CHEMICAL HAZARDOUS WASTE MINIMIZATION TIPS

Waste minimization represents those activities that prevent or minimize the amount of waste generated.

This will allow for the most efficient use of resources, minimize the impact on health and the environment and lower disposal costs.

Researchers and laboratory workers have the most knowledge of chemical analyses and processes, which makes them best suited to make determinations on how to minimize waste.

There are five main categories of activity that can help to minimize the amount of hazardous chemical waste that is generated.

Good Housekeeping

By purchasing chemicals in appropriate volumes, maintaining an inventory of purchased chemicals and ensuring that materials are clearly identified, a laboratory can significantly reduce the volume of its chemical waste. The following tips will assist in achieving this goal:

- Centralize purchasing of chemicals through one person in the lab so that purchases are not duplicated.
- Purchase container sizes that can be used up in two to four months. Purchasing large containers because of the apparent quantity discount has been shown to increase total cost because the cost of disposing residuals in containers is more than the savings of purchasing in bulk quantities.
- Maintain an accurate chemical inventory in your laboratory to reduce or eliminate the number of duplicated chemical containers purchased. A successful laboratory inventory will catalog chemicals at least once a year, identify the storage locations of chemicals and eliminate chemicals from the inventory when they are consumed. Remember to date chemical containers when they are received so that older ones will be used first. Any unwanted or unneeded chemicals should be tagged and labeled as hazardous waste so that they can be removed by Environmental Affairs and purged from the inventory.
- Make sure that each chemical container is labeled with the full chemical name (no chemical formulas or abbreviations) along with the potential hazard associated with the contents (corrosive, flammable, toxic, etc.). Containers are to be labeled in English. This decreases the amount of unknown waste generated in the laboratory.

Product or Process Substitution

By substituting a material or a process that will not become or generate a chemical hazardous waste, some laboratories can significantly reduce their chemical waste volumes. Consider the following practices:

- Avoid the use of reagents containing the following metals: barium, arsenic, cadmium, chromium, lead, mercury, selenium and silver. Solutions of these metals meet EPA's criteria for the toxicity characteristic and will be considered hazardous waste if metal concentrations exceed the low regulatory levels.
- Avoid the use of reagents containing the following solvents: benzene, carbon tetrachloride, chlorobenzene, chloroform, cresol, dichlorobenzene, methyl ethyl ketone, nitrobenzene, pyridine, tetrachloroethylene, trichloroethylene, trichlorophenol and vinyl chloride. Solutions of these solvents meet EPA's criteria for the toxicity characteristic and will be considered hazardous waste if solvent concentrations exceed the low regulatory levels.
- Avoid the use of a listed chemical wherever possible. For example, ethanol can be used in place of methanol for some blotting techniques. If the concentration of non-listed alcohols in an aqueous solution is less than 24 percent, it is not considered an ignitable hazardous waste by the EPA. Contact Environmental Health and Safety for a list of potential substitutes for different processes.
- Eliminate the use of chromic acid cleaning solution, if possible, for cleaning glassware.

- Where possible, use less hazardous or non-hazardous agents such as alconox, no-chromix, terg-a-zime or other non-toxic detergents.
- Substitute non-hazardous liquid scintillation cocktails for xylene and toluene based cocktails.
- Use the least amount of fixing/washing solutions as possible for fixing/washing DNA sequencing gels. Doing so may reduce waste by 90 percent.
- For fixing and washing DNA sequencing gels replace 10 percent acetic acid and 10 percent methanol with deionized water for indistinguishable results in the autoradiograph.
- Substitute red liquid (alcohol) thermometers (range up to 150 degrees C) or digital thermometers for mercury thermometers wherever possible.
- Consider the quality and type of waste produced when purchasing new equipment. Purchase equipment that enables the use of procedures that produce less waste.
- Consider using microscaling techniques to reduce waste.
- In teaching labs, use demonstrations or video presentations as a substitute for some student experiments that generate chemical wastes.

Segregation

Researchers can reduce a significant amount of waste in their laboratories by the following segregation guidelines:

- Hazardous waste and non-hazardous waste should always be segregated. When non-hazardous waste is mixed with hazardous waste, it creates a mixture that is considered hazardous waste.
- Avoid experiments that produce mixed wastes that contain both radioactive and hazardous chemical waste. Currently, there are no available disposal outlets for certain types of mixed waste. Environmental Health and Safety must also be contacted prior to the generation of a mixed waste.
- Keep organic wastes separate from metal-containing or inorganic wastes.
- Collect highly toxic chemical waste (i.e. cyanides, osmium tetroxide) and all other chemical waste in separate containers.

Recycling, Redistillation and Neutralization

The following guidelines outline methods that can be used in the laboratory to eliminate unnecessary amounts of chemical waste:

- Determine if there are other uses for chemicals. Establish a recycling program for the laboratory and consult with neighboring labs, departments or areas to find a use for the chemicals. Unopened containers are ideal for redistribution.
- If no one in your lab, department or area is interested in your unopened chemical containers, visit the "Eli Surplus Exchange" and upload your chemical information and picture directly to the site. Please be sure to review the Environmental Health and Safety safety protocols before posting any chemicals on the "Eli Surplus Exchange".
- Conduct treatment, neutralization and/or detoxification of hazardous waste in laboratories where the actual treatment procedure is part of the experiment. These procedures must be part of the experimental protocol prior to generating a waste due to strict EPA guidelines that prohibit the treatment of waste without a permit. Please contact Environmental Affairs at 203-432-6545 regarding the proper instructions and information for any treatment procedures.
- Be sure to purchase compressed gas cylinders, including lecture bottles, from suppliers who will accept the empty cylinders. Empty gas cylinders should be returned to the supplier.

Preventing Mixed Waste

A "mixed waste" is a waste that contains any combination of chemical, radioactive or biological hazards. These "multi-hazardous" wastes are extremely difficult and expensive to dispose of because the treatment method for one of the hazards is often inappropriate for the treatment of another. For example, an infectious agent mixed with a volatile hazardous solvent cannot be autoclaved due to the potential release of solvent into the work environment. For some multi-hazardous wastes (radioactive/chemical) there may be no disposal outlets available today.

Researchers should review the processes that generate mixed waste and find practical methods to eliminate or at least minimize and effectively manage the mixed waste generated. Minimization of mixed waste can be achieved by modifying laboratory processes, improving operations, or using substitute materials. Whenever possible, a multi-hazardous waste should be reduced to a waste with a single hazard so that it can be managed and treated accordingly.

The following guidelines describe the different types of mixed waste and provide methods to eliminate and/or minimize the generation of mixed waste in laboratories:

Chemical /Radioactive Mixed Waste

A mixed waste of this type contains a chemical hazardous waste regulated by the EPA and a radioactive component regulated by the NRC. Currently, there are no available disposal outlets for certain types of mixed waste. If a research protocol requires the generation of a mixed waste, please contact Environmental Affairs at 203-432-6545 to discuss possible protocol alternatives.

Examples include:

- Used flammable liquid scintillation cocktails
- Phenol-Chloroform mixtures generated from the extraction of nucleic acids and radiolabeled cell components
- Aqueous solutions containing radioactive material and more than six ppm chloroform (exceeding TCLP test limit)
- Certain gel electrophoresis waste (e.g., methanol or acetic acid containing radionuclides)
- Lead contaminated with radioactivity

The following methods can be used to minimize and/or eliminate chemical/radioactive mixed waste:

- Keep radioactive waste separate from hazardous chemical waste
- Substitute non-hazardous solvents for hazardous liquid scintillation cocktails
- Substitute short-lived isotopes such as 32P and 35S for long lived isotopes such as 14C and 3H
- Decontaminate lead shielding

Biological Mixed Waste

A chemical/biological mixed waste is a laboratory waste that is chemically hazardous and is also considered biomedical waste (infectious or pathological).

Examples of this type of laboratory waste include:

- Animal carcasses and tissues that contain a toxic chemical
- Blood or body fluids containing toxic chemicals
- Chemically contaminated labware (such as cultures, stocks, petri plates, gloves, pipettes and tips)

Animals that have been infected with hazardous chemicals should be disposed of through the Yale Animal Resource Center.

The following guidelines provide methods to manage and effectively reduce the generation of chemical/biological mixed waste:

- Designate and mark a red bucket and/or sharps container for biological and chemical mixed waste. If the bucket has been designated for a hazardous waste it should be labeled as "Hazardous Waste" and with its specific chemical contents.
- Chemical and biological contaminated syringes, cuvettes, gloves, needles, pipettes, Eliza plates and gels should be placed in the appropriately labeled container.
- Do not Autoclave when mixed waste containers are full. Place in appropriately labeled box/bag unit and call Environmental Affairs 203-432-6545 for box/bag unit disposal.

If a chemical/biological mixed waste is part of a research protocol, please contact the Occupational Health and Safety Office at 203-785-3550 or contact your Safety Advisor for more information and research alternatives. Waste minimization and biological disposal questions and concerns can be directed to Environmental Affairs at 203-432-6545.