Recommendations For Storage of Laboratory Chemicals

INDIANA UNIVERSITY-PURDUE UNIVERSITY at INDIANAPOLIS IUPUI
•Department of Environmental Health and Safety •
620 Union Drive, Room 043, Indianapolis, Indiana 46202

The following general suggestions for safe storage of chemicals in the laboratory should be implemented.

- The quantities of chemicals that are stored within a laboratory should be minimized, as specified by NFPA 45 and OSHA. Many authorities recommend that the NFPA guidelines for maximum quantities and sizes of containers should be reduced to one-half or even one-third of the recommended values.

- Bulk quantities of chemicals (i.e., larger than one-gallon) must be stored in a separate storage area. Transfer of flammable liquid from 5 gallon or larger metal containers may not be done in the laboratory.

- Chemicals must be stored at an appropriate temperature and humidity level. This can be especially problematic in hot, humid climates. As a rule, chemicals should not be stored near heat sources, such as steam pipes or laboratory ovens. Chemicals should never be stored in direct sunlight.

- Chemicals should be dated when received and when opened. If the chemical is one that degrades in quality or becomes unsafe after prolonged storage, the shelf-life expiration date should also be included.

- Visual inspection of the material and its container should be conducted routinely. Indications for disposal include:
  - cloudiness in liquids
  - material changing color
  - evidence of liquids in solids or solids in liquids
  - "puddling" of material around outside of container
  - pressure build-up within bottle
  - obvious deterioration of container

- Chemicals should not be routinely stored on the benchtops. In such locations they are unprotected from exposure and participation in a fire situation and are also more readily knocked over. Each chemical should have a specific storage area and be returned there after use. Large quantities of flammable materials should not be stored in the laboratory. Only the amounts needed should be kept on benchtops, the remainder should be kept in flammable storage cabinets.

- Laboratory shelves should have a raised lip along the outer edge to prevent containers from falling. Never allow the container to hang off the edge of the shelf! Liquid or corrosive chemicals should never be

stored on shelves above eye-level. Glass containers should not touch each other on the shelves. Secondary containers or trays should be used for chemical storage whenever possible to minimize the flow of material should a spill or rupture occur. Round bottom flasks should always be supported properly in cork rings or by other means to keep them from tipping.

- Adequate security must be provided so that unauthorized personnel do not have access to hazardous materials.

- Chemicals must never be stored on the floor, not even temporarily!

- Chemicals that are no longer to be used for research purposes should be properly disposed of or given to another research group that has a use for it.

- Flammable materials must never be stored in domestic-type refrigerators. Only explosion-proof or flammable material refrigerators should be used for storage of these chemicals within a laboratory environment.

- All containers stored within the refrigerator should be tightly capped to keep vapors from interacting with each other and to alleviate "smell" problems. Flasks with cork, rubber or glass stoppers should be avoided because of the potential for leaking. All containers stored in the refrigerator must be properly labeled.

- Inventory the materials in your refrigerator frequently to avoid overcrowding with materials that have long since been forgotten. Also make it a point to defrost your refrigerator occasionally so that chemicals do not become trapped in unique ice formations!

- Before flammable materials are stored in a refrigerator, it should be determined if keeping the material chilled will serve any purpose. No benefit is derived from refrigerating a chemical that has a flash point below the temperature of the refrigerator. Never store peroxide formers (i.e., ether) in a refrigerator!

- Fume hoods should not be used as general storage areas for chemicals. This may seriously impair the ventilating capacity of the hood.

- Gas cylinders must be securely strapped to a permanent structure (wall, lab bench, etc.). When they are not in use they should be capped off.

- On termination, graduation or transfer of any laboratory personnel, all hazardous materials must be properly disposed of, or arrangements made to transfer them to the laboratory supervisor.

Segregation Based on Hazard Classes

In addition to general safe storage practices, segregated storage of incompatible materials is a must. As a minimum, laboratories should separate chemicals according to similar hazards, such as flammability, corrosivity, sensitivity to water or air, and toxicity. The following major categories of chemicals, each of which will be discussed in greater detail, are strongly recommended:

- Flammables
- Oxidizers
- Corrosives
  - acids
  - bases
- Highly Reactives
- Extreme Toxics/Regulated Materials
- Low Hazard

However, problems may arise with a general segregation of chemicals. Below, you will find a few of these potential problems.

1. **The actual identification of the hazards themselves**. Recent legislation has made this task somewhat easier since all chemical manufacturers are now required to list all hazards on outgoing chemical containers and each chemical must be accompanied by a Material Safety Data Sheet (MSDS). The chemical label thus furnishes a quick method of determining whether the material is a fire hazard, health hazard or reactivity hazard. The MSDS furnishes more detailed information regarding toxicity exposure levels, flashpoints, required safety equipment and recommended procedures for spill containment.

2. **Multiple hazards for chemicals**. Most chemicals have multiple hazards and a decision must be made as to which storage area would be most appropriate for each specific chemical. First you have to determine your priorities!
   a. When establishing a storage scheme, the number one consideration should be the flammability characteristics of the material. If the material is flammable, it should be stored in a flammable cabinet.
   b. If the material will contribute significantly to a fire (i.e., oxidizers), it should be isolated from the flammables. If there were a fire in the lab and response to the fire with water would exaggerate the situation, isolate the water reactive material away from contact with water.
   c. Next look at the corrosivity of the material, and store accordingly.
   d. Finally, consider the toxicity of the material, with particular attention paid to regulated materials. In some cases, this may mean that certain chemicals will be isolated within a storage area, for instance, a material that is an extreme poison but is also flammable, should be locked away in the flammable storage area to protect it against accidental release. There will always be some chemicals that will not fit neatly in one category or another, but with careful consideration of the hazards involved, most of these cases can be handled in a reasonable fashion. For the safety of all personnel and to protect the integrity of the facilities, hazardous materials must be segregated.

Peroxide-Forming Materials

Peroxides are very unstable and some chemicals that can form them are commonly used in laboratories. This makes peroxide-forming materials some of the most hazardous substances found in a lab. Peroxide-forming materials are chemicals that react with air, moisture, or impurities to form peroxides. The tendency to form peroxides by most of these materials is greatly increased by evaporation or distillation. Organic peroxides are extremely sensitive to shock, sparks, heat, friction, impact, and light. Many peroxides formed from materials used in laboratories are more shock sensitive than TNT. Just the friction from unscrewing the cap of a container of an ether that has peroxides in it can provide enough energy to cause a severe explosion.

Use and Storage of Peroxide-Formers

1. Do not open the chemical container if peroxide formation is suspected. The act of opening the container could be sufficient to cause a severe explosion. Visually inspect liquid peroxide-forming materials for crystals or unusual viscosity before opening. Pay special attention to the area around the cap. Peroxides usually form upon evaporation, so they will most likely be formed on the threads under the cap.

2. Date all peroxide forming materials with the date received, and the expected shelf life. Chemicals such as diisopropyl ether, divinyl acetylene, sodium amide, and vinylidene chloride should be discarded after three months. Chemicals such as dioxane, diethyl ether, and tetrahydrofuran should be submitted to Environmental Management Operations (EMO) Waste Management Depart for disposal after one year.

3. Store all peroxide-forming materials away from heat, sunlight, and sources of ignition. Sunlight accelerates the formation of peroxides.

4. Secure the lids and caps on these containers to discourage the evaporation and concentration of these chemicals.

5. Never store peroxide-forming materials in glass containers with screw cap lids or glass stoppers. Friction and grinding must be avoided. Also, never store these chemicals in a clear glass bottle where they would be exposed to light.

6. Contamination of an ether by peroxides or hydroperoxides can be detected simply by mixing the ether with 10% (wt/wt) aqueous potassium iodide solution - a yellow color change due to the oxidation of iodide to iodine confirms the presence of peroxides. Small amounts of peroxides can be removed from contaminated ethers via distillation from lithium aluminum hydride (LiAlH-4-), which both reduces the peroxide and removes contaminating water and alcohols. However, if you suspect that peroxides may be present, it would be wise to call the Environmental Management Operations (EMO) Waste Management Department at ANL for disposal. If

you notice crystal formation in the container or around the cap, do not attempt to open or move the container. Call the ANL Waste Handling Group for proper disposal.

7. Never distill an ether unless it is known to be free of peroxides.