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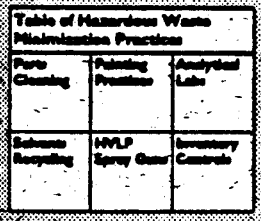
Waste Minimization in Action:

Educational and Analytical Laboratories

Inside:



Laboratories, whether educational, research, or private, have the potential for very expensive hazardous waste management and disposal problems. This is because labs use a wide variety of chemicals and generate wastes through many different chemical reactions and laboratory practices. In addition, if the chemicals are not used within their shelf-life period or, worse yet, the label disintegrates, a waste results. Out-dated and unknown chemicals are an unfortunately common problem for many labs in Hawai'i. Disposing of these wastes can be expensive because disposal often involves lab-packing the chemical containers in drums and shipping them to North America for disposal at certified hazardous waste landfills or incinerators. This is one of the most expensive disposal options for hazardous wastes.

This article will outline solutions to the problem of hazardous waste disposal from laboratories. Preventing out-dated and unknown chemical wastes is one aspect of waste minimization. Changing the constituents or size of experiments to reduce the hazards or volume of waste generated is another.

TAKING CHARGE OF WASTE MINIMIZATION

The first step in developing a successful waste minimization program is a commitment from management to support the concept. This top level support is necessary to the success of employee involvement and practice changes essential to a waste minimization program. Other organization and planning steps include setting specific waste reduction goals, creating an incentive program for employees to stimulate creative problem-solving, conducting a waste audit to assess waste minimization potential, and organizing trainings on waste minimization practices [for assistance, contact the Solid and Hazardous Waste Branch (SHWB), Waste Minimization Coordinator, 586-4226].

When the groundwork has been laid, activities can be developed to address specific waste problems. A backlog of out-dated or unlabeled chemicals can be a huge waste problem, particularly for the public school system. The following practices can be helpful in avoiding perpetuation of this problem: inventory and purchasing controls, centralized storage, agreement with manufacturers to accept returned out-dated materials, and a policy to purchase the smallest containers possible.

Minimizing waste due to spills, which can result in large amounts of mixed waste and absorbent material, is fairly easy to address. The lab should have a comprehensive leak and spill prevention policy, train staff in spill prevention and cleanup, ensure that proper cleanup equipment is easily accessible, and keep an accurate record of spills that occur, labeling the con-

(Continued, page 2)

Waste Minimization in Action:

Educational and Analytical Laboratories

tainers that contain the cleanup waste appropriately. By having a strong centralized inventory and storage program in place, and by purchasing small containers, the potential for large volume spills can be reduced.

Laboratory practices that can help reduce the toxicity and quantity of wastes generated through reactions include implementing micro-scale experiments and product substitutions (TABLE, page 3). Other practices to reduce volumes and toxicity of wastes include strict waste segregation to simplify recycling, when possible, and disposal, when necessary; filtration or distillation of solvents for reuse; and neutralization or chemical conversions (REFERENCES, page 2). Recycling of laboratory materials is also possible through materials exchanges between labs (LOCAL ISSUES, below).

For analytical labs, hazardous waste due to excess testing samples can become a disposal problem. Maintaining strict limits on quantities for testing, and forming agreements with clients to accept unused sample materials can help reduce this waste stream generation.

The suggestions above will vary in success and application depending on the different laboratory situations; the best waste minimization programs are usually developed by the staff who deal with the hazardous materials and wastes on a daily basis. Support can be gained from REFERENCES (page 2), or through contacting the SHWB, Waste Minimization Coordinator. You can use the CHECKLIST (page 4) to assist in identifying waste minimization methods already in place, and other practices that could help your business reduce its hazardous waste generation.

LOCAL ISSUES

Currently in Hawai'i, educational and analytical laboratories are dealing with reducing hazardous waste generation in a few ways. For some time, the public school system has been concerned about disposal of old, out-dated and unlabeled chemicals originally purchased for chemistry laboratory classes. Some schools have disposed of wastes through hazardous waste disposal services funded by the individual school or the Department of Education (DOE). Another opportunity for disposal of the school's waste chemicals came available this year when Hawai'i's legislature funded the DOE to conduct a hazardous waste disposal project. The backlog of chemicals that must be disposed of from the schools will be cleaned out eventually, at great expense. The long term solution to this problem, however, is not more funding for disposal of chemicals. It is minimizing waste generation through implementation of methods mentioned above.

A few local analytical laboratories have already taken the initiative to develop a passive materials exchange to reduce the amounts of waste chemicals to dispose. The laboratories share a listing of surplus chemicals and update it periodically to reflect successful exchanges. These laboratories also plan to develop a centralized inventory list that will allow each laboratory to acquire small amounts of chemicals they may need for a specific test without having to purchase containers that will become out-dated before they can be used up. Other laboratories are welcome to join this exchange network; this can help to enhance opportunities for successful exchanges of materials for all the laboratories. Please contact the SHWB, Waste Minimization Coordinator (586-4226) for information on joining the laboratory exchange network.

REFERENCES

American Chemical Society. 1985. Less is Better. Pamphlet.

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Municipality of Metropolitan Seattle. 1990. METRO Industrial Waste Program: Waste Management Guidelines for Analytical Laboratories.

Ross and Associates. 1991. Materials developed for Meeting on Hazardous Waste Minimization in Schools and Laboratories. Funded by Hawai'i Department of Health, Solid and Hazardous Waste Branch.

Waste Minimization in Action:

Laboratory Substitutes Table

Original Material	Substitute	Comments
Acetamide	Stearic Acid	In phase change and freezing point depression.
Benzoyl peroxide	Lauryl peroxide	When used as a polymer catalyst.
Chloroform	1,1,1-trichloroethane	
Carbon tetrachloride	Cyclohexane	In test for halide ions.
Carbon tetrachloride	1,1,1-trichloroethane, 1,1,2-trichlorotrifluoroethane	
Formaldehyde	Peracetic acid	In cleaning of kidney dialysis machines.
Formaldehyde	Formalternate" (Flinn Scientific), Ethanol	For storage of biological specimens.
Halogenated solvents	Non-halogenated solvents	In parts washers or other solvent processes.
Sodium dichromate	Sodium hypochlorite	
Sulfide ion	Hydroxide ion	In analysis of heavy metals.
Toluene	Simple alcohols and ketones	
Wood's metal	Onion's Fusible alloy	
Xylene	Simple alcohols and ketones	
Xylene or toluene based liquid scintillation cocktails	Non-hazardous proprietary liquid scintillation cocktails	In radioactive tracer studies.

Source: Klein-Banay, Cindy, Chuck Maier, and Peter Ashbrook. 101 Ways to Reduce Hazardous Waste in the Lab. Funded by the Illinois Hazardous Waste Research and Information Center.

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Waste Minimization in Action:

Laboratories Checklist

ORGANIZATIONAL STRATEGIES:

___ Develop a written statement of commitment to waste minimization.
___ Perform a waste audit of the laboratory.
___ Set up training program for employees on hazardous materials handling and waste minimization.
___ Set up an incentive program to solicit waste minimization ideas from employees.
___ For schools: provide students with the opportunity to research waste minimization techniques.
___ Set specific reduction goals (e.g., 50% reduction in hazardous waste).

HANDLING AND STORING MATERIALS:

___ Develop a purchasing strategy for hazardous materials:
__Designate a single person to be responsible for purchasing and tracking of hazardous materials.
__Purchase hazardous materials in smaller sizes.
___ Institute inventory control:
__Designate a centralized place for raw hazardous materials and for hazardous waste, with spill containment.
___ Label all materials properly and keep covered to prevent spills.
___ Use a first-in/first-out policy for materials:
__Return expired materials to supplier.
___ Work on spill and leak prevention:
__Inspect equipment used for hazardous materials and repair any leaks.
__Keep a record of spills and note why they happen.

BETTER LABORATORY PROCEDURES:

___ Segregate wastes:
__Keep hazardous waste separate from non-hazardous waste.
__Keep different groups of solvents separate (i.e., halogenated and non-halogenated solvents).
___ Use solvents and other hazardous materials sparingly.
___ Monitor chemical reactions closely, and add additional chemicals only as necessary.
___ Run "micro-scale" experiments (i.e., smaller scale experiments using less chemicals).
___ Set up a procedure to filter used solvent for reuse where possible.
___ Set up procedures for non-regulated lab treatment of waste materials:
__Neutralize acids and bases.
__Perform chemical conversions to create non-hazardous substances.

MATERIALS SUBSTITUTION:

___ Substitute less hazardous chemicals for more hazardous ones:
__Use laboratory detergents rather than hazardous cleaning baths (for example, substitute detergents for chromic acid solutions).
___ Use non-halogenated solvents rather than halogenated solvents (for example, substitute cyclohexane for carbon tetrachloride):
__Use less toxic/hazardous solvents rather than more toxic/hazardous solvents.

RECYCLING:

___ Set up an internal surplus chemical exchange.
___ Participate in outside chemical/waste exchange programs.
___ Distill spent solvents on-site.
___ Recycle solvents via a solvent recycling service.

[Checklist prepared by Ross and Associates, Seattle, WA. 1991.]