certain chemicals may react and create a hazardous condition. Separate storage areas should be provided for such incompatible chemicals. Some examples of incompatible chemicals are given below:

| CHEMICAL | INCOMPATIBLE WITH (\therefore keep out) |
|--------------------------------------|--|
| Flammable liquids | Ammonium nitrate, chromic acid, peroxides, nitric acid, halogens |
| Acetic acid | Chromic acid, nitric acid, ethylene glycol, perchloric acids, peroxides, permanganates |
| Alkali metals (sodium, potassium) | Water, tetrachloromethane, carbon dioxide |
| Ammonium nitrate | Acids, metal powders, flammable liquids, chlorates, nitrites, sulfur, finely divided organic or combustible materials |
| Aniline | Nitric acid, peroxides |
| Bromine & Chlorine | Ammonia, acetylene, butadiene, petroleum gases, hydrogen, carbides, turpentine, benzene, finely divided metals |
| Chlorates | Ammonium salts, acids, metal powders, sulfur, finely divided organic or combustible materials |
| Hydrogen peroxide | Most metals or their salts, alcohols, acetone, organic materials, anilines, nitromethane, flammable liquids, combustible materials |
| Hydrogen sulfide | Fuming nitric acids, oxidizing gases |
| Potassium permanganate | Glycerine, ethylene glycol, benzaldehyde, sulfuric acid |

Reagents and Solutions

You need to use chemicals for making reagents, preparations, and solutions. Read the label twice before using any chemical. Chemicals are available in various levels of purity. Depending on the need, choose the right grade of chemical. Following is a list of *different grades of chemicals*:

Commercial or Technical Grade (good for industrial use);

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Practical Grade (good enough for most organic preparations);

USP Grade (U.S. Pharmacopoeia; acceptable for drug use; good for most laboratory purposes);

CP Grade (Chemically Pure; almost as pure as Reagent-Grade chemicals - see below);

Spectroscopic Grade (solvent of optical purity; for use in spectrophotometry);

Chromatography Grade (> 99+ mol %; accompanies its own chromatogram);

Reagent Grade or Reagent Analyzed (for use in analytical work);

Primary Standard (extremely pure, impurities < 0.05 %; to prepare reference standards in analytical procedures).

Before you open the bottle (or any other container), wipe off dust with a piece of clean cloth.

Transferring solids from a bottle: Use a clean spatula to dig out and remove the chemical; spatulas are available in a variety of shapes, sizes, and designs, and the correct spatula should be chosen depending on the need. Place the stopper upside down on a clean surface. Soon after transferring the chemical, replace the stopper in the bottle.

Transferring liquids from a bottle: Pour the liquid as needed to a measuring cylinder by safely holding the stopper between fingers.

Transferring liquids from beakers or other containers: Hold a glass stirring rod against the pouring tip of the beaker. Tilt the container, allowing liquid to flow around the stirring rod which guides the liquid to the receiver.

Transferring solutions into containers from pipettes or droppers: Fill the pipette (or dropper) using a pipette bulb; never pipette solutions by mouth. Hold it above the solution to which it is to be transferred. Do not immerse the pipette or dropper in the solution because it will then become contaminated by the solution.

Shaking a test tube: To mix substances in a test tube, always use a clean cork or rubber stopper; never use your bare finger. Shake with an up-and-down motion. Use care when the stopper is removed. Pressure may have built up and the liquid may foam out from the test tube.

Mixing solutions in a test tube: Agitate sideways so that liquid is not spilled. Or, use a glass rod, preferably with a small rubber policeman.

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Some tips to increase the dissolution of solids: Use a mortar and pestle to pulverize the solid. This will increase the surface area of the solid on contact with the liquid. Stirring the mixture (using a glass rod or a magnetic stirrer) and heating the solvent also help dissolution.

Heating Liquids

Nonflammable liquid in a test tube: Fill the test tube less than one-half full. Hold the test tube with a test-tube clamp. Point the mouth of the test tube away from you and anyone near you. Move the test tube constantly in the flame. If the test tube is not kept in motion, the liquid will get very hot and vapour will form and eject liquid violently.

Nonflammable liquid in a beaker or flask: Place the beaker or flask on asbestos-centered wire gauze resting on a tripod or ring stand. Heat with a gas burner.

Flammable liquids: Heat a sand bath, a high-boiling mineral oil bath, or a water bath with a gas burner. Turn off the burner. Immerse the beaker or flask containing the liquid, in the heated bath.

Flameless heating devices: Heating mantles, heating tapes, electrically heated oil baths and water baths, and hot plates can also be used for heating liquids. There are hot plates with magnetic stirring attached to it. With these devices, it is common practice to start magnetic stirring before starting the heating function.

Water for Laboratory Use

Ordinary tap water contains dissolved gases such as oxygen, nitrogen and carbon dioxide, dissolved inorganic substances, dissolved organic compounds of biological origin, microorganisms, and particulate matter. Tap water cannot be used for testing procedures, analytical evaluations, and biological work. Depending on the level of purity needed, one of the following grades can be used for making solutions:

Distilled water (from distillation);

Deionized water (by passing through ion-exchange resins)

Reagent Grade water (by passing distilled and deionized water through activated carbon, ion-exchange resins, and membrane filters).

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Safety and Toxicity

Consider all chemicals, reagents, and solutions as toxic substances. Many of the hazards of chemicals are not obvious, or evident by smell, odour, appearance, or immediately detectable by the organs of the body.

General guidelines to minimise toxic exposure:

1. Know the chemical and toxic properties of all materials involved before starting manipulations, using the Material Safety Data Sheets (MSDS) or Master Chemical Records (MSR); the MSR of benzene is attached to this document.
2. Substitute a less toxic substance whenever possible.
3. Always use fume hoods.
4. Bear in mind that toxic exposure can occur through respiration, ingestion, or through the skin. Use personal protective equipment (lab coats, gloves, masks, spatulas, etc.).
5. Avoid excessive exposure to all chemicals.
6. Avoid alcoholic beverages on the job. Ethanol has a synergistic effect with many other solvents.

Chemical Spills in the Laboratory

Solid dry substances: These chemicals can be swept together, brushed onto a shovel, dustpan, or cardboard, and then deposited in the proper waste container.

Acid solutions: Acid spills should be diluted with water and flushed to floor drains. Soda ash or sodium carbonate solid or solution can be used to neutralize any residual acid. This is followed by flushing with water.

Alkali solutions: These should be flushed with water to a floor drain.

Volatile solvents: Volatile solvent evaporate rapidly and this kind of spill can cause a fire hazard. If minor quantities are spilled, wipe up the liquid with rags and discard them in the proper waste receptacle. If a large amount of solvent is involved in the spill, use a mop and pail. Squeeze out the mop in the pail and continue as needed.

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Oily substances: Remove the excess liquid by mopping. Pour a suitable nonvolatile solvent on an absorbent rag, and then wipe up the spilled substance. Finally, a thorough detergent-water scrub will clean up any oily remains.

Mercury: Push droplets together to form pools. To pick up the mercury, use a suction device made from a filter flask, rubber stopper, and several pieces of rubber and glass tubing.

Disposal of Chemical Waste

Acid or basic solution waste: Pour into the sink while running water continuously from the tap to dilute the acid or base. When you have finished pouring the waste into the sink, flush with large volumes of water to dilute any corrosive effect.

Organic waste residues: These are insoluble in water. Discard the bulk of the residues in a waste-disposal container. Discard all volatile solvent in a waste-solvent receptacle which will contain the vapours and will not constitute a fire hazard.

Sodium and potassium waste: Destroy properly by adding the waste slowly to absolute ethanol.

NEVER LEAVE THE LABORATORY AFTER USING CHEMICALS WITHOUT WASHING THOROUGHLY.

CENTRAL ENVIRONMENTAL AUTHORITY
Chemical Database Information System
Master Chemical Record

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REFERENCE NO : 145

Chemical Name : BENZENE

Trade Name(s) : BENZOL
ANNULENE
COAL NAPHTHA
PHENE
PYROBENZOL

CAS No. : [71-43-2]

Physical/Chemical properties :
State - Liquid
Colour - Colourless/yellow
Appearance - Mobile; non polar
Odour - Aromatic
Missibility - Alcohol, ether, CCl4

Melting Point : 5 oC

Boiling Point : 80.1 oC

Vapour Pressure : 100 mm(26.1 oC)

Solubility in water : Slightly soluble

F-- solubility : Miscible in oils, waxes

Molecular Weight : 78.11

Molecular Formula : C6H6

Acute Toxicity data : Local : Irritant - moderate toxicity
Local : Ingestion - slight toxicity
Local : Inhalation - slight toxicity
Systemic : Ingestion - moderate toxicity
Systemic : Inhalation - moderate toxicity
Systemic : Skin absorp. - moderate toxicity

LD50 Value : Or1-rat : 4894 mg/kg

Chronic Toxicity data : Local : No toxicity
Systemic : Ingestion - severe toxicity
Systemic : Inhalation - moderate toxicity
Systemic : Skin absorp. - severe toxicity

Environmental Effects : Flammable
Dangerous fire risk

Health Effects : Low toxicity
Toxic by ingestion, inhalation and skin absorption
A suspected carcinogen
Exposure may cause nausea and headache
Prolonged exposure may cause narcotic effect
May cause dizziness

May cause blood disorders

Bioaccumulation : Carbon dioxide and carbon monoxide

Type of Use : Detergents
For nylon
For aniline
Solvent

Special Precautions in Transport & Storage :
Keep away from heat, sparks and open flame
Store under nitrogen

Other Precautions : Wear appropriate OSHA/MSHA approved respirator
Wear Chemical resistant gloves
Wear safety goggles
Wear other protective clothing
Use safety shower and eye bath
Use only in a chemical fume hood
Do not breathe vapour
Do not get in eyes, on skin, on clothing

Treatment of Poisoning: If inhaled remove to fresh air
If not breathing give artificial respiration
If breathing is difficult give Oxygen
Call a Physician
Wash contaminated clothing promptly before reuse

Legal Status : SWT:Prohibited
CHL:Prohibited
DEN:Prohibited
FIN:Prohibited
JPN:Prohibited
NZL:Available for commercial users only

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