



Practices for Proper Chemical Storage

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Safety**

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Introduction

Proper storage is needed to minimize the hazards associated with accidentally mixing incompatible chemicals.

Do not sort and store chemicals alphabetically unless they have first been separated into hazard classes. Additional guidelines on storing chemicals according to their hazard classes are presented later in this section.

Basic Guidelines

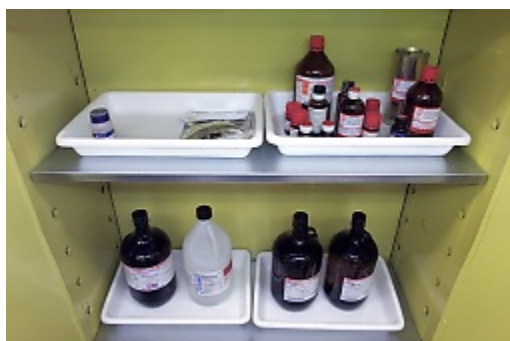
Observe the following general storage guidelines:

In general, chemicals should be separated according to the following categories:

- Solvents, which include flammable/combustible liquids and halogenated hydrocarbons (e.g., acetone, benzene, ethers, alcohols) Note: Store glacial acetic acid as a flammable liquid
- Inorganic mineral acids (e.g., nitric, sulfuric, hydrochloric, and perchloric acids).
- Bases (e.g., sodium hydroxide, ammonium hydroxide)
- Oxidizers
- Poisons
- Explosives or unstable reactive chemicals such as picric acid. Store separately outdoors in flammable storage cabinets

Ensure that caps and lids on all chemical containers are tightly closed to prevent evaporation of contents.

Store all hazardous liquid chemicals in drip trays that are chemically resistant.



- Avoid storing chemicals on countertops or in fume hoods except for those being currently used.
- Label all containers (squeeze bottles) to which hazardous materials are transferred with the identity of the substance and its hazards.
- Be aware that squeeze bottles have varying resistances to different chemicals. Some can form peroxide crystals that can lead to deterioration and degradation of container integrity.
- Limit the amount of chemicals stored to the minimum required.
- Avoid exposure of chemicals to heat or direct sunlight. This may lead to the deterioration of storage containers as well as the degradation of the chemicals.
- Use approved corrosive storage cabinets (constructed of chemically resistant components) for storing acids and bases.



- Use flammable storage cabinets to store flammable liquids.
- Existing cabinets showing signs of interior corrosion should be replaced and chemicals present should be evaluated for compatibility.
- Refrigerators used for storing chemicals, samples or media must be labeled with words to the effect as follows: "Caution – Do Not Store Food Or Beverages In This Refrigerator". Labels may be fabricated by users provided they are legible and securely affixed to the refrigerator.

- Refrigerators and freezers for storing flammable liquids (including ethanol) must be designed, constructed and approved for that purpose. Domestic refrigerator/freezers as well as units that have been modified to remove spark sources are not acceptable alternatives.



Storage Based on Hazard Class

The following guidelines are provided for the safe storage of hazardous materials in accordance with their hazard classes (consult Environmental Health & Safety for additional guidance):

Acids

- Segregate acids from reactive metals such as sodium, potassium, magnesium, etc.
- Segregate oxidizing acids from organic acids, flammable and combustible materials.
- Segregate acids from chemicals which could generate toxic or flammable gases upon contact, such as sodium cyanide, iron sulfide, calcium carbide, etc.
- Segregate acids from bases.

Bases

- Segregate bases from acids, metals, explosives, organic peroxides and easily ignitable materials.

Solvents (Flammable and Halogenated Solvents)

- Store in approved safety cans or cabinets.
- Segregate from oxidizing acids and oxidizers.
- Keep away from any source of ignition (heat, sparks, or open flames).

Oxidizers

- Store in a cool, dry place.
- Keep away from combustible and flammable materials.
- Keep away from reducing agents such as zinc, alkali metals, and formic acid.

Cyanides

- Segregate from acids and oxidizers.

Water Reactive Chemicals

- Store in a cool, dry place away from any water source.
- Make certain that a Class D fire extinguisher is available in case of fire.

Pyrophoric Substance

- (Materials which will react with the air to ignite when exposed, e.g., white phosphorus.)
- Store in a cool, dry place making provisions for an airtight seal.

Light Sensitive Chemicals

- Store in amber bottles in a cool, dry, dark place.

Peroxide Forming Chemicals

- Store in airtight containers in a dark, cool, and dry place.
- Label containers with receiving, opening, and disposal dates.
- Periodically test for the presence of peroxides.

Toxic Chemicals

- Store according to the nature of the chemical, using appropriate security where necessary.

(From "Safe Chemical Storage: A Pound of Prevention is Worth a Ton of Trouble" by David Pipitone and Donald Hedberg, Journal of Chemical Education, Volume 59, Number 5, May 1982 and "Fire Protection Guide on Hazardous Materials," NFPA, 1978.)

Know the properties of the chemicals used.

Material Safety Data Sheets

It is important for laboratory personnel to thoroughly research the properties of the chemicals they are using. Material Safety Data Sheets (MSDS) have sections on chemical incompatibility. The container's label should also provide storage guidelines.

Chemwatch

Faculty and students have access to **Chemwatch**, an on-line chemical MSDS database. Chemwatch is a relatively users friendly database. It was acquired for your use as a laboratory/chemical safety tool in providing access to information for thousands of Material Safety Data Sheets (MSDS) for chemicals. All you need to get in is a University issued IP address to access the Chemwatch database. General function keys (back, print, search, etc...) can be accessed using the blue keys/toolbar at the top left corner. As you pass your cursor over them their functions are identified. The blue key with the small letter a is the language key that allows you to choose viewing the information from approximately twenty (20) different languages.

Chemwatch Database access:

1. Go to the Environmental Health and Safety website (www.csuohio.edu/safety_environment) – it may be accessed using the A-Z link off of the main CSU page (under Environmental Health and Safety)
2. Once you are on the Environmental Health and Safety website, simply click on the link in the center of the page that says Chemwatch Access and you are in.
3. After a few seconds, a screen will appear and a trailer will pass across the screen, indicating that the default mode has changed and that you are in the simple mode – move your cursor over to the box on the left side of the screen that has the heading: Mode. Click on the top button with the graduation hat – you are now in the advanced mode and the trailer disappears.
4. Type the Name or CAS number of any chemical in the space under the heading Chemgold II and click on Search – after a few seconds a window with the heading Chemwatch List will appear containing all chemical names that include the one you typed in.

5. Chose the particular chemical and a summary of information from the MSDS will appear. To view the entire MSDS, move your cursor to the left side of the screen and click on the MSDS button to bring up an MSDS. If you are looking for an MSDS from a specific manufacturer, click on the SUPPLIER MSDS

6. Once you have performed a search a chosen a particular chemical, a set of keys appear on the left of the screen – their identity and function are as follows:
 - a. **Mini MSDS** – Contains select information from an MSDS such as Properties, Health Hazards, Precautions for use, etc...compressed onto one page.
 - b. **MSDS** – Contains the full MSDS for the chosen chemical. Chemwatch defaults to the first MSDS from the manufacturers listed alphabetically
 - c. **Summary** – Contains select information from an MSDS including Personal Protective Equipment, Risk statements, safety statements, etc... This is the screen that first appears following a requested search for a particular chemical
 - d. **MSDS++** - Not active
 - e. **Supplier MSDS** – Chemwatch will provide a list of all manufacturer's that have an MSDS for the chosen chemical as part of the Chemwatch database
 - f. **Sections** – choosing this will activate a menu on the right side of your screen that contains the heading of every section of an MSDS and you can select a particular section heading, (Identification, Supplier, Use, physical properties, etc...)
 - g. **Notes** – allows the user to enter any information they desire regarding the particular chemical they have searched for, perhaps relative to a particular experiment they are working on.
 - h. **Labels** – provides a template of labels for you to choose and print out from that can be included in reports or even affixed to chemical bottles
 - i. **Molecule** – this feature allows you to view molecular structures – However, a particular software package (Cosmo Player) is required and can be downloaded at no cost
 - j. **Monographs** – this provides a list of articles that contain information relative to the chosen chemical from such organizations as the Environmental Protection Agency, the National Institute of Safety and Health, Centers for Disease Control, etc...
 - k. **Environment** – provides information relating to the impact of the chosen chemical on the environment

Chemical Storage - Incompatible Chemicals

Certain hazardous chemicals should not be mixed or stored with other chemicals because a severe reaction can take place or an extremely toxic reaction product can result. The label and MSDS will contain information on incompatibilities.

The following incompatibility matrix and table contains examples of incompatible chemicals:

Chemical Incompatibility Matrix

	Acids, Inorganic	Acids, Oxidizing	Acids, Organic	Alkalis (Bases)	Oxidizers	Poisons, inorganic	Poisons, organic	Water reactives	Organic solvents
Acids, Inorganic			X	X		X	X	X	X
Acids, Oxidizing			X	X		X	X	X	X
Acids, Organic	X	X		X	X	X	X	X	
Alkalis (Bases)	X	X	X				X	X	X
Oxidizers			X				X	X	X
Poisons, inorganic	X	X	X				X	X	X
Poisons, organic	X	X	X	X	X	X			
Water reactives	X	X	X	X	X	X			
Organic solvents	X	X		X	X	X			

X = Not compatible – do not store together

CHEMICAL	KEEP OUT OF CONTACT WITH
Acetic Acid	Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates
Acetone	Concentrated nitric and sulfuric acid mixtures, and strong bases
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Alkali Metals	Water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, the halogens
Ammonia, anhydrous	Mercury, chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid
Ammonium Nitrate	Acids, metal powders, flammable liquids, chlorates, nitrites, sulfur, finely divided organic or combustible materials
Aniline	Nitric acid, hydrogen peroxide
Arsenic materials	Any reducing agent
Azides	Acids
Bromine	Same as chlorine
Calcium Oxide	Water
Carbon (activated)	Calcium hypochlorite, all oxidizing agents
Carbon tetrachloride	Sodium
Chlorates	Ammonium salts, acids, metal powders, sulfur, finely divided organic or combustible materials
Chromic Acid and Chromium trioxide	Acetic acid, naphthalene, camphor, glycerol, glycerin, turpentine, alcohol, flammable liquids in general
Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, turpentine, benzene, finely divided metals

Chlorine Dioxide	Ammonia, methane, phosphine, hydrogen sulfide
Copper	Acetylene, hydrogen peroxide
Cumene Hydroperoxide	Acids, organic or inorganic
Cyanides	Acids
Flammable Liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
Hydrocarbons	Fluorine, chlorine, bromine, chromic acid, sodium peroxide
Hydrocyanic Acid	Nitric acid, alkali
Hydrofluoric Acid	Ammonia, aqueous or anhydrous
Hydrogen Peroxide	Copper, chromium, iron, most metals or their salts, alcohols, acetone, organic materials, aniline, nitromethane, flammable liquids
Hydrogen Sulfide	Fuming nitric acid, other acids, oxidizing gases, acetylene, ammonia (aqueous or anhydrous), hydrogen
Hypochlorites	Acids, activated carbon
Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen
Mercury	Acetylene, fulminic acid, ammonia
Nitrates	Sulfuric acid
Nitric Acid (concentrated)	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases, copper, brass, any heavy metals
Nitrites	Acids
Nitroparaffins	Inorganic bases, amines
Oxalic Acid	Silver, mercury
Oxygen	Oils, grease, hydrogen; flammable liquids, solids, or gases

Perchloric Acid	Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, grease and oils
Peroxides, organic	Acids (organic or mineral), avoid friction, store cold
Phosphorus (white)	Air, oxygen, alkalis, reducing agents
Potassium	Carbon tetrachloride, carbon dioxide, water
Potassium chlorate and perchlorate	Sulfuric and other acids
Potassium Permanganate	Glycerin, ethylene glycol, benzaldehyde, sulfuric acid
Selenides	Reducing agents
Silver	Acetylene, oxalic acid, tartaric acid, ammonium compounds, fulminic acid
Sodium	Carbon tetrachloride, carbon dioxide, water
Sodium nitrite	Ammonium nitrate and other ammonium salts
Sodium Peroxide	Ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural
Sulfides	Acids
Sulfuric Acid	Potassium chlorate, potassium perchlorate, potassium permanganate (or compounds with similar light metals, such as sodium, lithium, etc.)
Tellurides	Reducing agents

(From Manufacturing Chemists' Association, *Guide for Safety in the Chemical Laboratory*, pp. 215-217, Van Nostrand Reinhold, 2nd Edition.)

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