Waste Minimization Guide

January 2015

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Introduction

The University of South Florida System disposes more than 100,000 pounds of hazardous waste and spends more than $150,000 annually on the disposal of hazardous waste. This does not include the cost of hazardous waste supplies, labor, and fuel surcharges related to the transport of hazardous waste on and off site. Therefore, waste minimization efforts should be used to reduce environmental impacts and costs associated with the disposal of hazardous waste. Hazardous waste is generated in areas on USF's campuses that include laboratories, maintenance shops, garages, machine shops, art studios, and other facility areas. Waste Minimization, is defined by the U.S. Environmental Protection Agency (EPA), as any action that reduces the amount and/or toxicity of chemical wastes that must be shipped off-site for disposal as hazardous waste. Examples of these actions include source reduction and environmentally sound recycling of hazardous wastes regulated under the Resource Conservation and Recovery Act (RCRA). These waste minimization approaches are preferred over the treatment, disposal, or release of harmful chemicals to the environment.

While it is important that proper waste management is an integral part of all operating procedures, this guide has been developed to assist area supervisors, principal investigators, and lab managers with adopting waste minimization techniques in their respective areas to reduce chemical hazards, environmental impacts, and disposal costs associated with hazardous wastes.

Waste minimization efforts must be reported by the University to EPA and the Florida Department of Environmental Protection (FDEP) through the RCRA Biennial Report. The USF Division of Environmental Health & Safety (EH&S) will provide support with the implementation of waste minimization efforts through training, providing best management practices, and facilitating information sharing among University personnel.

Methods for Waste Minimization

Source Reduction

Reduce the scale of chemical processes/experiments. The use of microscale techniques and specially designed lab glassware in chemistry promotes waste minimization and pollution prevention. This allows chemical processes to use small quantities of chemicals without compromising the quality and standard of chemical applications in education and research. Other benefits include promoting shorter experiment times and storage space savings. It is also recommended to consider pre-weighed or pre-measured reagent packets where waste generation is high.

Use computer modeling. Another option is the use of computer modeling instead of experimentation to eliminate the creation of chemical waste; especially in teaching situations.

Reduce chemical purchases. Within the last 3 years, the University has disposed of approximately 7,000 unused, unwanted, or expired chemical containers through requested laboratory cleanouts. When disposal costs are considered, it is more economical to purchase only the quantities of chemicals that will be used. Purchasing chemicals in larger containers at an initial lower cost, rather than smaller containers, appears to be a good way to save money. However, there are other costs to consider when purchasing chemicals in large quantities. In a laboratory that has not adequately implemented waste minimization programs, unused chemicals typically constitute 40% or more of the hazardous waste stream generated. Costs incurred as a result of these unneeded chemicals include analysis, storage, packaging, transport, and disposal. When labels are missing or unclear, the cost of having even a small amount of an unknown chemical analyzed prior to disposal will far exceed the purchase prices of an entire container of the materials. Furthermore, long-term storage of expired or reactive unused chemicals increases the risk of accidents. In addition to this, if small bottles do break, there is less spillage, making clean-up safer, easier, and less expensive.

Note: Before you call EH&S to dispose of an unwanted but usable chemical, please check to see whether other labs in your building can use the material. This can be facilitated through EH&S or a designated safety liaison within your department or College.

Substitute with a less hazardous chemical. A less hazardous chemical can often be used in place of more hazardous chemicals.

Examples of less toxic alternatives:

- Use non mercury thermometers instead of mercury thermometers.
- Use water or calibrated oils instead of mercury manometers. Or switch to pressure transducers or electronic gauges.
- Use enzymatic cleaners, detergents or elbow grease when cleaning glassware instead of chromium based cleaners.
- Use quaternary amine detergents instead of isopropyl alcohol when sterilizing equipment.
- Replace thermal distillation apparatus with dry solvent purification systems for purifying or drying solvents. This minimizes the use of energy, water, and solvents. Also, it has the added bonus of reducing your fire risk.
- Use alcohol as a fixative instead of formaldehyde.
- Use SYBR Safe DNA Gel Stain instead of Ethidium Bromide (a known mutagen).
- Use non-halogenated rather than halogenated solvents when applicable.
- Use digital photography or a digital X-ray machine

Better management of chemical inventory. It is important for each USF laboratory to manage their chemical inventories stored within the Hazardous Inventory Tracking System (HITS). The HITS system is a great tool to assist laboratories in maintaining an updated inventory of their chemicals. The system also provides the opportunity for laboratories to offer up their unopened chemicals that can be reused by other laboratories in the USF System.

Note: If a small amount of a chemical is needed, EH&S can coordinate efforts to identify and contact another lab that may have the chemical available in their inventory and would be willing to provide you with a small amount.

Environmentally Sound Recycling (ESR)

ESR, in the context of RCRA, includes materials that are used, reused, or reclaimed. A material is reclaimed if it is processed to recover a usable product, or if it is regenerated.
The USF System currently has bulk recycling stations within USF Physical Plant and USF St. Petersburg Recycling that recycles fluorescent bulbs, fixture ballasts, used oil, and non-alkaline batteries.

Additional ESR processes that can be used within your area include:

- Treating photographic wastes with silver recovery units.
- Redistilling used solvents.
- Purchasing gas cylinders, including lecture bottles, from manufactures who will accept the return of the partially used or empty cylinders.
- Sending used flammable solvents to offsite facilities, such as cement kilns, to be used as supplemental fuels for their BTU value.

Treatment

The last technique for waste minimization is treatment of waste generated during use. As part of the experiment, neutralization, precipitation, oxidation/reduction, and distillation are examples of treatment techniques that may be applied to reduce hazardous waste quantities. These processes are commonly used in laboratories. **It should be noted that if treatment is not a part of the end step and is done separately from the experiment, it is considered hazardous waste treatment, which cannot be done without a treatment permit from the State.**

Wastes that are neutralized or detoxified and managed at the source can reduce environmental risks that might occur during transportation and handling. These steps either decrease or eliminate toxicity or help to reduce the volume of waste. Please note that the chemical waste is still considered a hazardous waste and must be disposed of as hazardous waste by USF EH&S. If you have any questions regarding treatment techniques within your experiment, please contact USF EH&S at 813-974-4036.

Managing Waste Efficiently

The following sections are meant to give waste generators some information on how to minimize waste volumes and disposal costs of some of the more common waste streams generated at USF. In some situations these suggestions may be difficult or impractical to implement. In such cases, please consult with EH&S (813-974-4036) to determine the best method for collection and disposal.

Flammable Liquids and Solids

Examples: acetone, ethanol, methanol, toluene, xylene, hexane, acetonitrile, camphor, sulfur, and naphthalene.

Flammable liquid disposal is easy and relatively inexpensive than many other waste streams since they can be burned as a fuel or simply incinerated independently. Solvents contaminated with materials not permitted for incineration will require alternative, costly treatment methods.

Some suggestions for waste minimization include:

- Use the solvent distillation process to produce a recycled product that can be reused.
- Keep water content as low as possible in these wastes; increase in water increases disposal costs – minimize dilutions.
- Do not allow heavy metals, pesticides, corrosives, or acutely hazardous chemicals to mix with the flammable liquids.
- Replace solvent-based inks in printing operation with soy-based inks. Soy bean inks are non-toxic, recyclable, and low in volatile organic compounds.
- Use Paraclear instead of Xylene.
- Use Toluene or alcohols instead of Benzene.
- Use detergent and hot water to clean items instead of solvents.

Halogenated Solvents

Examples: chloroform, carbon tetrachloride, methylene chloride, trichloroethane

Many halogenated solvents are carcinogenic, difficult to dispose of, and can cost three times more to dispose of as compared to non-halogenated solvents. Making an effort to keep halogenated and non-halogenated solvents separate can reduce disposal costs.

Some suggestions for waste minimization include:

- Hydrocarbon solvents may serve in the place of their halogenated counterparts
- Investigate the use of alternative non-halogenated solvents
- Keep separate from acidic or alkaline waste streams
- Minimize unnecessary dilution
- Keep chloroform in a separate waste stream and do not mix it with any other solvents. It is dangerous and difficult to dispose of because of its flammable and corrosive nature
- If possible, keep separate from wastes that contain heavy metals, pesticides, cyanides, or acutely toxic "P-listed" wastes. Refer to USF Hazardous Waste Management Procedure
  These wastes tend to increase the costs of disposal due to the need for more complex waste treatment

- Recycle or re-distill solvents

Solvent Contaminated Towels and Rags

Solvent-contaminated towels and rags can be sent to an approved laundering service for cleaning and reuse, rather than disposing of them as waste. The service will reuse the towels until their useful life is reached or until they are contaminated beyond the vendor's ability to clean them, in which case they are typically incinerated. By using a shop towel service, the number of contaminated towels that need to be shipped as waste can be greatly reduced.

USF departments where large quantities of solvent-contaminated towels and rags are used are now managing their rags and towels as excluded solvent-contaminated rags. As of January 31, 2014, the U.S. Environmental Protection Agency (EPA) modified the hazardous waste management regulations under the Resource Conservation and Recovery Act (RCRA) to **conditionally exclude** solvent-contaminated wipes from hazardous waste regulations provided that businesses clean or dispose of them properly. In order to be excluded from hazardous waste regulation, solvent-contaminated rags in these areas must be managed according to specific management standards:

- Solvent-contaminated wipes must be managed in closed containers that are labeled "Excluded Solvent-Contaminated Wipes."
- Generators may accumulate solvent-contaminated wipes for no longer than 180 days.
- Solvent-contaminated wipes must not contain free liquids at the point of being sent for cleaning or disposal.
- Generators must maintain the following documentation on-site so that states and EPA can ensure the generators are maintaining compliance with the conditions of the exclusion.
    - Name and address of laundry, dry cleaner, landfill, or combustor
    - Documentation that the 180 day time limit is being met
    - Description of the process the generator is using to meet the "no free liquids" condition

Paint related Wastes

Waste oil-based paints and solvents are hazardous wastes due to their flammable and/or toxic natures. These types of waste paint materials must be disposed of in accordance with EH&S hazardous waste disposal procedures as outlined in the USF's Hazardous Waste Management Procedure.

Some suggestions for waste minimization include:

- When possible, substitute use water-based paints
- Minimize volume by reducing any unnecessary dilution
- Use paints with less or non-toxic pigments
- Do not contaminate the paint by mixing latex paints with non-latex paints or any other hazardous materials. Always reseal the containers to allow for recycling.
- Minimize inventory of paints and solvents by ordering based on immediate need.
- Use heat guns to remove paint rather than chemical solvents
- Consolidate latex paints prior to submitting for EH&S disposal. Excess latex paint that has been completely dried can be disposed of in the regular trash.
- Clean out stockpiles of old paints and call EH&S for disposal or recycling

Unknown Chemicals

The generation of unknown chemicals results in an expensive waste disposal challenge. The disposal of unknown chemicals can cost up to ten times more to dispose of than properly labeled chemicals. Original chemical container labels should be kept on the containers until the chemicals are completely used and the containers no longer have any hazards related to its contents. When a chemical is transferred into secondary container, these containers should also be labeled at a minimum with the chemical name and the primary hazard (i.e. flammable, poison, etc.).

Some suggestions for waste minimization include:

- Keep all chemical containers labeled.
- Clean out stockpiles of old chemicals and products before they become "unknowns." Submit a USF Laboratory Cleanout Request Form.
- Label all samples and chemical formulations before a laboratory researcher or graduate student leaves USF.
- Transfer chemicals to another individual or request for proper disposal prior to the individual's departure. This can be facilitated through EH&S.

P-Listed Chemicals

Examples: Sodium Azide, Cyanide, Osmium Textroxide

P-listed wastes are chemicals that can be acutely toxic to humans and animals in very small amounts. Both the waste and the chemical bottle must be disposed of which becomes very costly. Refer to EH&S's website for a complete list of P-Listed chemicals, http://www.gpo.gov/fdsys/pkg/CFR-2012-title40-vol27/xml/CFR-2012-title40-vol27-sec261-33.xml.

Some suggestions for waste minimization include:

- Substitute P-listed waste for less toxic and more environmentally friendly chemicals
- Use Phenoxyethanol as a substitute for sodium azide
- Sodium cyanide can be treated to yield sodium cyanate
- Segregate very toxic waste from less toxic waste

Heavy Metals

Examples: Cadmium, Barium, Chromium, Lead, Silver

Some suggestions from waste minimization include:

- Eliminate the use of pigments containing heavy metals in art practices.
- In photography labs, eliminate silver from waste streams through recovery.
- In teaching labs, eliminate experiments using heavy metals. Replace with iron, cobalt, copper, etc.
- Avoid reagents or paints containing heavy metals

Mercury

Mercury can be found in elemental, organic, or inorganic forms. Most laboratory and hospital encounters with mercury are in thermometers, manometers, and mercury reagents. The EPA encourages waste minimization techniques applied to mercury because it is extremely costly to dispose of. The ideal management method is to recover mercury and ship for reclamation.

Some suggestions from waste minimization include:

- Survey your facility for potential sources of mercury.
- For differential manometers, use water or calibrated oils instead of mercury.
- Replace mercury thermometers with non-mercury alternatives, such as alcohol or digital. If you must use mercury thermometers, purchase those with a Teflon coating.
- Use metal-oven thermometers instead of mercury thermometers in ovens.
- Use mercury-free compound alternatives in laboratories.
- Use mercury-free catalysts or simply let the reaction run longer.
- Do not use mercury thermometers as stirring rods.
- Use secondary containment under mercury containing devices.
- Keep mercury wastes separate from all other waste streams.

Reactive Chemicals

Examples: tributyllithium, trichloromethleyne.

Reactive chemicals are more expensive to dispose of since many times these chemicals have special storage requirements or become too dangerous to handle. On some occasions an outside contractor may be called to remove the chemical. Reactive chemical waste can be minimized through thorough planning of chemicals needed, proper estimation of chemical consumption rate, and exchanging unwanted chemicals with others. It is also important to check with EH&S before purchasing reactives or any extremely dangerous chemicals to see if they are capable of responding to an incident or storing the chemical waste for pickup.

Some suggestions from waste minimization include:

- Store chemicals in appropriate package, especially for reactive chemicals with short shelf life or peroxide forming chemicals
- Place bottles with shorter expiration date in front
- Label chemicals with the date received, date opened and date of expiration

Formalin & Formaldehyde

Formaldehyde is a suspected human carcinogen, which is toxic; very irritating to the eyes, throat and breathing passages; and can cause dermatitis. Formaldehyde is also a sensitizer, so the more a person is exposed to it, the smaller a dose it takes to have an effect on that person.

Some suggestions from waste minimization include:

- Minimize the volume of formaldehyde/formalin waste generated by eliminating any unnecessary dilution
- Do not mix with any other waste streams
- Substitute ethanol, or a commercial fixative like CarosafeR or FormalternateR in place of formaldehyde/formalin for storage of biological specimens

Universal Waste

The University of South Florida manages the recycling of mercury-containing ballasts and fluorescent lamps, non-alkaline batteries, electronic waste, and scrap metal through the USF Recycling Center. These items are classified by EPA regulations as universal waste. You can request for the recycling of these items in your area through the submittal of a USF Physical Plant work order, http://www.pplant.usf.edu/facnetcustomerweb/. Pharmaceutical waste is also managed as universal waste at USF.

Some suggestions from waste minimization include:

- *Eliminate the use of batteries by a direct connection to an electrical outlet.*

- *If possible, purchase batteries with non-hazardous characteristics instead of those which will need to be managed as hazardous waste.*
- *Do not throw electronic scrap in the regular trash. Examples of electronic waste include circuit boards, batteries, cathode ray tubes (CRT), televisions and CRT monitors.*

Conclusion

The University of South Florida's Waste Minimization Program is fully dependent on the willing and active participation of the whole University community. All faculty, staff, and students should make waste minimization an ongoing component of their overall hazardous waste management strategy. Waste prevention and minimization has positive environmental, human health and safety, and economic impacts. Implementing a "less is better" concept provides better protection of human health and safety by reducing exposures, generating less demand for disposal on the environment, and lower disposal costs.

Appendix I

USF Chemical Redistribution Program

Many items that USF laboratories submit as chemical waste are reusable. As part of Environmental Health and Safety's (EH&S) commitment to waste minimization, the Chemical Redistribution Program will facilitate the redistribution of surplus chemicals that are submitted to EH&S through the laboratory chemical cleanout process. The redistributed chemicals are provided at no cost to any University operation that has a useful purpose for these materials.

Procedure

1. Chemicals are submitted to EH&S through the lab chemical cleanout form (Lab Cleanout Form) for disposal.
2. EH&S will schedule an appointment for the cleanout within 3 working days after a request is submitted.
3. Chemicals selected for redistribution are carefully examined to determine whether they meet the following criteria:
    - The material is in the original container and displays the original manufacturer's label;
    - The container is at least half full;
    - The material does not exhibit any visible signs of contamination or deterioration;
    - The container doesn't have an offensive odor;
    - The chemical doesn't require special handling (i.e., stored under gas, refrigeration, light sensitive, etc.);
    - The chemical is free of radioactive or biological contamination;

    NOTE: The Chemical Redistribution Program makes no claim as to the purity of the materials available for re-use.
4. Chemicals that are unsafe to redistribute (poor condition of containers, unknowns, controlled substances, expired time sensitive items) would be removed from availability.
5. A list of available chemicals, and a date and location of the redistribution will be emailed to University laboratories. Individuals interested may submit requests for the available chemicals by following the provided link to the online signup sheet. The individual will receive an e-mail with a confirmation of the chemicals selected. Requests for chemicals are filled on first come, first served basis.
6. The chemicals will be grouped per requestor by EH&S using stickers or bins.
7. A lab representative must pick up the chemicals from the redistribution location within the advertised time window. EH&S guidelines for moving chemicals must be followed (see Moving Guidelines). Unclaimed chemicals will also be available for distribution on a first come, first serve basis. EH&S will record the transfer of the chemicals on site and

will make changes within the HITS system to reflect the new owners of the chemicals redistributed. A reminder email will be sent to people who have requested chemicals to make sure they come to collect them. The number of chemicals collected during the redistribution event will be recorded by EH&S for reporting purposes.

8. After the redistribution, remaining chemicals are removed by the HazWaste Team or the hazardous waste disposal vendor.