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Segregation of Incompatible Chemicals

Chemicals are an important component of laboratory functions. If used carelessly, they can cause severe physical, structural, and/or financial damage to the University and its employees. These damages may be brought about by an immediate reaction or long-term misuse/neglect of a chemical. To prevent the misuse of chemicals, the employee must identify any hazards associated with the chemical in use. This can be done by reviewing the Safety Data Sheet (SDS) before working with the chemical. Plan work carefully. At the beginning of complex research projects, conduct a risk assessment. Ask these questions:

- What are the hazard(s) associated with the chemicals involved in the research? (Nitric Acid, Xylene, Sodium Azide)
- What kind of PPE is needed? (fume hood, biosafety cabinet, apron, splash proof goggles)
- Will the process generate waste?
- Will the waste be hazardous? (reactive, ignitable, corrosive, toxic)
- What type of reactions take place when using the chemicals? (generate heat, acid-gas formation, freeze)

Tips for Chemical Storage

Many laboratories find it convenient to store their chemicals alphabetically. This may seem like good lab organization, but it can lead to incompatible hazardous chemicals being stored together. For example, say we store all the chemicals starting with "S" together. What usually happens in this situation is Sulfuric Acid (Strong Acid) gets stored on the same shelf or in the same cabinet as Sodium Nitrite (Strong Oxidizer). If one of these containers leaked (or the shelf falls), an acid gas could result as a reaction between the two chemicals. **Consult the chemical's SDS for identifying hazards and compatibility issues**. See below for tips on chemical storage.

- Separate solids from liquids (preferably organic from inorganic). Note: Within the solids group, separate metals from non-metals. Keep metals away from water and moisture to prevent corrosion or reaction.

- Separate non-hazardous from hazardous.

- Separate toxic from irritants (non-hazardous). Note: Irritants are usually denoted by a black "X" on the bottle. Toxic are labeled with a skull-and-crossbones symbol. Toxic chemicals should be stored away from sink and sanitary areas.

- Containers of flammable liquids are often stored in refrigerators or cold rooms. This is an unsafe practice. Evaporation occurs, and in the closed chamber, an explosive mixture may rapidly be achieved. A spark from a door switch, light mullion heater, defrost timer, compressor relay, thermostat, or other source can result in an explosion. Cold rooms also may have many ignition sources, typically from fan

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motors, light switches, or electrical equipment being operated in the room.

Evaporation of flammable liquids can occur even from tightly capped containers. At lower temperatures, this happens at a slower rate, but if the chamber is opened infrequently, the concentration of vapor may still approach the lower explosive limit. Spills of flammable liquids within a refrigerator also are a major hazard. The spark from the door switch when the refrigerator opens will result in an explosion.

If flammable materials must be refrigerated, they should be stored in explosion-proof or laboratory-safe refrigerators. These units differ greatly but are both suitable for most research laboratory applications. The sources of ignition are eliminated from the chamber (e.g., light, door switch, thermostat). These units possess a magnetic door catch instead of a mechanical latch to eliminate a source of sparks.

- Separate corrosives from remaining hazardous chemicals including flammables. Note: Among the corrosives, separate acids from bases. Acids and bases can be stored in the same cabinet as long as they are stored in secondary containment separate from each other. Corrosives can be stored in cabinets underneath fume hoods (usually in the cabinet provided on the right).
- Separate reactive/oxidizers from remaining hazardous chemicals. Note: Oxidizers can be stored on shelves, preferably below eye level. Some oxidizers can be stored in explosion-proof refrigerators to prevent peroxide formation. Water-reactive chemicals should be stored clear of sinks or any areas of moisture.
- Review the list of Chemical Substance Incompatibilities to further refine your chemical segregation.
- The Group A and B incompatible chemicals list also can be useful for determining how to segregate your chemicals.

Amounts in Storage

Labs should limit the quantity of chemicals to what is necessary to complete the task. Limits for the National Fire Protection Association must be met for all locations. Prudent practice is that the quantities of chemicals in a laboratory not exceed a total of 60 gallons (with approved storage cabinets) or three month's supply (for all such chemicals combined).

Storage Locations

A designated storage location should be identified and should be away from sun and heat. Storage under sinks is not allowed except for cleaning chemicals used in the laboratory. All storage locations for chemicals must be secured against theft. To prevent theft, workers should ensure doors are locked when unattended. Chemicals

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regulated by the Drug Enforcement Agency require registration and have specific storage requirements. Storage above eye level should be avoided.

Shelving

The best shelving is steel with acid-resistant paint with a raised lip along the outer edge to prevent containers from falling. Porous materials should be avoided. Shelving should be labeled clearly to indicate what kinds of chemicals may be stored there. An easy way to do this is to color-code the edges of shelves with paint or tape to match the color-coding of labels. Materials then can be returned to proper storage at a glance. Lips or restraining devices on shelves should be used and all shelving must be securely attached to the building or its components. Free standing shelving is not allowed. In no circumstance can chemicals extend beyond the edge of the shelf.

Liquid Chemicals

Liquid chemicals must be in some type of secondary container. Compatible liquids may be stored in the same secondary container. Secondary containers must have a capacity of 110% of the largest container or 10% of the aggregate volume of the containers, whichever is greater.

Lecture Bottles

Lecture bottles must be placed in a rack designed for the purpose (resembling an oversize test-tube rack) or be firmly clamped to a ring stand with a heavy base, in an upright position. They may not be used or stored lying on their sides. These precautions are designed to avoid the cylinder cap being broken off through a fall or a sudden increase in pressure. In such events explosions may result, and the gas cylinder may become a dangerous projectile.

Fume Hoods

Exhausted fume hoods should not be used for dual use (i.e. process use and storage). If the fume hood is used for process use, any items, such as hazardous waste containers and other nonessential equipment placed in the hood will create turbulence or block airflow in the exhausted fume hood. Keep only those items necessary for the experimental procedure in the hood enclosure. Clutter in the hood disrupts the airflow, reducing its capture efficiency and may provide fuel if there is a fire. If the fume hood will be used for storage of chemicals, the fume hood must be marked “CHEMICAL STORAGE ONLY” and no processes are allowed in the fume hood.

Storage on the Floor

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Glass and liquid filled containers are not allowed to be stored directly on the floor. They must be in secondary containers. It is advisable to not store any chemicals on the floor to avoid the possibility of spills during cleaning.

Compatibility

Chemicals must be stored by compatibility. Chemicals can be stored alphabetically with other compatible chemicals. Many chemicals pose hazards that correspond to more than one storage type. These chemicals should be stored in the lowest type number (see below).

Storage Containers

Use

All chemicals should be maintained per manufacturer requirements. Stock containers should be returned to the storage location after each use and not left on the bench top work area. Storage on bench-tops prevents protection from ignition sources and are more easily knocked over. The law requires that damaged containers be disposed of immediately. "Damaged" includes: cracked or broken caps; chipped threads on bottle necks; and corrosion of metal containers, even if an interior glass container is intact. Do not stack containers in storage areas.

Closures

All containers must have tight closing lids and be secure and in place when not in use.

Labeling

All chemicals must be appropriately labeled. If possible store chemicals in their original containers. If they are transferred to secondary containers, the secondary container must have a label that contains a minimum of full chemical name, concentration of each chemical, hazard (danger, warning, caution, water reactive, flammable, etc.) and date of transfer. See “Container Labeling” for more information.

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The following is a quick reference of incompatibilities for many chemicals commonly encountered in the laboratory. It is not a comprehensive list of all possible combinations and chemicals. For details on any chemical, check the MSDS.

- **Acetic acid** with chromic acid, ethylene glycol, hydroxyl compounds, nitric acid, perchloric acid, permanganates, peroxides
- **Acetone** with concentrated sulfuric and nitric acid mixtures, hydrogen peroxide
- **Acetylene** with copper (tubing), bromine, chlorine, fluorine, iodine, silver, mercury and their compounds
- **Alkali metals** (e.g. powdered aluminum or magnesium, calcium, lithium, potassium, sodium) with carbon dioxide, carbon tetrachloride, chlorinated hydrocarbons, flammable liquids, oxidizers, salt sulfur, water
- **Ammonia** (anhydrous) with mercury, halogens, calcium hypochlorite, hydrogen fluoride
- **Ammonium nitrate** with acids, metal powders, flammable fluids, chlorates, nitrates, sulfur, and finely divided organics or combustibles materials
- **Aniline** with nitric acid, hydrogen peroxide, inorganic acids, oxidizers
- **Bromine** with ammonia, acetylene, benzene, butadiene, butane, petroleum gases, hydrogen, sodium carbide, turpentine, and finely divided metals
- **Chlorates** with ammonium salts, acids, metal powders, sulfur, finely divided organics or combustible materials
- **Chromic acid** with acetic acid, naphthalene, camphor, alcohol, glycerol, turpentine, and other flammable liquids
- **Chlorine** with ammonia, acetylene, butadiene, benzene, and other petroleum fractions, hydrogen, sodium carbide, turpentine, and finely divided powdered metals
- **Cyanides** with acids
- **Hydrocarbons**, general with fluorine, chlorine, bromine, chromic acid, sodium peroxide
- **Hydrogen peroxide** with copper, chromium, iron, most metals or their respective salts, flammable fluids, and other combustible materials, aniline, and nitromethane.
- **Hydrogen sulfide** with nitric acid, oxidizing gases
- **Iodine** with acetylene, ammonia (anhydrous or aqueous)
- **Mercury** with acetylene, ammonia, fulminic acid, hydrogen
- **Nitric acid** with acetic, chromic, and hydrocyanic acids, aniline, hydrogen sulfide, flammable liquids or gases and substances which are readily nitrated
- **Oxalic acid** with silver, mercury and their salts
- **Oxygen** with oils, grease, hydrogen, flammable liquids, solids and gases
- **Perchloric acid** with acetic anhydride, bismuth and its alloys, alcohol, paper, wood and other organic materials
- **Phosphorous pentoxide** with water, alcohols, strong bases
- **Potassium permanganate** with glycerol, ethylene glycol, benzadehyde, sulfuric acid

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- **Sodium peroxide** with any oxidizable substances (e.g. ethanol, methanol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerol, ethylene glycol, ethyl acetate, methyl acetate, furfural)
- **Sulfuric acid** with chlorates, perchlorates, permanganates, and water