

# **Waste Minimization Guide**

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## **Definitions and Concepts**

### **Waste Minimization**

Waste Minimization, as currently defined by EPA, is the reduction in the amount of toxicity or waste produced by a facility. This includes source reduction and environmentally sound recycling of wastes regulated under the Resource Conservation and Recovery Act (RCRA), particularly hazardous waste.

WM focuses on reducing the generation and subsequent release to the environment of the most persistent, bioaccumulative, and toxic chemicals in hazardous waste.

Treatment, dilution, and disposal are not considered waste minimization because the waste was generated, not minimized.

### **Source Reduction**

Source Reduction, as defined by the Pollution Prevention Act, includes any practice which 1) reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment prior to recycling, treatment, or disposal and 2) reduces hazards to public health and the environment associated with their release.

### **Environmentally Sound Recycling**

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 use or reuse of a waste as an effective substitute for a commercial product, or as an ingredient or feedstock in an industrial process.
- The use, reuse, or reclamation of a waste, either on or off-site, after it is generated by a particular process.

## **Why Waste Minimization is Important**

There are several reasons why WM is becoming a focus of environmental managers.

- Businesses are facing stricter regulatory requirements in the management, transportation, and disposal of hazardous waste.
- The number of hazardous waste disposal facilities has decreased.
- There are greater restrictions in the use of landfills.
- Transportation and disposal costs are rising.
- The long-term liability associated with handling and disposal of hazardous waste is substantial.

## **Benefits of Waste Minimization**

A well organized WM program can produce many benefits for a facility.

- Lower operating costs from the substitution of less expensive raw materials.
- Lower end disposal costs.
- Lower energy costs through the use of newer, more efficient equipment.
- Increased health and safety of your staff from reduced exposure to hazardous materials.
- Reduced concerns about penalties, liabilities, and regulatory burdens.
- Improved public image promotes positive public relations with client, customers, and the local community.

## **Assess Your Current Waste Minimization Efforts**

By reviewing company documents and conducting facility audits, environmental managers can evaluate how to proceed in designing or improving a WM program.

- Solicit commitment from upper management to write a company policy and to endorse all components of a waste minimization program.
- Set up a chemical control committee composed of chemical users and environmental staff, encouraging participation from everyone in the process.
- Review company records – including purchasing records and waste manifests.

- Review inventory management to evaluate procedures for purchasing and distributing chemicals.
- Conduct facility walkthroughs to review operations.
- Examine waste streams and volumes currently being generated.
- Determine if waste streams are properly segregated for safety reasons and to reduce disposal costs.
- Determine if containers are properly labeled with the correct information.
- Confirm that employees are thoroughly familiar with the products they handle.
- Continue to review and evaluate these steps.

## **Waste Minimization Techniques**

### **Purchasing**

A key component to an effective WM program is to control the chemicals which come into your facility. The ideal method would be through a centralized purchasing and distribution department.

- Evaluate why, or if, you need the chemical prior to purchasing.
- Order chemicals in smaller quantities; saving money and the need to dispose of excess chemicals.
- Purchase less toxic raw materials that require no further treatment prior to disposal (avoid highly toxic chemicals or those containing heavy metals).
- Purchase smaller packages of chemicals to reduce storage requirements and to reduce the risk of breakage and accidents.
- Purchase chemicals and supplies from vendors who will take back unopened bottles.
- Purchase equipment that enables the use of procedures that produce less waste.
- Learn which categories of chemicals are costliest to dispose of prior to purchasing.
- Contract with vendors who will take back empty gas cylinders.

## **Inventory Controls**

- Implement an effective inventory system to reduce waste.
- Use oldest chemicals first.
- Use chemicals in the stockroom before ordering new product.
- Label and date all chemicals when received and when opened.
- Prevent “unknowns” in the laboratory setting. They are very expensive to dispose of.
- Perform a complete inventory review at least once a year.

## **Use and Reuse**

- Use water-based solvents.
- Never mix wastes without safety and end-disposal knowledge.
- Improve waste segregation to maximize recovery of materials and ability to treat wastes.
- Keep wastes separate from normal trash.
- Separate non-hazardous chemical waste from hazardous wastes.
- If possible, convert waste to product from another reaction.
- Keep metal-containing waste separate from other wastes.
- Recover metals such as mercury and silver.
- Avoid use of reagents containing arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver.
- Avoid experiments that produce wastes which contain both radioactive and hazardous components.
- Implement a chemical exchange program with other users.
- Polymerize epoxy waste to a safe solid.

## **Housekeeping/Cleanup/Loss Prevention**

- Encourage orderly and tidy behavior in the lab.
- Establish an area for storing chemical waste.
- Use smaller, more compatible containers to minimize and/or contain spills.
- Use detergents and hot water for cleaning of parts instead of chromic acid solutions.

- When using solvents for cleaning purposes – use spent solvents for initial cleaning and fresh solvents for final cleaning.
- Use ultrasonicators instead of solvents for cleaning.
- Properly dispose of waste that you generate and do so in a timely manner.

### **Microchemistry**

Micro chemistry builds pollution prevention, waste minimization, and safety into the design stage instead of doing it at the disposal stage.

- Uses minute quantities and small-scale reactions instead of large amounts of chemicals in laboratory experiments.
- Considers the use of computer modeling, instead of experimentation, especially in teaching situations. This eliminates creation of chemical waste.
- Encourage students to consider the potential impact on the environment from the waste that they generate.

### **Flammable Liquids**

Disposal of flammable liquids is less expensive and easier than many other waste streams. They can be burned as a fuel or simply incinerated independently. If these flammable liquids contain components which are not eligible for incineration, then they would require another treatment method, which would increase costs.

- Keep water content as low as possible in these wastes.
- Do not allow heavy metals, pesticides, or acutely hazardous chemicals to mix with the flammable liquids.
- Keep separate from corrosive waste streams.

### **Formaldehyde and Formalin**

- Do not mix with other waste streams.
- Use alternatives such as “Carosafe” and “Formalternate” as an alternative to formaldehyde for storing biological specimens.

## **Photographic Wastes**

Photographic film consists of either a thin film of polyester plastic called Mylar or Cronar or a thin film of plastic called cellulose acetate, on which there is a thin film of silver bromide and silver iodide suspended in gelatin. During the developing and fixing process, the silver is removed from the photographic film and must be disposed of properly.

- Keep the darkroom and other work areas uncluttered.
- Do not store chemicals that may react with each other in the same area.
- Label all containers so unused material and waste is properly identified.
- Keep all containers and trays closed to prevent the escape of toxic vapors from liquids and toxic dusts from powders.
- Keep a spill kit in the darkroom.
- Use silver recovery ion exchange units that are directly connected to the process to reclaim silver.

## **Paint-related Waste**

Non-latex paints and solvents are hazardous waste due to their flammable and/or toxic components (such as heavy metals).

- Whenever possible, substitute water-based paints for solvent-based ones.
- Substitute paints with less or non-toxic pigments.
- Use UV lights to cure paint instead of using paints that contain solvents.
- Do not mix latex paints with non-latex paints or any other hazardous materials.
- Minimize inventory of paints and solvents. Only order based on immediate need.

## **Cleaning Solutions**

Universities have numerous opportunities for WM with cleaning solutions.

- Consider modifying experiments so that equipment does not become contaminated and is easier to clean.
- Don't assume that cleaners may only be used one time – reuse them.
- Avoid using chromic acid if at all possible. It is hazardous to work with and expensive to dispose of. Even if neutralized, it must be disposed of as a hazardous waste because of the chromium.

- Properly store used and unused cleaning solutions in compatible containers that are properly labeled. Provide secondary containment when appropriate.

## **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. Environmental managers encourage WM techniques applied to mercury because it is extremely costly to dispose of. The ideal management method is to recover mercury and ship for reclamation.

- 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.

## **Fluorescent Light Bulbs**

The University of South Florida recycles fluorescent, high intensity, and other mercury-bearing lamps. Industry and government data show that each lamp contains between 15 and 40 mg/Kg of mercury, with a national average of 24 mg/Kg. These lamps cannot be disposed of in the regular trash. All lamps should be collected by Physical Plant and disposal coordinated through Dorothy Monroe, USF's Recycling Coordinator.

## **Batteries**

Batteries have the potential of being hazardous due to their corrosivity, reactivity, or toxicity. Nickel-cadmium batteries are considered hazardous because of the heavy metal

cadmium. Lithium batteries have the potential to qualify as reactive. Lead-acid batteries are considered to be corrosive and toxic. “Button” batteries need to be considered on an individual basis because of varying hazards.

- 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.
- Nickel-metal hydride or lithium batteries should be chosen over nickel-cadmium batteries whenever possible.
- Turn off battery-powered equipment when not in use.
- Remove batteries from equipment if it will not be used for extended periods.
- Purchase only the number of batteries you know you will need during the next six months.

### **Compressed Gases**

Compressed gas cylinders are necessary in many campus operations and research. Safety concerns to consider include physical hazards from the pressurized containers and inhalation/asphyxiation hazards associated with gases in the vessel.

- Most distributors of the larger (4 foot) cylinders will recycle them for the users. Be sure to confirm this at the time you initiate the contract.
- Specialized cylinders, such as lecture bottles and bubblers, are often not accepted back by the distributor. Disposal is expensive, so practice good inventory control. Purchase only what you need.

### **Electronic Scrap**

Do not throw electronic scrap in the regular trash - recycle.

- Circuit boards, batteries, and cathode ray tubes (CRT) may contain lead, mercury, and hexavalent chromium.
- Televisions and CRT monitors contain four pounds of lead, on average, depending on size and make.
- Mercury from electronics has been cited as a leading source of mercury in municipal waste.

- Plastics in electronics commonly contain brominated flame retardants.

## **Conclusion**

The success of any waste minimization program is dependent on the users of chemicals. It is imperative that members of the University community are aware of the hazards and disposal costs for the material they purchase and seeking to minimize the waste they are generating.

- Seek a solid commitment from upper management to support a waste minimization program.
- Evaluate your current waste minimization efforts.
- Determine potential innovations to reduce waste.
- Set goals – both short and long term.
- Train and supervise employees to properly implement waste minimization techniques.
- Continue to review and revise your waste minimization plan to maintain relevance and enthusiasm.