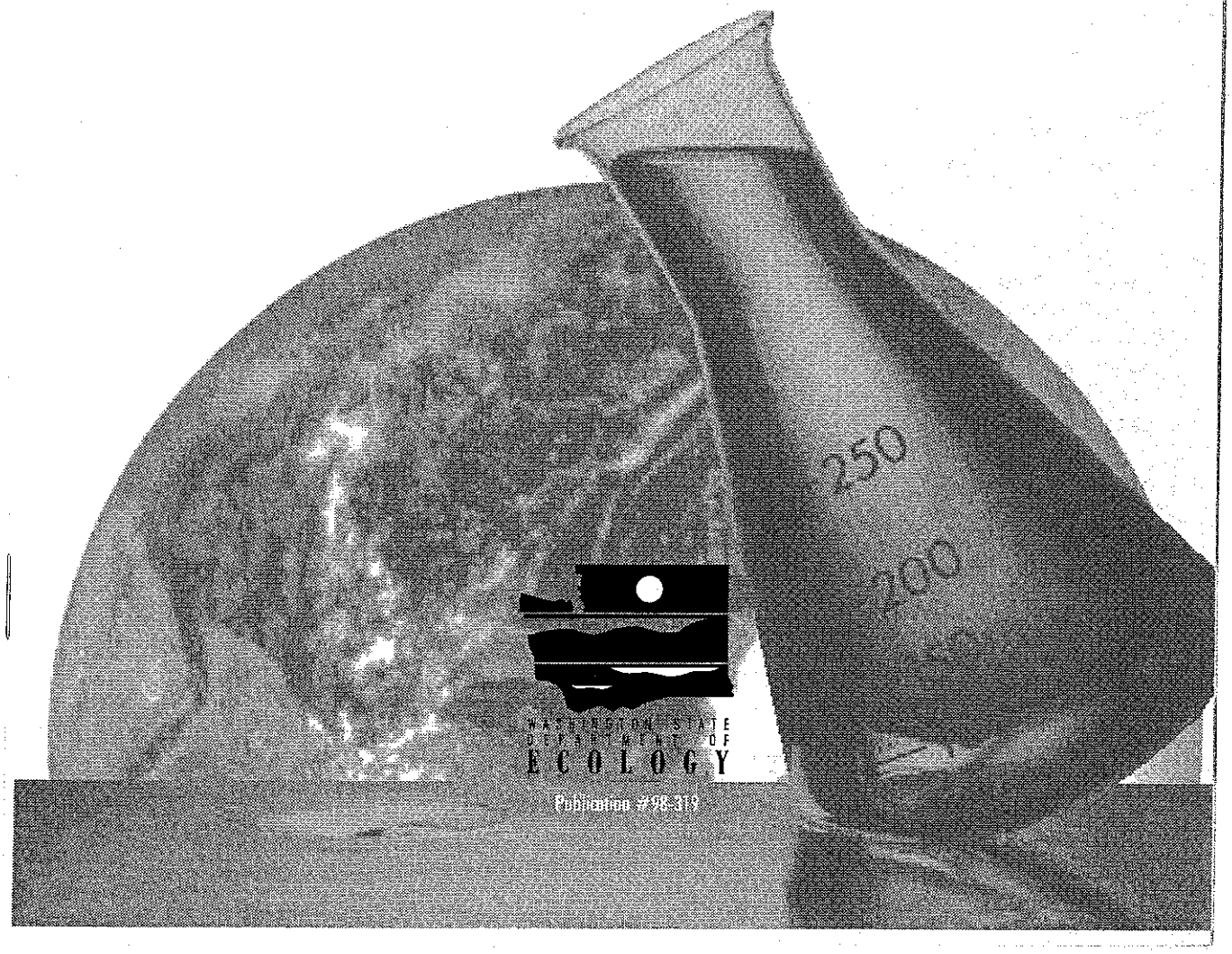
P2:
Pollution Prevention for Environmental Analytical Laboratories



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Dedication

Arnold Gahler prepared the first draft of this document. Arnold retired as the director of EPA's Region 10 Laboratory in 1985. He contributed over 2600 hours to the Washington State Department of Ecology as a Senior Volunteer in this office from 1989 until his death in 1996. His assistance is greatly appreciated and his warmth and gentle eloquence is sorely missed. This guidance is dedicated to his memory.

Acknowledgements

Ron Blair of the USEPA Region 10 Manchester Environmental Laboratory and Christa Colouzis and Camille Frensdorf of the Washington State Department of Ecology Hazardous Waste and Toxics Reduction Program reviewed this document and provided many helpful and constructive comments.

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P 2:
Pollution Prevention for Environmental Analytical Laboratories

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Introduction

The Pollution Prevention Act of 1990 established pollution prevention as a "national objective" and the first choice among environmental management practices. The Act states that pollution should be prevented or reduced at the source whenever feasible and created the new Office of Pollution Prevention within EPA.

Erickson, et. al [1] maintain that adoption of pollution prevention practices is necessary for the environmental analytical community as regulations tighten, waste disposal costs escalate, and public scrutiny increases. Analytical chemists should take the lead in protecting the environment as they measure its condition.

The Washington State Department of Ecology encourages environmental laboratories to implement a pollution prevention program to reduce their contribution to environmental pollution from chemical, biological, or radiochemical wastes. Through conservation, source reduction, inventory control, recycling and reclamation, pollution prevention reduces costs and liabilities associated with waste accumulation and disposal.

This document describes pollution prevention methods for the environmental analytical laboratory. Procedures and regulations relating to storage, processing, and disposal of hazardous waste are also discussed

Waste Minimization

Congress has declared waste minimization a national policy[2]. Waste volume reduction becomes increasingly important as businesses attempt to deal with stricter regulations. More waste means increased disposal costs, more paperwork and potentially greater liability.

Conservation

Conservation of materials and resources is the key to reducing the impact of human activities on the natural environment. All lab operations should be reviewed periodically for ways to minimize that impact.

Look For Ways To Conserve Power, Water, Supplies And Cleaning Materials As Well As Chemicals Used In Laboratory Procedures

- Install energy efficient lighting and energy and water efficient appliances. @Bullet = Use both sides of the paper for printed documents and recycle one-sided documents for printing drafts
- Use bottle-top dispensers to conserve reagents and avoid spills.
- Clean and reuse glassware.
- Encourage staff to devise new conservation techniques and reward their efforts

Everyone Benefits From Conservation

Purchasing

Effective waste minimization begins with purchasing decisions.

- **Buy Only What You Need**

Check existing inventories before ordering more chemicals. The purchase of larger quantities may encourage wasteful practices and increase risk to human health and the environment and always increases potential liability[3].

- **If You Don't Buy It You Don't Need To Dispose Of It:** Purchase laboratory chemicals in quantities that will be used before their shelf life expires. *The cost of disposal of unused chemicals exceeds the savings realized by purchasing them in bulk quantities* Inventories shrink when small quantities are purchased more often
- Buy pre-packaged reagents instead of bulk.
- Find a supplier who can deliver small quantities of chemicals on short notice and who accepts unopened containers of surplus chemicals for credit.
- Table 1 lists the reagents used in SW-846 [4] analytical methods which are also listed as hazardous wastes in 40 CFR 261, the federal dangerous waste regulation and/or the Washington State Dangerous Waste Regulation[5].
- Purchase cleaning and maintenance supplies that are biodegradable; have low toxicity; and contain no phosphates, phenolics or petroleum distillates.
- Install or upgrade air conditioning, fire suppression and refrigeration systems to eliminate ozone-depleting chlorofluorocarbons (CFCs).

Inventory Control

o Old inventories of chemicals are a serious liability: an accident waiting to happen. An effective inventory control system which tracks chemicals from purchase through use to disposal is essential to waste minimization. A readily accessible inventory facilitates sharing of surplus chemicals with those who can use them. Chemical inventory software is available for personal computers.

The Department of Ecology's *Step-by-Step Guide to Better Laboratory Management Practices*[6] includes an extensive Chemical Inventory List on computer disc

o Store chemicals so the oldest are used first. Chemicals that have exceeded their expiration date become hazardous waste.

o When you discontinue a procedure get rid of surplus reagents immediately

Sample Control

Coordinate with clients to limit the size and number of potentially hazardous samples so that excess material does not need to be disposed of as hazardous waste.

o Collect/request only enough sample to do the analyses.

o If possible, return leftover samples to clients for disposal.

Alternative Reagents

The reagents used in many analytical procedures become hazardous waste (see Table 1). There may be alternatives to the compounds recommended in these methods. Some examples are:

o Perchlorate drying agents can be replaced with other desiccants.

o Phenylarsine oxide (PAO) can be replaced as a titrant for iodine with sodium thiosulfate in the determination of chlorine by EPA Method 330.1.

o Mercuric sulfate can be replaced with copper sulfate in the determination of Kjeldahl nitrogen by EPA Method 351.2.

o Benzene and carbon tetrachloride often can be replaced by less hazardous solvents.

o Chromic acid cleaning solution is corrosive and toxic. Alcoholic potassium hydroxide is flammable and corrosive. Both can be replaced with detergents specifically formulated for use in the lab such as Alconox® or Pierce RBS-35®. These are available from scientific products supply houses.

Alternative Methods

Unfortunately, most analytical methods were not developed with the principles of pollution prevention in mind. To reduce the quantity of hazardous waste generated in the lab, staff will need to actively explore alternatives

For example, Fluorocarbon 113 (Freon®) is used in the determination of oil and grease by EPA Method 413 1. Method 1664, *Hexane Extractable Material*, uses hexane to extract petroleum products. EPA has not promulgated this method for NPDES reporting; however, the Region 10 administrator has granted conditional approval for its use in Washington, Oregon, Idaho, and Alaska. Other EPA regions may have done so as well

In the methods for Chemical Oxygen Demand (COD), some of the reagents become hazardous waste. Alternate methods such as those for Biochemical Oxygen Demand (BOD) and Total Organic Carbon (TOC) may provide comparable information. Also, microscale procedures, such as EPA Method 410 4, are available for COD. HACH® [HACH Company, Loveland, CO, (800)2274224] now offers a method for COD which uses manganese instead of mercury or chromium. The method is not approved for regulatory reporting but may be used for purposes such as internal process control.

Automated methods often require fewer samples and smaller volumes of reagents than their manual counterparts.

Consider microwave digestion, supercritical fluid extraction (SFE) and solid phase extraction (SPE) techniques In SW-846, microwave digestion methods 3015 and 3051, method 3535 (SPE), and methods 3560 and 3561 (SFE) are approved for use in RCRA projects.

Accelerated solvent extraction (ASE) equipment by Dionex® Corp. [Sunnyvale, CA, (408)737-0700] can reduce solvent use by 90% in the extraction of organics from solid samples as well as reduce the time required for the extraction. This equipment is relatively expensive but the cost can be recovered in a few years through savings in the purchase and disposal of solvents and increased efficiency of the analyses

A shorter HPLC column packed with smaller particles will shorten run time and reduce solvent usage considerably. For example, a 3.2 mm HPLC column used in place of a 4.6 mm column requires 50% less solvent[7]

Any laboratory adapting routine methods to microscale techniques needs to validate the changes using QC sample results to demonstrate that the new procedure is providing data of known and consistent quality

Except for projects regulated under the federal Resource Conservation and Recovery Act (RCRA), SW-846 is offered as guidance and the use of reasonable adaptations of the published method is allowed. Also, EPA is moving toward performance-based methods in which changes to reference methods are acceptable when proficiency is documented with standardized quality control (QC) results. This change allows laboratories the flexibility to adopt newer or better methods.

Waste Management, Storage & Disposal

Solid Waste

In the State of Washington, anything that can't be used, whether solid, liquid, or gas, is solid waste This includes chemicals that are past their shelf life. Some solid wastes are also hazardous wastes under the Dangerous Waste Regulations[5]. Non-hazardous wastes are regulated by local health departments while hazardous wastes are regulated by the Department of Ecology.

Inert solid waste may be disposed of in the local solid waste system.

Never Dispose of Chemicals in The Garbage

No hazardous waste is allowed in the Seattle/King County solid waste system, including garbage cans, dumpsters and landfills. Certain landfills accept some hazardous waste Check with the local solid waste utility. There are restrictions on any sludges or liquids in solid waste streams. In Washington State, see WAC 173-303-140, *Land Disposal Restrictions*

Regulations Affecting Laboratories

Any Material That is of No Further Use is Regulated as a Waste

Materials that must be recycled before they can be used also may be classified as wastes. For example, solvents that are accumulated, distilled and reused must be managed as wastes prior to distillation[2].

RCRA specifies some listed chemicals as hazardous (40 CFR 261). Other wastes are designated as hazardous based on characteristics of ignitability, corrosivity, reactivity and toxicity

The State of Washington Dangerous Waste Regulation[5] generally parallels federal regulations. The regulation defines the same two categories of hazardous waste: Dangerous Waste (DW) and Extremely Hazardous Waste (EHW).

In addition, the state regulation defines Special Wastes that are corrosive, toxic, or persistent and are *not* regulated as hazardous wastes by EPA. See WAC 173-303-040, *Definitions*. Examples of special wastes are solid wastes contaminated with polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), dioxins/furans and their precursors, petroleum products or asbestos.

Laboratories are responsible for the management and designation of their hazardous wastes.

Potential Criminal And Civil Liability Exists for Organizations or Individuals if Hazardous Wastes are not Handled Properly

WAC 173-303-060[5] states that any person who generates, offers for transport or transfers a dangerous waste must have a current EPA/state identification number. An ID number may be obtained by submitting a completed Washington State Notification of Dangerous Waste Activities (Form 2) to the Department of Ecology.

Most laboratories qualify as Small Quantity Generators (SQGs) under federal and state regulations. An SQG may generate up to 1 kg of extremely hazardous waste (EHW) or 100 kg of dangerous waste (DW) per month and store up to 1000 kg of DW. Up to 100 kg per month of EHW in the form of residues or contaminated soil, water, etc can be accumulated on site.

Small Quantity Generators must complete part of the Dangerous Waste Generator Report annually and ship their wastes to a licensed Treatment, Storage or Disposal (TSD) facility within 90 days after these quantities are accumulated on site

Chemicals that are listed as hazardous wastes in 40 CFR 261 and WAC 173-303 *and* are used in SW-846 analytical methods are listed in Table 1. These lists are revised and expanded periodically. Changes are published in the federal register or comparable state regulatory publications.

Off-site shipments of hazardous wastes must be accompanied by a Uniform Hazardous Waste Manifest (EPA Form 8700-22 or 8700-22A) which lists all hazardous wastes in the shipment and includes certification regarding the shipper's waste minimization program.

Contact the Washington Department of Ecology for information on handling and disposal of any material containing PCBs. Specific questions concerning the regulations may be addressed to the staff of the Hazardous Waste & Toxics Reduction Program in the Washington State Department of Ecology listed below or use the Hazardous Substance Information Hotline at (800)633-7585.

Contact the hazardous waste specialist at the appropriate Regional Office:

- Northwest (425)649-7000
- Southwest (360)407-6300
- Central (509)575-2490
- Eastern (509)456-2926

Laboratories located outside the state of Washington should check on applicable state and local regulations.

Precautions Must Be Taken to Prevent the Release of Toxic Substances into the Air

For information on volatile compounds discharged from fume hoods, contact your local air pollution control agency (APCA). The location of the laboratory may determine whether special disposal or reclamation procedures are required. In the State of Washington, contact the following agencies:

- **Olympic APCA** *Clallam, Grays Harbor and Jefferson, Mason, Pacific and Thurston counties:* (360) 438-8768 or (800) 422-5623
- **Department of Ecology** *San Juan county:* (425)649-7000
- **Northwest APCA** *Island, Skagit and Whatcom counties:* (360)428-1617
- **Puget Sound APCA** *King, Kitsap, Pierce and Snohomish counties:* (206)343-8800 or (800)552-3565
- **Southwest APCA** *Clark, Cowlitz, Lewis, Skamania, and Wahkiakum counties:* (360) 574-3058 or (800) 633-0709
- **Department of Ecology** *Chelan, Douglas, Kittitas Klickitat and Okanogan counties:* (509) 575-2490
- **Yakima Regional Clean Air Authority** *Yakima county:* (800)540-6950
- **Department of Ecology** *Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Stevens, Walla Walla and Whitman counties:* (509)456-2926
- **Spokane Co. APCA** *Spokane County:* (509)456-4727
- **Benton Co. Clean Air Authority** *Benton County:* (509)943-3396

It is advisable to have on file documentation from the local APCA of the applicable regulatory requirements.

Waste Treatment

In-House Treatment Of Hazardous Waste is Subject to Regulation and May Require a Permit

Treatment refers to procedures that make wastes less dangerous by reducing their volume, toxicity or both[3,8]. Federal regulations allow limited treatment of hazardous wastes without a permit. In the State of Washington, the following treatment methods are allowed without a permit:

- Solidification or Stabilization
- Elementary Neutralization
- Carbon Adsorption
- Filtration
- Evaporation (of water from inorganic waste)
- Separation by:
  - Centrifugation
  - Floculation
  - Air Flotation
  - Coagulation

Some states require permits for any treatment process. In-house treatment for hazardous waste has been added to Washington State regulations and are described in a series of Ecology Technical Information Memoranda[8]. Treatments requiring a permit from the Department of Ecology or written permission of an Ecology Hazardous Waste Inspector include:
Solidification or Stabilization

- Sterilization
- Precipitation
- Distillation
- Ion Exchange
- Reverse Osmosis
- Oxidation/Reduction
- Sedimentation
- Separation Stabilization
- Phase Separation

Recycling

In-house recycling offers control of chemical quality and reduces the potential liability incurred when waste chemicals are sent to an off-site recycler. Solvents such as methanol, xylene, methylene chloride, acetone, toluene, hexane, acetonitrile, and Freon® can be reclaimed by distillation. Regulations require maintenance of a detailed still log[9].

Although this equipment is relatively expensive, the cost can be recovered by reducing the quantity of solvents purchased and discarded.

- Chlorinated solvents should be distilled only in glass or stainless steel equipment.
- Recovery of ethanol by distillation requires a permit from the U. S. Treasury Department, Bureau of Alcohol, Tobacco and Firearms.
- **On-line solvent recovery systems are available for some analytical equipment.** Several firms offer smart column waste valves for HPLC instruments. These divert solvent to the waste receptacle only when the detector senses a peak, reducing solvent consumption by 50% or more
- Methylene chloride can be recovered from a K-D apparatus rather than expelling it into the air. Devices such as the Organomation S Evap® [Organomation Associates, Berlin, MA, (888)838-7300] are available for this purpose.
- Recovered solvents are usually adequate and may be better than solvents available from your supplier. The purity of recovered solvents can be checked by analyzing them along with routine samples.

O Still bottoms may be hazardous wastes In Washington, you must determine whether the still bottoms designate as dangerous waste[5,6]. The Uniform Fire Code applies to stills used to process flammable materials. Contact the local Fire Marshall. Most require UL listed distillation equipment.

In Washington, the Department of Ecology regulates stills used for recycling. In western Washington, contact *Scott Lamb* at (425)649-7268, and in eastern Washington, contact *Camille Frensdorf* at (509)456-6369.

O It may be possible to contract with recyclers to recover used solvents. Some companies that recover solvents will deliver recycled solvent when they pick up used chemicals.

O Another approach is to use spent or recovered solvents for initial rinses and reserve fresh solvents for use in the final rinse

O Other businesses may be able to use chemicals of lower purity and some accept waste streams from laboratories if they can recover valuable constituents. For example, potters may be able to use metal salts for ceramic glazes and auto repair shops can use distilled solvents for parts cleaning

O List surplus chemicals with a local hazardous waste exchange: Passive surplus exchange services allow generators to advertise their waste materials Active exchanges may be able to find market alternatives for reusable chemical wastes. IMEX [(206)296-4899] a free industrial materials exchange operated by King County Hazardous Waste Division publishes a catalog of available chemicals which includes a listing of other exchanges. There internet address is: http://www.metrokc.gov/hazwaste/imex.

O Hendrickson et al.[10] describe a procedure for recovering mercury and silver. Companies such as Mercury Waste Solutions Inc., (414)878-2599 and Bethlehem Apparatus, (610)838-7034 recover mercury for reuse. Businesses that reclaim silver are listed in the yellow pages under *Precious Metals, Refiners, or Photographic or X-Ray Equipment*.

O Recycle solid waste such as aluminum, batteries, cardboard, packing materials, paper and plastics whenever possible. In Washington, call Ecology's *Recycle Hotline* at 1 (800) RECYCLE for information on local facilities and services Recyclers may not accept laboratory glassware, even if it has been cleaned.

Many waste treatment techniques for laboratories are documented in the scientific literature[11,12,13]. Some of these may not be legal in specific localities. In Washington State, check with the Department of Ecology.

Waste Storage

After everything feasible has been done to minimize the quantity of hazardous waste generated in the laboratory, there will remain some wastes that require storage and disposal.

Improper storage or disposal of hazardous wastes can create health risks for employees, damage the environment and lead to costly penalties and litigation. Lab management and staff are liable for any harm done to others, including lab staff; for damage to sewer pipes; and for any environmental damage caused by lab operations[14].

Storage of some chemicals, such as diazomethane used for esterification, is not recommended because of the instability of the compound. It is advisable to prepare only a sufficient quantity for immediate use with semi-micro apparatus Destroy the excess behind a safety shield in a hood by slowly adding excess water or acetic acid until the yellow color disappears.

Segregating wastes is important for safety, pollution prevention, and disposal cost control. The following substances should not be mixed: (1) hazardous and non-hazardous wastes, (2) organic and inorganic waste, and (3) chlorinated and non-chlorinated solvents.

According to the American Society for Testing and Materials (ASTM), laboratory wastes should be segregated into the following types[15] (recommended container material is in parentheses):

- Uncontaminated trash and inert chemicals
- Corrosives
  - Aqueous acid solutions (glass)
  - Aqueous alkaline solutions (glass)
- Organic Solvents
  Flammable
  - Halogenated (glass)
  - Non-Halogenated (glass)
  Non-flammable
  - Halogenated (glass)
  - Non-halogenated (glass)
- Organic acids (glass)
- Organic bases (glass)
- Oxidizers (glass)
- Reducing agents (glass)
- Toxic heavy metals (plastic or glass)
- Herbicides and pesticides (plastic or glass)
- PCBs (glass)
- Explosives (consult DOT regulations for containers)
- Radioactive waste (consult DOH regulations for containers)
- Infectious waste (consult DOH regulations for containers)
- Empty chemical containers are solid waste if triple-rinsed
- Asbestos or asbestos-containing materials are special waste in Washington State
- Contaminated labware is handled by special vendors

Glass containers should always have secondary containment in case of breakage.

Waste containers for shipment should be stored where they are protected from weather and secure from vandalism

Containers must be compatible with the material stored in them. Wastes must be properly classified according to state regulations. In Washington State, see WAC 173-303-200, *Accumulating dangerous waste on-site* and WAC 173-303-210, *Generator recordkeeping*.

A waste management firm can help set up a waste collection and identification system to facilitate compliance with applicable regulations, safe waste management practices and cost-effective disposal[2].

Some laboratory chemicals are used by manufacturers of illicit drugs. Care must be exercised to control chemicals during storage and disposal.

Store chemicals in a secure area and maintain strict inventory control[14]

Contact the local Fire Marshal and emergency planning organization. Educate them about waste storage practices at the laboratory and provide them with a copy of the waste inventory. In case of emergency, fire and rescue personnel are reluctant to enter a facility when they don't know the nature and location of the hazardous materials they may have to confront.

Help with waste storage issues is available from the Washington State Department of Ecology Hazardous Waste and Toxics Reduction Program. In Eastern Washington

contact Camille Frensdorf at (509)456-6369; in Northwest Washington contact Christa Colouzis at (425)649-7143; and in Southwest Washington contact Bob Goldberg at (360)407-6350 or Vern Meinz at (360)407-6346.

Labeling of Chemical Containers

The cost of having mislabeled or unidentified containers of chemicals on premises begins with the analyses necessary to identify the contents. Proper labeling also decreases costs associated with accidents and injuries and makes it easier to comply with regulatory requirements. Lab policy should require identification of all chemical containers, including waste containers, and designate responsibility for doing so.

- Adopt standard labeling procedures. Use labels that are colorfast and permanent.
- Identify the waste as a specific compound or mixture of specific compounds. If a waste is not a specific compound, provide a description of its probable hazards, chemical class, functional groups and compatibility.

Disposal to the Sewer System

It may be permissible to discharge some dilute, treatable waste streams to the sanitary sewer system.

Obtain written permission from the Department of Ecology or the Sewer Utility[14] before discharging any chemical wastes to the sewer system.

- Monitor waste streams to make sure that they meet the requirements in the approval document.
- Nothing should be placed in the sewer drain that would interfere with the operation of the treatment plant or cause its effluent to violate permitted discharge limits. Aqueous acidic or alkaline solutions should be neutralized before pouring them into a drain connected to the sewer system. Specific requirements for the pH of wastewater vary with the sewer utility. Make sure that other contaminants are not present in excess of regulatory limits. In Washington, see Ecology Publication Number 96-417, *Elementary Neutralization*, one of the Treatment By Generator memoranda[8].
- When treating aqueous acidic or alkaline waste always wear personal protection equipment, use ice to cool the waste, add the neutralizing solution slowly, and check the pH frequently. Never neutralize strong acids with strong bases or vice-versa.
- Methylene chloride and diethyl ether are miscible with water. Methylene chloride forms a 1.3% solution which can harm the bacteria in a treatment facility. Diethyl ether forms a 7% solution that fails the ignitability test (see WAC 173-303-090). Water samples extracted with these solvents should not be placed in the sanitary sewer system.

Dangerous Wastes* Should Never Be Poured Down Any Drain

A substance that goes down one sink may arise as a vapor from another[15]. The commingling of waste from different sources in the sewer system may also lead to hazardous chemical reactions. Laboratory sinks can be vented to protect staff from fumes.

Never pour volatile organic solvents, chlorinated or otherwise; waste from the chemical oxygen demand (COD) procedure containing mercury or chromium; naptha; toxic metal stock standards; or Kjeldahl nitrogen wastes down the sewer drain.

** As defined by federal or state dangerous waste regulations.*

It is illegal to dilute hazardous waste with water to achieve discharge limits

The Washington State Department of Ecology can provide information on discharge rules and regulations. Ecology's contacts for this information in the four regional offices are:

- *Kevin Fitzpatrick*
  Northwest Regional Office (425) 649-6198
- *Steve Eberl*
  Southwest Regional Office (360) 407-6293
- *Rick Frye*
  Central Regional Office (509) 575-2821
- *Carl Neuchterlein*
  Eastern Regional Office (509) 456-6198

No Laboratory Waste Should Ever Be Placed in a Storm Drain

Storm drains flow directly to surface water bodies which can be seriously damaged by even small amounts of chemical waste.

Biological Wastes

- Microbiology wastes must be sterilized by autoclaving before disposal
- Liquids from toxicity tests (bioassays) should be disposed of based on their chemical composition. The biological specimens tested should be separated from the aqueous phase and incinerated.
- *Effluent From A Permitted Wastewater Treatment Facility Is Not Considered Hazardous Waste*
- Pathogens should always be handled in a hood that is vented through High Efficiency Particulate Arresting (HEPA) filters.
- In the state of Washington, biological wastes are regulated by the Department of Health and local health departments.

Radiochemical Waste

- Air from hoods should be vented through HEPA filters.
- Substitute biodegradable scintillation solutions for the toxic xylene- or toluene-based variety.
- Store solids or solutions in a shielded vault until their level of radioactivity is below the regulatory criteria.
- Low-level radioactive waste must be in solid form for land disposal.

Adding Absorbent Materials to Liquid Radioactive Wastes is Not Permitted Special Wastes

In the state of Washington, radiological wastes are regulated by the Department of Health and local health departments.

Shipment of Wastes

Wastes to be shipped off site must be segregated, packaged, and classified according to federal Department of Transportation (DOT) regulations. In Washington, see WAC 173-303-190, *Preparing dangerous waste for transport*.

Wastes must be segregated into the following classifications:

- Poisons
- Oxidizers
- Flammables
- Corrosives-acids
- Corrosives-alkalis
- Explosives

A licensed hazardous waste handler should be retained to package, transport and dispose of these wastes. A *Hazardous Waste Services Directory* is available from the Washington Department of Ecology by calling the Publications Office at (360)407-7472. Ask for Ecology Publication Number 91-12, December 1994 revision.

Secure competitive bids from prospective hazardous waste handlers. Consider the technical competence and experience of the vendors in awarding the bid. Low bidders can be very expensive in the long run if they fail to handle and dispose of waste properly. Ask prospective vendors for references and check them. Also, ask for proof of insurance. If the waste handler will contract to a separate disposal facility, check on the management of that facility as well.

In Washington, call the Hazardous Substances Information hotline at (800)633-7585 to verify that vendors have EPA identification numbers and to find out if they have been cited for violations.

Your Liability Does Not End When Waste Leaves The Laboratory

Be sure to obtain a copy of the completed manifest (EPA Form 8700-22) signed by the facility that receives the waste and a *certificate of destruction*. It is a good idea to withhold part of the payment until the certificate is provided. These records MUST be retained for at least five years and should be retained indefinitely to protect against future liability.

Wastes containing mercury must be sent to a facility with a retort incineration furnace. For COD wastes, neutralize the sulfuric acid solution containing the mercury and chromium before shipping.

Hazardous Waste Disposal: A Guide for Business is available from King County by calling (206)684-2325.

- Maintain records documenting the proper disposal of hazardous waste to reduce liability
- Keep copies of all transactions for at least five years

Further discussion of waste minimization, treatment and/or disposal can be found in Standard Methods[16].

In Washington, the Department of Ecology will provide on-site pollution prevention assistance free of charge.

Waste Management Plan

Each Laboratory Should Prepare and Implement a Waste Management Plan

Proper management of hazardous materials will reduce the amount of hazardous waste and associated disposal costs. The plan includes written procedures and assigns responsibility for carrying them out. Lab personnel recognize that the chemical wastes they generate are their responsibility and that waste management procedures are necessary.

The waste management plan should include the following elements:

- Waste minimization
- Inventory management and control
- Recycling (WAC 173-303-120)
- Disposal to sanitary sewers
- Disposal to solid waste facilities (WAC 173-303-140)
- Waste treatment
- Identification and labeling of wastes (WAC 173-303-070)
- Waste segregation
- Storage of waste (WAC 173-303-200)
- Hazardous waste disposal (WAC 173-303-190)
- Records (WAC 173-303-210)
- Reporting (WAC 173-303-220)
- Staff training (WAC 173-303-330)
- Emergency procedures (WAC 173-303-350)

Lab management should designate an individual as waste manager[15]. The waste manager is responsible for interacting with local, state, and federal regulatory agencies; developing and maintaining the waste management plan; and training lab staff to carry out their waste management responsibilities. The waste manager is also responsible for collection, storage and shipping procedures[2].

Lab personnel are uniquely qualified to contribute to the tasks of segregating, labeling and properly storing wastes. All staff responsible for handling and disposal of chemicals or samples must be familiar with and follow the Waste Management Plan. The plan should include the responsibilities of laboratory personnel in the receiving area, stockroom, and storage areas. Employees must be trained to handle and dispose of hazardous waste properly and to use solvents and other hazardous materials sparingly. Keep Material Safety Data Sheets on file and accessible to staff.

The waste management plan should include an emergency response plan for the storage area in the event of fire, flood, earthquakes, spills or leaks. The emergency response plan should be rehearsed periodically. The plan should also call for periodic inspection of stored chemicals to check for container deterioration.

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15. Standard Guide for Disposal of Laboratory Chemicals and Samples, ASTM Standard D 4447-84 (1990)

16. Standard Methods for the Examination of Water and Wastewater, Section 1100, APHA, 19th ed., 1995.

Some local libraries maintain bibliographies of laboratory waste management references.

Table 1

Reagents Used in SW-846 Methods Which Become Hazardous Waste

These compounds are included in 40 CFR 261.33 and WAC 173-303-9903 "P" list of "acutely hazardous" chemicals. Small Quantity Generators may accumulate no more than 1 kg of these compounds.

- ACROLEIN
- BRUCINE SULFATE
- CARBON DISULFIDE
- POTASSIUM CYANIDE

These compounds are included in 40 CFR 261.33 and WAC 173-303-9903 "U" list of "toxic" chemicals. Small Quantity Generators may accumulate no more than 100 kg of these compounds.

- ACETONE
- ACETONITRILE
- ACRYLAMIDE
- BENZENE
- CHLOROBENZENE
- CHLOROFORM
- CHLORINATED FLUOROCARBONS (e.g. FREON)
- CYCLOHEXANE
- 1,2-DIBROMO-3-CHLOROPROPANE
- DI-ETHYL ETHER
- ETHYL ACETATE
- ETHYLENE GLYCOL MONOETHYL ETHER
- FORMALDEHYDE
- MERCURY
- METHANOL
- METHYLENE CHLORIDE
- METHYLISOBUTYL KETONE
- PHENOL
- PYRIDINE
- TETRAHYDROFURAN
- TOLUENE
- TRICHLOROPHENOL
- VINYL CHLORIDE
- XYLENE