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Disposal of Chemical Wastes

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ABSTRACT

The risk of chemicals in laboratories discussed in this document include elements, compounds, mixtures, commercial products, cleaning products, solvents, and lubricants. Many chemicals are poisonous, irritating, corrosive, carcinogenic, pyrophoric, or explosive. It is not uncommon for chemicals to have two or more of these properties. Chemicals that may be relatively safe when used alone can become very dangerous when mixed with other substances, either in a planned experiment or by accident. Furthermore, a material may not present any risk of exposure in one form, but may in another (e.g. solid vs. aerosol). Therefore, personnel who handle chemicals must consider the hazards and use appropriate controls and procedures.
This document is intended to provide the user of chemicals with general guidelines on safe storage, and use of such chemicals in compliance with regulatory requirements.

Definition of chemical waste:

Any chemical that exhibits hazardous characteristics as defined by federal and Illinois rules and regulations, is unusable or unwanted in any way and poses a potential hazard to individuals, the environment or public health is a hazardous chemical waste.

Examples:

• Waste and opened surplus chemicals.
• Expired or off-specification chemicals.
• Carcinogens and cytotoxic (antineoplastic) agents
• Prescription drugs and controlled substances
• Empty chemical drums and other chemical containers with a capacity of 10 gallons and greater
• Thermometers and other items containing mercury
• Non-returnable gas cylinders and lecture bottles or pressurized chemicals
• Residue of spill clean-up materials-contaminated rags and absorbents
• Non-radioactive lead shielding and lead scrap
• Photographic film processing solutions
• Used oil --- motor, vacuum pump, lubricating
• Pesticides
• Used solvents
• Batteries
• Paint, paint thinners, brush cleaners, linseed oil, thinner contaminated rags
• Heavy metal containing waste or products (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver)

General principle for managing laboratory chemicals:

• **Less is better**. Purchase small amounts that you will use up within a year. Whereas the per-unit cost may be greater significant savings are realized in reduced disposal costs and safer storage.

• Buy pre-made molar and normal solutions, thereby reducing the likelihood of waste.

• Read labels. Handling and storage information on the manufacturer‘s label.

• Purchase chemicals in plastic containers to minimize potential breakage. If this is not possible, purchase shatter-resistant plastic coated bottles.

Manage first-in, first-out! **Indicate the date received and the date opened.** Pay particular attention to expiration dates.

• Dispose of open, partially used or expired chemicals.

• Peroxide-forming compounds require frequent testing or disposal.

• Keep all chemical containers off floors, carts and electrical equipment.

• Physically segregate your chemicals according to compatibility.

• Label the secondary storage containers or areas in which particularly hazardous chemicals may be used. These substances must be kept in a Designated Area.

• Store hazardous chemicals **below** eye level. This simple task greatly reduces the likelihood of something falling from above and breaking.

• Cabinets with doors are safer locations than open shelves for hazardous chemicals.

• Safely transport any hazardous chemical. Place in secondary containment such as a bottle carrier.

• Avoid placing any chemical container in direct sunlight, underneath a sink or near heat sources.

• Place volatile or flammable chemicals only in specially designed refrigerators.

• Do not store hazardous chemicals in cold rooms.

• Be especially careful with reactive chemicals. Obtain and read the SDS for each reactive chemical that you may have or may work near.

• Label all containers in the laboratory with the following information (this includes any stock or working solutions):

Name of chemical or stock solution Date started

Your initials

Hazard warning (i.e., flammable, toxic, corrosive, reactive)

• Store chemical by hazard class. Do not store merely by alphabetical order.

• Use and manage your chemical fume hood, wisely. Too many chemical containers or equipment block the air slots and compromise the containment performance.

• Follow all waste disposal guidelines provided by ORS.

Storage of flammable liquids:

• Limit the amount of flammable liquids in use to the smallest practical volume. Work with flammable liquids inside a chemical fume hood. At the end of the day, return all flammable liquids to an approved flammable storage cabinet. The doors flammable storage cabinets must be close securely. Self-closing doors are best. Contact ORS for assistance in ordering flammable storage cabinets.

• The maximum quantity of flammable and combustible liquids that can be stored openly or **within** an approved flammable storage cabinet is defined for each campus. See the *Laboratory Safety and Chemical Hygiene Plan*

• The purchase of 5-gallon containers of flammable liquids is strongly discouraged. All transfers of flammable liquids from containers of five gallons or more must be performed inside a fume hood. These containers also must be stored in a flammable storage cabinet.

• Segregate flammables from oxidizers and oxidizing acids.

• Most refrigerators/freezers purchased by the labs are designed for non-hazardous materials. Refrigerators and freezers suitable for flammable material storage are specially labeled ―Explosion safe‖ or ―Explosion proof.‖

Storage of gas cylinders

• In general, only keep cylinders in your lab that are in current use or waiting for immediate use.

• Large toxic gas cylinders must be in an approved gas cylinder cabinet.

• Maximum allowable storage quantities for cylinders is defined in the ORS *Compressed or Liquified Gas Cylinders in Laboratories* policy.

• All cylinders **not** attached to a regulator must have a valve protection cap in place.

• For vertical storage, cylinders must be secured (at a minimum) in their upper third by a tight fitting chain or belt secured to the wall or non-movable casework. This applies to all cylinders.

• One cylinder per chain or web belt.

• Horizontal storage of cylinders is only allowed in racks designed for the purpose. Cylinders must be chained to the rack.

• Cylinders must not be kept in corridors, hallways, stairways or cold rooms (or any other area with limited ventilation). Exceptions must be approved by ORS.

Disposal procedures for specific waste streams: Acids and Bases:

1. Collect concentrated acids and bases in original containers whenever possible. This includes nitric, hydrofluoric, sulfuric, glacial acetic, hydrochloric, sodium hydroxide, ammonium hydroxide. Hydrofluoric acid etches glass and must be collected in plastic containers.

2. Dilute acid and base solutions may be disposed of down a lab sink with copious amounts of water **provided they are treated as follows**:

• Slowly stir acid in a large amount of an ice-water-to dilute to about 5%.

• Prepare a base solution of one of the following: sodium carbonate (soda ash), calcium hydroxide (slaked lime), or sodium hydroxide. The base concentration should be 5 to 10 % for nitric and perchloric acids. A one-molar solution is about 4% (4 grams per 100 ml).

• Slowly stir diluted acid into the base solution until the pH is at least 5 but not greater than 13.

• Slowly pour the neutralized solution down the drain with large amounts of water.

3. No solvent or metal contamination is permitted for drain disposal.

The pH of solutions poured down the drain shall be between 5 and 10 to avoid violating local, state, or federal regulations.

Acrylamide:

1. Unused/unwanted acrylamide powder or opened liquid must be disposed of through ORS using Container.
2. For the collection of acrylamide gels that contain ethidium bromide, dispose of in a five-gallon plastic.

Aerosol cans:

If completely empty, aerosol cans may be disposed of as non-hazardous waste. If contents or pressure remains, dispose through ORS.

Chemical carcinogenic and mutagens:

Triple rinse empty containers and collect all rinsate as hazardous waste or present to ORS for cleaning.

Contaminated glassware:

Chemically contaminated glass ware, pipette tips, needles, blades and sharps are collected in a puncture proof container.

Broken glass ware not contaminated with hazardous chemicals can be put in a card board container, sealed and picked up as trash.

Cyanides:

Cyanides, nitrites and sulfides are among the most toxic and rapidly acting substances found in a chemical lab. Symptoms of toxicity occur if these materials are swallowed, inhaled or absorbed through the skin. Keep stored in locked and secure locations. Always use secondary containers to help prevent breaks or spills.

Dioxane:

Dioxane (1,4-Dioxane) is a highly flammable liquid and can form potentially explosive peroxides upon long exposure to air. Containers of dioxane must be dated when opened and tested periodically for the presence of peroxides.

Drain disposal:

The range of substances that can be potentially hazardous is enormous. Almost any substance can be a hazardous waste if it is disposed of in large quantities or in high concentrations. Federal and state hazardous waste laws permit laboratories to dispose of small amounts of some chemicals in quantities that do not pose a hazard to human health or the environment such as:

1. Inherently toxic, malodorous or lachrymatory chemicals
2. Solutions containing heavy metals
3. Flammable liquids (flash point < 140◦F) of any type.
4. Organic solvents—methanol, acetone, hexane, chloroform
5. Paint and paint thinner
6. Poisons, carcinogens, teratogens.
7. Toxic dyes and stains
8. Sodium azide
9. Strong acids and bases (either in pH extremes/concentration)
10. Chromic/sulfuric acid cleaning solutions

11. Photographic fixer
12. Motor oil, gasoline, degreasing solutions, antifreeze or other automotive fluid
13. Pesticides

Ether :

Ether is a highly flammable liquid and can form potentially explosive peroxides over time. Containers of ether must be dated when opened and tested periodically for the presence of peroxides. Ether cans have expiration dates on the label. Dispose before they expire. If old, undated
ether is found, do not open and contact ORS immediately.

Formalin / Formaldehyde:

1. Unwanted or unused formalin or formaldehyde must be disposed through ORS using Container.
2. If you have a large number of specimens preserved in formalin that you wish to dispose of, contact ORS to discuss disposal options.

Gas cylinders:

Compressed gases are among the most problematic wastes to handle and dispose. Avoid buying gas cylinders if at all possible. Buy only what you need, use all you buy and return cylinders to the gas vendors if empty or not routinely used. Lecture bottles can be a serious disposal problem. If at all possible, return these to the manufacturer or supplier for reuse. If not, dispose of through ORS. Label integrity is essential. Ensure that the label on each cylinder is legible. Keep the valve protection cap on the cylinder when not in use. When the cylinder is in use, keep this valve cap near the cylinder so that it does not get misplaced. Attach an ORS Hazardous Waste Label when the cylinder is to be disposed.

Mercury:

Mercury and mercury compounds are especially hazardous. If spilled, elemental mercury in cracks of lab benches or floor tiles may pose an exposure hazard for years. Few hazardous waste facilities accept mercury. Therefore, it is essential that the use of mercury be avoided. Substitute mercury thermometers with non-mercury alternatives or electronic devices to measure temperature and
pressure. All mercury compounds and materials must be disposed through ORS. For mercury spills, contact ORS.

Nitric acid:

Many reported waste container ruptures and explosions in laboratories involve the accidental mixing of nitric acid with reducing agents (e.g., organic compounds). Avoid creating nitric acid waste mixtures with acetone, acetic acid, acetic anhydride, alkali metals, cyanides, aldehydes, powdered metals organic materials, ammonia, acetonitrile, alcohols, acrylonitrile and organic matter. Nitric acid is a powerful oxidant and reacts violently, sometimes explosively with liberation of toxic nitrogen oxides. Oxidation is invariably accompanied by more or less gas evolution, usually capable of rupturing closed vessels.

Oils:

Uncontaminated instrument and machine oils such as centrifuge, diffusion pump and vacuum pump oils must be collected in plastic containers and labeled with an ORS Hazardous Waste Label. Oils found in X-Ray machines and other similar devices may contain PCB's (polychlorinated
biphenyls), especially if the equipment is old. DO NOT MIX PCB CONTAMINATED OIL WITH OTHER OILS.
NOTE: *All vacuum pumps must be emptied of oil prior to disposal. If sending them out or to the shop for service, they must be rinsed and purged with clean oil. Collect rinse oil for disposal through ORS.*

Organic mercury (Alkyl and Aryl) compounds:

Organic mercury compounds pose special hazards in the laboratory. Under *all* circumstances, these compounds must be handled according to the Laboratory Safety and Chemical Hygiene Plan. Alkyl mercury compounds require prior approval from ORS before purchase or use. Contact ORS for assistance in planning, use and disposal before using these compounds.

Perchloric acid:

Perchloric acid reacts violently with many oxidizable substances. The anhydrous (dehydrated) acid presents a serious explosion hazard. It is unstable and can decompose explosively at ordinary temperatures or in contact with many organic compounds. Amounts in labs must be limited to *1*
pound or less. Any work with perchloric acid heated above ambient temperature requires ORS approval. Special wash-down hoods may be required. Many heavy metal perchlorates and organic perchlorate salts are extremely sensitive explosives; the ammonium, alkali metal and alkali earth perchlorates are somewhat less hazardous. Mixtures of perchlorates with many oxidizable substances are explosive. Cold 70% perchloric acid is a strong acid but is not considered to be a strong oxidizing agent; however more concentrated solutions are good oxidizers. Work with >85% perchloric acid requires special precautions and should be carried out only by specially trained personnel and in specially designed fume hoods.

Peroxide forming compounds:

Certain chemicals such as isopropyl ether, diethyl ether, dioxane, 2-butanol, tetrahydrofuran can form organic peroxides if they are exposed to air, become more concentrated or age. These compounds may violently explode when combined with certain other compounds (i.e., metals or by heat, shock, friction or static discharge).

Never move or open a container if crusty deposits formed on the material or its container, an oily, viscous layer appeared, or there are solids on the bottom.

• Clearly and explicitly label chemicals known to form peroxides.
• Always date the container when received and when opened.
• Limit the on-hand stock to a three (3) month supply or less.
• Air dry empty containers under the hood, flush with water, deface the label and put containers in the glass disposal container.
• Store away from heat and light.

• Protect from ignition sources, physical damage, contact with strong reducing agents or oxidizers, or other contamination.
• Ensure air-tight closures on containers, purge head space with nitrogen when possible.
• Keep a minimal working inventory.
• Never store in a freezer. Use explosion-proof or explosion-safe refrigerators, as needed.
• Never store in glass bottles with glass stoppers.
• Never attempt to clean containers that were used to store peroxide forming compounds by scraping or rubbing, especially if an oily deposit or crusty residue is present.

Pharmaceuticals:

The possession of controlled substances is only permitted with a valid DEA license. Keep Drug Enforcement Administration (DEA) regulated drugs under lock and key security until time of pick up. Dispose otherwise acquired Schedule 2-5 DEA Controlled Substances through a reverse distributor such as Pharma Logistics.

Phenol/ Chloroform:

1. Collect liquid mixtures using Container . Indicate percentages on the label.
2. Phenol/Chloroform contaminated labware such as pipette tips and Eppendorf tubes with small volumes of liquid must be collected using Container

It is not acceptable to throw this type of waste into general trash containers, autoclave in biohazard bags, or dispose of as biological waste.

Reactives:

Chemicals that are considered reactive can react violently with air, water or other substances and also have the potential to explode. These chemicals include picric acid, sodium cyanide and sodium azide.
• Segregate oxidizers from flammable and combustible materials, organic material and reducers.

Pyrophoric chemicals ignite spontaneously on contact with air. Store breakable glass bottles inside a plastic bottle carrier. Keep these chemicals in a glove box.
• Shock-sensitive and/or explosive materials (benzoyl peroxide) can spontaneously release large amounts of energy when struck, shaken, dropped or agitated. Some chemicals become increasingly shock sensitive with age. Inspect these regularly for degradation and dispose of promptly. Consult the Safety Data Sheet (SDS) before working with reactives**.**
• Never contaminate reactive chemicals with heavy metals or incompatibles.

Small vials:

Small vials filled with compatible chemicals may be collected in wide mouth quart and gallon jars or 5gal buckets with lids. Separate containers are required for the collection of mercury containing liquids, reactive, oxidizing and acutely toxic liquids. Label the outside of the collection container with all chemical contents.

Choose the container size according to expected waste volumes so the container can be filled and picked up in less than 60 days.

Sodium azide:

Sodium azide is commonly used in low concentrations as a microbiocide to preserve samples. If used as a microbiocide, purchase sodium azide in solution. Avoid exposure to the pure material. Avoid weighing the solid by adding solvent to the material and diluting to working concentrations. Take care not to contaminate pure sodium azide with metals or foreign materials as this can lead to the formation of explosive metal azides. Azide solutions can also form explosive metal azides in drain pipes. Collect solutions and pure material for disposal through ORS.

Solvents:

All solvents must be collected using Container . Aqueous, halogenated and non-halogenated waste streams should be separated if possible. Halogenated solvents include methylene chloride and chloroform. Non-halogenated solvents include methanol, acetone and xylene. List **all** chemical constituents on the waste label. This includes any metals. The pH also is very important to note on the waste label. No excess solids or debris is allowed. For laboratories using large volumes of certain solvents, it may be possible to distill or purify these solvents for reuse. Please contact ORS .for more information on solvent recycling.

Staining solutions:

Staining solutions such as Wright's, eosin, iodine and methylene blue stains must be in Container. You must list the solvent concentrations on the waste label (i.e., water, glacial acetic acid, methanol).

Scientific equipment -surplus, repair or disposal

Any piece of scientific equipment must be carefully surveyed and decontaminated when it may have been in contact with potentially hazardous biological, chemical or radioactive materials. It is the responsibility of lab personnel to do this. All equipment that may have contained radioactivity must be cleared by the Radiation Safety Officer prior to being surplused, sent out for repair or for disposal. This includes refrigerators, freezers, incubators, centrifuges and counters (beta scintillation and gamma counters). Vacuum pumps must have oil removed prior to disposal and rinsed with clean oil if sent out for repair.

Guidelines for Handling Chemicals:

The chemical handling guidelines described in this document are founded on several basic principles:

*substitute less hazardous chemicals whenever possible
*minimize chemical exposures
*avoid underestimating risk
*provide adequate ventelation

Since most chemicals are hazardous to some degree, it is prudent to minimize exposure to chemicals as a general rule, rather than implementing safety protocols only for specific compounds. Avoid skin contact with chemicals as much as possible. Assume that mixtures are more toxic than their components and that all substances of

unknown toxicity are toxic. Do not work with a volatile or aerosolizing material without adequate ventilation from chemical fume hoods or other protective devices. Remember: Prepare yourself then protect yourself.

General Guidelines:

The following guidelines are applicable to nearly all uses of chemicals in laboratories. They apply to most hazardous chemicals, such as acids, bases, and flammable liquids. They are also applicable to chemicals that display low carcinogenic potency in animals and are not considered carcinogens. The general guidelines are not, by themselves, adequate for chemicals with high acute toxicity or high chronic toxicity such as heavy metals, chemical carcinogens, or reproductive toxins.

1. Wear eye protection at all times where chemicals are used or stored.
2. Wear a lab coat or other protective clothing (e.g., aprons).
3. Wear gloves selected on the basis of the hazard. Inspect them before use. Wash reusable gloves before removal. Turn disposable gloves inside out carefully when removing to avoid contaminating hands.
4. Wash hands immediately after removing gloves, after handling chemical agents, and before leaving the lab, even though you wore gloves.
5. Lab coats and gloves are worn only in the lab. They are not taken outside the lab to lunch rooms or offices nor are they worn outdoors. Lab coats shall be cleaned frequently.
6. Confine long hair and loose clothing.
7. Wear sturdy shoes that cover feet completely.
8. Do not store or prepare food, eat, drink, chew gum, apply lip balm or cosmetics, or handle contact lenses in areas where hazardous chemicals are present.
9. Check with your supervisor regarding contact lens policy in your lab. If wearing them is acceptable, take appropriate precautions such as informing other lab occupants and having a suction-type removal device in your first aid kit.
10. Food is stored in cabinets or refrigerators Never pipette or start a siphon by mouth.
11. Designated for such use only.
12. Label all chemical containers.
13. Chemical storage is by hazard class. Chemicals are not stored merely by alphabetical order.
14. Never smell or taste chemicals. Again, label containers properly to avoid confusion about contents.
15. Keep work areas clean and uncluttered.
16. Keep personal belongings away from chemicals.
17. Obtain an MSDS for each chemical, and consult the MSDS before you use a chemical.
18. Know the emergency procedures for the building, the department, and the chemicals being used.

19. Vent into local exhaust devices any apparatus that may discharge toxic vapors, fumes, mists, dusts, or gases. Never release toxic chemicals into cold rooms or warm rooms that have recirculating atmospheres.
20. Use chemical fume hoods or other engineering controls to minimize exposure to airborne contaminants.