Table of Contents

Environmental Health and Safety Manual

3.1 Introduction

Columbia University's environmental programs operate under the guidelines of an Environmental Management System (EMS). Although the EMS was initially developed for the Morningside campus and the Lamont-Doherty Earth Observatory, the EMS now provides structure and function for many of the environmental management programs University-wide. The EMS includes many policies and procedures, which serve as the framework for CU's laboratory compliance program. Central to the success of the EMS are elements including the "5 L's of Hazardous Waste Management," the "*No Drain Disposal Policy*" and numerous recycling programs, which allows the University the properly and proactively manage laboratory waste operations to minimize health, safety and environmental impacts.

To ensure that laboratory waste is properly managed, it is essential that laboratory personnel have completed the University's "Laboratory Safety and Hazardous Waste Management" prior to commencing work. The program will provide important guidance regarding environmental regulations and University policies and procedures, which will assist laboratory personnel in making critical decisions about waste identification, collection, labeling and storage.

3.2 Waste Identification

Every type of waste that is generated needs to be managed in a manner specifically appropriate to that waste stream. The application of incorrect or inappropriate waste management techniques, or the deliberate commingling of incompatible waste streams, can have significant adverse consequences for both the individual laboratory and the Columbia University community. The following sections detail the waste handling procedures for Chemical/Hazardous Waste (section 3.3), Radioactive Waste (section 3.5), and Regulated Medical Waste (section 2.12). Information on handling special waste streams can be found in section 3.4. For clarification on any of these procedures, or for more information, contact the EH&S office.

3.3 Chemical/Hazardous Waste

EH&S coordinates the disposal of all chemical waste generated at Columbia University. The following procedures apply to all chemical substances generated during laboratory activities, as well as all other University business operations, that are classified as hazardous based on the information below. Radioactive Waste (see section 3.5) or Regulated Medical Waste (section 2.12).

3.3.1 No Drain Disposal Policy

Columbia University has a *No Drain Disposal* policy for Chemical/Hazardous Waste. Any chemical or material that matches any of the characteristics described in section 3.3.2, or is a possible carcinogen, mutagen, or reproductive toxin, or may otherwise be harmful to the human health or the environment, regardless of quantity, must never be drain disposed. If you are unsure, call EH&S for assistance.

3.3.2 Classification and Identification of Hazardous Waste

Hazardous Waste is any unwanted material with properties that make it potentially harmful to human health or the environment. The definition of waste materials includes spent reaction products, expired virgin materials, and materials that have no reasonably foreseen intended use. A Hazardous Waste may be any material that is specifically listed in the federal or state regulations or exhibits at least one of four characteristics—ignitability, corrosivity, reactivity, or toxicity.

3.3.2.1 Listed Hazardous Waste

Listed Hazardous Wastes are specifically defined in federal and state regulations (See NYSDEC Part 361 and 40 CFR 265). They include chemicals from specific processes such as cleaning solvents or degreasers (i.e., acetone, ethyl acetate, methylene chloride, xylene), toxic chemicals (i.e. heavy metals), and acutely toxic chemicals, (i.e., cyanides, osmium tetroxide, epinephrine).

3.3.2.2 Characteristic Hazardous Waste

In the EPA scheme of classification, there are four types of Characteristic Hazardous Waste.

- Ignitable Waste: chemicals likely to cause a fire or exhibit the characteristic of a strong oxidizing agent, such as solvents.
- Corrosive Waste: chemicals with a high or low pH and which can also severely damage skin or corrode metal.
- Reactive Wastes: chemicals that react with air and/or water to produce toxic gases or are explosive.
- Toxic Waste: heavy metals, and certain solvents.

3.3.2.3 Wastes Not Defined as Hazardous by USEPA but Prohibited from Drain Disposal by Columbia University Policy

Any materials with the potential to harm human health or the environment must be collected and managed as a Chemical/Hazardous Waste, even if not specifically cited as such by the USEPA or NYSDEC. Examples include, but are not limited to, solid sodium hydroxide and gels containing ethidium bromide.

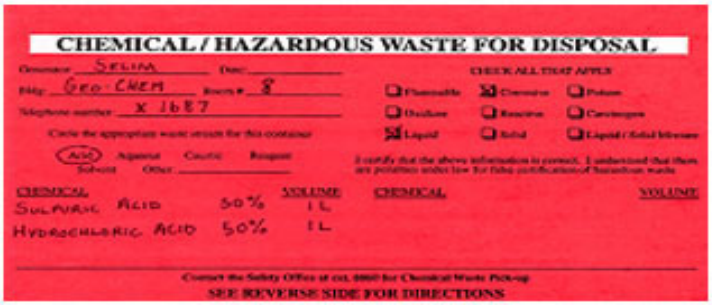
3.3.3 Procedures for the Collection and Removal of Hazardous Waste

All Hazardous Wastes must be managed in accordance with USEPA and NYSDEC regulations; no volume of waste is excluded from these requirements including trace amounts of reagents used for sterilization, such as alcohol. Since the hazardous waste management regulations are complex and lengthy, EH&S created the 5 L's as a quick reference guide for complying with these regulations.

3.3.3.1 Hazardous Waste Collection Requirements

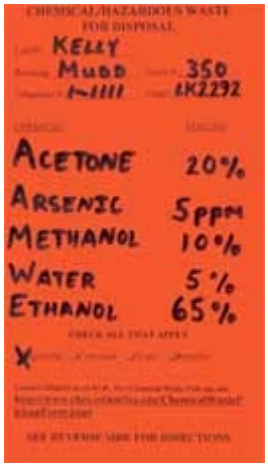
Hazardous Waste must be collected in sealable, labeled containers that are compatible with the waste being collected. Waste containers must bear an official EH&S Hazardous Waste Label that is completed in its entirety. The Hazardous Waste Label must contain complete information about container contents at all times; for example, no abbreviations or formulas are permitted. The Hazardous Waste collection containers must be periodically checked for leaks and may not be moved from one laboratory room to another lab. Hazardous waste must be stored at the "point of generation" near to where the waste is generated (i.e. hazardous waste may not be stored in hallway closets).

LDEO sample Hazardous Waste label



CUMC sample Hazardous Waste label

Morningside & Nevis sample Hazardous Waste label



3.3.3.2 Hazardous Waste Removal

Hazardous Waste may only be removed from laboratories by EH&S personnel or EH&S approved vendors. Hazardous Waste pickup requests should be submitted to EH&S via online chemical waste pickup request prior to completely filling the containers to prevent overflow, typically when 80% - 90% full. Pickups may be requested via the online pickup request form on the EH&S website. It should be noted that at LDEO and Morningside, the chemical waste pickup request may be used to request regulated medical waste supplies and services. At the Medical Center campus,

this request must be placed with Facilities Operations office via an online service request. At Nevis, this request must be made directly by the laboratory to the vendor.

3.3.5 Laboratory Glassware and Chemical Containers

Containers that held acutely toxic (P-list) materials must be treated as hazardous waste (see section 3.3.3).

Empty chemical bottles make excellent hazardous waste collection containers, but lab employees must ensure that the waste stream being collected is compatible with the container. If reusing a container for this purpose at the Morningside campus, ensure that the ChemTracker barcode is not covered by the waste label. The barcodes for chemical bottles that will be reused for waste collection must have the barcodes removed prior to reuse. These barcodes must be removed by lab employee and submitted to ChemTracker staff for removal from the ChemTracker system.

To dispose of unwanted empty chemical containers, rinse the container with tap water, if necessary, and deposit it in specially designated plastic-lined cardboard Glassware Disposal Box located in the lab. The Glassware Disposal Boxes may be obtained through ChemStores or the Biology Stock Room staff at Morningside. For all other campuses, the boxes may be purchased directly from a general supplier of laboratory materials. Glassware and containers must be completely empty of chemicals and residue. Close the box once filled and place it in the hallway for Facilities Operations to recycle. At the Morningside campus, empty barcoded chemical containers must be collected in order to be removed from the Principle Investigator's ChemTracker inventory by being placed in the hallway yellow bins. See the Morningside Chemical Container and Labware Disposal Policy for more information.

3.4 Special Waste Streams

Certain waste streams generated at Columbia University have alternate handling procedures, compared with those listed in section 3.3.3.

3.4.1 Aerosol Cans

All empty/unwanted aerosol cans generated at Columbia University must be handled as Hazardous Waste, as outlined in section 3.3.3. Many aerosols contain hazardous constituents that can damage the environment when improperly disposed of in the trash or can explode if compacted or incinerated.

3.4.2 Batteries

Used batteries are collected for recycling at various locations throughout Columbia University and are managed as Universal Waste. Please visit the EH&S Universal Waste webpage for information on where to deposit unwanted batteries throughout campus. Leaking or damaged batteries must be handled as Hazardous Waste, as outlined in section 3.3.3 and must not be deposited with other batteries. If the battery is leaking, place it in a container and label it as hazardous waste per the

above requirements in section 3.3.3.2. Federal regulations require covering electrical contacts on batteries other than alkalines prior to transportation. One such method of compliance is taping the battery terminals to prevent contact and the generation of heat which could cause a potential for fire. Therefore, EH&S has installed tape dispensers on all battery collection containers to facilitate compliance with this requirement, please see photo.

3.4.3 Computer Monitor Recycling

Computer monitors and other cathode ray tube devices contain quantities of lead that can be harmful to the environment. Most municipal landfills will no longer accept computer monitors for disposal, as EPA considers them hazardous waste. Columbia University maintains a recycling program to prevent this hazardous waste stream from entering landfills. If you have a non-functional or obsolete computer monitor that can be recycled, please contact Facilities Operations (212) 305-3753 at CUMC or 854-2222 at MS) for assistance. For LDEO please contact the Safety Office at 1-845-365-8860 or x8862. For Nevis contact the Facilities Safety Manager onsite to arrange for removal.

3.4.4 Controlled Substances

Controlled substances require specific management procedures detailed on the Columbia University Use and Management of Controlled Substances website.

3.4.5 Dark Room and Photo Processing Waste

Effluent fixer from photo processing contains silver halide, a hazardous material that must be excluded from the sewer discharge. EH&S coordinates installation of maintenance-free silver-recovery units on all photo processors; if you suspect a problem with the unit attached to the processor, or are missing a recovery unit, please contact EH&S. A Darkroom Log sheet is required to be completed with each use of the darkroom for tracking and maintenance purposes. Scrap film must also be collected in specially marked containers. Contact EH&S to obtain a Scrap Film Container.

3.4.6 Ethidium Bromide Waste

Ethidium bromide is mutagenic, requiring gels and debris to be managed accordingly. This waste must be collected in a EH&S provided, pre-labeled container marked as such:

"Nonhazardous Waste label: Ethidium Bromide Gels & Debris"

3.4.7 Fluorescent Lamps

Fluorescent lamps, including the germicidal lamp in Biological Safety Cabinets (see section 2.4.1) may contain mercury and must be handled carefully. Contact Facilities Operations (212) 305-7367 ext. 3 at CUMC or (212) 854-2222 for MS and Nevis. At LDEO please submit a chemical waste pickup request to arrange for the disposal of fluorescent lamps.

3.4.8 Mercury-Containing Devices

Broken mercury-containing devices, such as thermometers, are a leading cause of chemical spill cleanup responses at Columbia University. Every effort should be made to replace mercury-containing temperature and pressure sensing devices with safer alternatives. See 5.4.1.1.1 for information on replacing mercury thermometers with safer alternatives. Contact EH&S to take advantage of this program or submit a chemical waste pickup form to discard of mercury containing devices through EH&S.

3.4.9 Nanotechnology Waste

Nanomaterials are substances that have at least one dimension between 1 and 100 nanometers. Currently, health effects of exposure to engineered nanomaterials are poorly understood, though recent research has indicated that exposure is likely to cause adverse effects similar to those caused by ultrafine particles with similar chemical and physical characteristics. Nanomaterials should be collected and managed as hazardous waste until the health effects of various nanomaterials are better characterized. It is recommended that their handling be approached with caution, accompanied by the use of the standard engineering controls, administrative controls, and personal protective equipment used for manipulating other hazardous materials in the laboratory setting, and that waste streams be managed accordingly as hazardous waste.

3.4.10 Piranha Waste

A highly reactive mixture of sulfuric acid and hydrogen peroxide, piranha solution is commonly used as an etchant in clean rooms. Due to its tendency to evolve gas, piranha solution must always be stored in a plastic waste container outfitted with a vented cap (EH&S can provide vented caps for 5 gallon waste collection containers) to prevent a dangerous buildup of pressure that could cause a sealed container to rupture. Piranha waste must be segregated from all other waste streams and collected in dedicated containers. When collecting waste, the solution should be allowed to cool before being added to a plastic waste container.

3.4.11 Reactive materials

Highly explosive, shock, temperature or friction sensitive materials such as pyrophoric material, water and air-reactive materials or highly toxic compressed gases must be managed with extreme care. Please consult with EH&S prior to purchasing these materials to ensure the lab is outfitted with the necessary safety equipment such as appropriate fire extinguisher and laboratory procedure specific training.

3.4.12 Refrigerant Reclamation

Old laboratory refrigerators/freezers, ice machines, window air-conditioning units, and the like may contain refrigerants that are harmful to human health as well as the environment. Prior to final disposal, it is required that each item is safely vacuumed of its refrigerant. EH&S has partnered with Facilities Operations to ensure that the safe collection of ozone-depleting refrigerants is performed on each appliance by an *EPA Certified Technician* using *EPA Certified Equipment*. Once complete, each item is "tagged" to identify that the refrigerant has been removed and that it is ready for disposal.

3.4.13 Solder Waste

Labs and shops that use solder must collect the solder waste as a hazardous waste if it contains lead. All applicable hazardous waste guidelines apply to lead based solder. Non-lead based solder must be collected for metal recycling through EH&S.

3.4.14 Solvent contaminated rags and debris

Rags and debris contaminated with solvents require a hazardous waste determination to be made by EH&S. Specific solvents are treated for flammability and others for both flammability and toxicity, therefore, specific containers and labels are required. Prior to generating this waste please contact EH&S for guidance. Always use nontoxic, nonflammable solvents whenever possible.

3.4.15 Solvent Recovery

Columbia University laboratories have been recycling several thousand gallons of spent solvent (i.e., xylene and alcohol) annually since 2001. In 2008, the Morningside campus began recycling

acetone and in 2011 methanol and ethanol. Please see the information posted on the solvent recycling webpage for further information. Additionally, over the years several newsletter articles have appeared in the Safety Matters EH&S newsletter that further illustrates the details of the successful program.

3.4.16 Used Oil

Used pump oil and other oils must be collected in closed containers marked "Used Oil." These containers must be kept closed at all times. To schedule a pickup of Used Oil, submit a chemical waste pickup form. If the laboratory area requires large volumes of oil, such as >55 gallons, it must also comply with University Storm Water Pollution Control Countermeasures (SPCC) requirements, specifically the use of secondary containment &/or spill containment pallets and weekly inspections.

3.5 Radioactive Waste Services

The Radioactive Waste program is mirrored after the hazardous waste program. Please refer to the Radiation Safety manual for specific guidance on safely working with radioactivity in labs. Radioactive Waste services such as radioactive waste pickups and supplies may be requested through an online radioactive waste pickup request form.

3.5.2 Radioactive Waste

Radioactive wastes have a unique set of requirements for collection and storage. The unshielded exposure rate at any surface of the container shall not exceed 2 mR/hr. Please consult the Radiation Safety Program for additional guidance on shielding applications. All isotopes must be separated by type and isotope, except H-3 and C-14 which may be commingled providing it is the same type of waste (please see below sections for brief descriptions of radioactive waste types). All activities must be listed per isotope and totaled on the radioactive waste label. Shared spaces must have separate waste collection containers per PI. All radioactive waste collection containers must be labeled and closed when not in active use (immediately upon adding waste to container). Short-lived isotope wastes may be stored for decay by the lab or submit a radioactive waste pickup request form. Please consult the radioactive waste brochure for additional information.

3.5.2.1 Animal Carcasses

Animal carcasses including and heavily soiled debris must be stored frozen. Radioactive animal carcasses must be placed in labeled, sealed, clear bags. Animal carcasses containing 3H &/or 14C < 0.05 μCi/g are exempt and may be disposed of as regulated medical waste. After clearance by RSO, radioactive warning labels must be removed prior to disposal.