General Guidelines for Storage and Management of Laboratory Chemicals

SafetyNet #: 42

Proper chemical management and storage is essential in assuring a safe work environment for students, staff, faculty, and visitors. These guidelines will help you manage and store chemicals safely in your work place. More detailed information is provided in the UC Davis Chemical and Laboratory Safety Manual [1].

Inventory

Federal, state and local regulations require the campus to maintain a chemical inventory. There are associated reporting requirements. To meet these requirements, Environmental Health and Safety has created a web-based Chemical Inventory System [2] (CIS). The system is a user-friendly way to enter, update, and report chemical inventories. It is the responsibility of the Principal Investigator to maintain their complete chemical inventory.

Labeling

All chemical containers must be clearly labeled. These labels should include the chemical name, chemical manufacturer, major hazard(s), and date received and/or prepared. If a set of abbreviations is routinely used by the lab, please post in a conspicuous place the abbreviations and their meanings.

All hazardous waste containers must be clearly labeled with a Hazardous Waste Label [3].

Storage

Chemicals must be segregated and stored with regard to compatibility and hazard classification. Storage areas must be clearly labeled. Laboratories must establish separate storage areas for each of the following:

- Flammable and combustible organic liquids and solvents,
- Corrosive inorganic acids,
- Dry poisons, dry salts and dry oxidizers,
- Corrosive bases,
Corrosive organic acids,
Reactives (air)/pyrophorics,
Reactives (water),
Reactives (light/wavelength),
Explosives

Cabinets or shelving should be sturdy and secured to the wall. Shelves should be fitted with a barrier or lip at least 1-1/2 inches high to prevent chemicals from falling off the shelves. Corrosives should be stored in wooden or plastic laminate cabinets, if possible. Metal cabinets are not recommended for storage of corrosives. Chemicals should not be stored under the sinks in a lab. Secondary containment is advised for liquids and for reactives; for liquids secondary containment may be a dish pan; for reactives secondary containment may be a Ziploc baggie.

When you initially sort your chemicals for storage, cross-reference the Safety Data Sheets (SDSs) for the incompatibilities of each chemical with other chemicals in the laboratory. A list of incompatible chemicals [4] is available from EH&S.

Specific storage guidelines by chemical group are included at the end of this SafetyNet.

**Ventilation**
If a chemical cabinet or storage area is ventilated, the ventilation system must exhaust through the fume hood exhaust system or be independently ducted to the outside of the building. Cabinets shall not be ventilated through the fume hood work surface. Contact EH&S with questions about ventilation in your chemical storage area.

**Spills**
Keep absorbent material available to absorb spills and leaks. A good general-purpose liquid absorbent is available from the Storehouse (Dri Zorb Cat. No. NC9571649) or by mixing clay kitty litter with baking soda. Spill cleanup kits for solvents, acids, mercury, hydrofluoric acid, and other chemicals are available commercially. Prepare a spill response plan for your laboratory to control unplanned chemical releases. See SafetyNet #13 [5], “Guidelines for Chemical Spill Control.”

**Outdated Chemicals and Chemical Waste**
Outdated chemicals and chemical wastes must be disposed by EH&S. A chemical waste disposal list can be submitted electronically from the EH&S website. See SafetyNet #8 [6], “Guidelines for Disposal of Chemical Waste”, for specific chemical disposal information.

**Carcinogens**
Campus Recognized Chemical Carcinogens must be stored and handled in strict accordance with the UC Davis Chemical Carcinogen Safety Program. Researchers wishing to use Campus Recognized Chemical Carcinogens must include the carcinogen on their chemical inventory
(CIS) and prepare a Standard Operating Procedure (SOP) specific to the carcinogen in use. SOP templates exist for formaldehyde [7] and methylene chloride [8] (dichloromethane) and a general SOP template is available for download in the Chemical Carcinogen Safety Manual.

**Smoking**

Smoking is not permitted in outdoor areas where chemicals are used or stored in accordance with UC Davis P&P 290-10 [9].

**Specific Storage Guidelines by Chemical Group**

Requirements for the storage of chemicals are detailed in the California Fire Code (CFC) and California Health and Safety Code. The National Fire Protection Association also has storage recommendations. Based on the occupancy rating of the space (the use of the space), the maximum allowable quantity of chemicals that can be stored in a given space is determined from the CFC. The types of cabinets and shelving required are also determined from the CFC.

**Acids:** This includes corrosive materials with a low pH such as: organic acids (e.g., acetic, boric and formic), and inorganic (mineral) acids (e.g., chromic, hydrochloric, sulfuric, nitric). Perchloric acid, when heated above room temperature, and hydrofluoric acid, because of their reactivity and toxicity, have special handling considerations.

1. Segregate organic acids from inorganic (mineral) acids. Many organic acids, like glacial acetic acid, are combustible and consideration should be given to storing combustible organic acids in a flammable liquid storage cabinet.
2. Segregate acids from bases and reactive metals such as sodium, potassium, finely divided magnesium, or zinc.
3. Segregate oxidizing acids, such as nitric, perchloric (heated above room temperature), and chromic from other mineral acids, organic acids, and combustible/flammable materials and liquids.
4. Segregate acids from cyanides and sulfides, such as sodium cyanide and iron sulfide that could liberate toxic gases upon contact.
5. Use bottle carriers, bins, tubs, buckets, or other secondary containment when transporting acids.
6. Store bottles of acid below eye level or in a cabinet specifically designed for storing corrosives. Laminated or epoxy-coated wooden cabinets with plastic-lined shelves are recommended for storing acids. Even purpose-designed metal cabinets and shelves will eventually degrade and potentially fail.
7. Store acid drums and carboys in a cool, dry place, away from direct sunlight and heat sources. Make sure spigots and liquid delivery devices are below eye level. Gravity feed, where a carboy is placed on an upper shelf and (potentially) hazardous liquid dispensed by gravity, is risky and should not be used.
8. Acid waste containers should be stored in non-metal secondary containment - a tub, bucket, tray, or tote - to contain leaks.

**Bases (Caustics or Alkalis):** This includes corrosive materials with a high pH such as
potassium hydroxide, sodium hydroxide, ammonium hydroxide, calcium hydroxide.

1. Segregate bases from acids.
2. Store solutions of inorganic hydroxides in polyethylene containers.
3. Use bottle carriers, bins, tubs, buckets, or other secondary containment when transporting bases.
4. Store containers of liquid bases below eye level or in a cabinet specifically designed for storing corrosives. Laminated or epoxy-coated wooden cabinets with plastic-lined shelves are recommended for storing bases. Even purpose-designed metal cabinets and shelves will eventually degrade and potentially fail.
5. Base waste containers should be stored in non-metal secondary containment - a tub, bucket, tray, or tote - to contain leaks.

**Flammable and Combustible Liquids:** This includes liquids with a low flash point and boiling point, such as acetone, toluene, xylene, hexanes, glacial acetic acid.

1. Quantities of flammable liquids greater than 10 gallons in any one room must be stored in a flammable liquid storage cabinet. This quantity may be doubled to 20 gallons, if metal safety cans are used for storage.
2. If flammable liquids need to be refrigerated, a lab-safe (flammable materials storage) refrigerator, purpose-designed, manufactured and labeled by the manufacturer for storing flammable liquids, must be used. Do not store flammable liquids in standard, residential-type refrigerators.
3. Safety cans or drums dispensing or receiving flammable liquids must be grounded and bonded when transferring liquids.
4. Store flammable and combustible liquids separate from acids, bases and oxidizers.

**Flammable Solids:** This includes solid materials such as calcium carbide, phosphorus pentachloride, lithium, sodium, potassium, and finely divided metals (magnesium, zinc, iron) that may spontaneously ignite in air or on contact with water.

1. These materials react violently in the presence of water, including water vapor as humidity in ambient air. Toxic or flammable gases may be evolved or the material may catch fire on contact with air. Review SDSs, manufacturer's recommendations, and other references carefully for proper storage conditions.
2. Elemental lithium, potassium, and sodium must be stored under mineral oil.

**Oxidizers:** This includes solids and liquids with an oxidizing functional group (consuming oxygen, causing the reaction to burn hotter and faster) such as benzoyl peroxide, potassium permanganate, hydrogen peroxide, nitric acid, perchloric acid (heated above room temperature), ammonium nitrate, potassium nitrate.

1. Segregate oxidizers from flammable/combustible liquids and solids.
   Flammable/combustible liquids and solids contribute fuel to the reaction. Oxidizers contribute oxygen to a reaction and can cause the reaction to rapidly get out of control.
2. Segregate oxidizers from reducing agents like hydroxylamine, sulfur dioxide, oxalic acid,
alkali metals, and formic acid.

**Highly Toxic and Sensitizing Compounds:** This includes liquid and solid compounds such as cyanide, sodium azide, osmium tetroxide, toxins and venoms, isocyanates, phenol and phenolic compounds.

1. Carefully review SDSs and other sources of hazard information BEFORE using these chemicals.

2. Make sure personal protective equipment is appropriate to the hazard, contacting the chemical manufacturer if necessary.

3. Make sure engineering controls, such as fume hoods and glove boxes, are in good working order, properly certified (within one year) and cleared of unnecessary clutter.

4. Under some circumstances, highly toxic compounds must be stored in a ventilated cabinet. Contact EH&S for advice.

5. Contact EH&S to determine if exposure monitoring is needed. For medical advice, contact Occupational Health Services (530-752-6051).

**Reactive to Air/Pyrophorics:** Chemicals that may react violently or ignite on contact with air must be stored in an inert atmosphere (e.g. argon gas) and used in a dry box or similar containment device.

**Reactive to Water:** Chemicals that may react violently with water must be stored in a moisture-free environment and protected from accidental contact with water. Use of moisture-sensitive chemicals should take into account moisture from the ambient air.

**Reactive to Light/Wavelengths:** Chemicals that may react violently on contact with light or certain wavelength light (e.g. ultraviolet) must be stored in a manner that precludes light exposure. Use of light-sensitive chemicals should be carefully planned due to the dual hazard of working in reduced lighting conditions and the potentially violent reactivity of the chemicals upon accidental light exposure.

**Explosives:** Chemical explosives must be used and stored in compliance with applicable Federal, State, and local laws and regulations, as well as UC Davis policies, procedures, and standards. Contact the Fire Department and EH&S/Safety Services for guidance.

**Compressed Gases:**

1. Segregate and clearly mark “full”, “in service”, and “empty” cylinders.

2. Separate and store gases by hazard classification and compatibility. For example, a small (size 3 or size 4) hydrogen cylinder should be stored in a ventilated flammable cabinet and a lecture bottle of hydrogen chloride should be stored in a ventilated corrosives (inorganic acid) cabinet.

3. Secure cylinders upright in a rack or chained with two straps or chains.

4. Replace valve caps when cylinders are not in use.
5. Do not use defective, damaged or unidentified gas cylinders. Remove from service and contact the manufacturer.

6. Use and store extremely hazardous gases only in ventilated safety cabinets. Depending on the gas, monitors, alarms, fire suppression, or other controls may be necessary. Contact EH&S for guidance.

7. Lecture bottles (small compressed gas bottles) must be labeled with chemical name, hazard(s), and date received. Segregate according to hazard class and chemical compatibility and in a secure place. Empty lecture bottles should be labeled, stored separately, and disposed through EH&S.

8. See SafetyNet #60 [10], "Compressed Gas Safety" for additional information about safe handling of compressed gases.

**Peroxide-forming Chemicals**, such as diethyl ether, tetrahydrofuran, p-dioxane


**Contact**

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**More information**

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1. Guidelines for Chemical Spill Control
2. Chemical Waste Disposal Guidelines
3. Compressed Gas Safety
4. Peroxide Formation in Chemicals

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