CHEMICAL WASTE
MANAGEMENT GUIDE

A Guide to the Generation, Storage and Disposal of Hazardous Waste at Auburn University

Department of Risk Management and Safety
Environmental Health & Safety
March 2020

NOTICE

This guidance manual should be located in the general vicinity of the Hazardous Waste Satellite Accumulation Area (SAA) or easily accessible online and readily available to all persons in the laboratory. This manual may be found at

https://cws.auburn.edu/rms/pm/wastemanagement

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Please read and understand this guide. The Department of Risk Management and Safety has instituted several major improvements in the handling of chemical waste.
Revised 17 April 2020 Version 6.0

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Mission Statement

Environmental Health & Safety (EHS) is a division of the Department of Risk Management and Safety (EHS). The mission of Environmental Safety & Health is to responsibly foster an atmosphere in which human health and the environment of the University is safeguarded through education, regulatory compliance and natural resources preservation and management. Priorities are as follows:

- Protect the health and well-being of students, faculty, staff and visitors at Auburn University;
- Develop and implement programs to minimize the amount and toxicity of chemicals used and wastes generated;
- Provide safe storage of chemical wastes pending disposition;
- Dispose of chemical wastes in an environmentally sound and cost-effective manner;
- Provide and assist emergency response to chemical spills; and
- Comply with federal, state and local regulations.

The success of the Hazardous Waste Management program depends not only on EHS but also on the conscientious efforts of you, the individual. In order for this program to be successful, you are expected to:

- Package, label and store waste solvents, unwanted chemical products and waste laboratory chemicals according to the procedures listed in this manual until EHS can pick them up for subsequent storage and off-campus disposal;
- Identify your chemical wastes properly so that unknowns are not generated;
- Seek the advice of EHS staff whenever you are in doubt regarding handling and disposal of any chemical product; and
- Make every effort to minimize the amount of hazardous waste that you generate, therefore reducing disposal costs.

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Introduction to this Guide

This Chemical Waste Management Guide provides University employees who work with hazardous materials an updated description of the program and information on how to minimize, store, handle, and package chemical wastes. An understanding of the enclosed procedures is necessary in order for generators to comply with new and existing rules from the regulatory agencies governing hazardous materials. This manual also contains information specific to Auburn University's philosophy on disposal and waste minimization. This guide does NOT contain specific information about the disposal of radioactive, medical, or normal solid wastes or about laboratory safety. A listing of the manuals offered and documents recommended by this office is included at the end of this guide. Visit the Auburn University Department of Risk Management and Safety's web site at https://cws.auburn.edu/rms/pm/chemguidestools for additional information on these topics. We have made several revisions to our chemical waste management program which, hopefully, will improve the chemical waste handling procedures for everyone. **This manual must be available to all workers in your laboratory.**

Organization of this Guide

Chapter 1 contains a general overview of hazardous waste regulations and defines hazardous waste.

Chapter 2 is specific to hazardous waste storage. The chapter begins with information on Hazardous Waste Satellite Accumulation Area requirements.

Chapter 3 contains detailed information about preparing waste for collection.. The chapter also introduces CHEMATIX™, our hazardous waste database. Users of CHEMATIX™ are able to submit waste pick up requests via the internet once assigned a user name and password. See the next page for more information.

Chapter 4 assists you in establishing prevention/cleanup procedures unique to your needs.

Chapter 5 covers special situations, sometimes referred to as "problem" materials, to help guide you in choosing the appropriate course of action.

Chapter 6 contains waste minimization procedures including information on the Chemical Surplus program.

Chapter 7 takes waste minimization further by providing several "cookbook" recipes for reducing hazards of specific waste streams. These methods are posted to our web site in Adobe® portable document format (pdf).

The next section contains a list of terms and their definitions used in this guide. Following that is a comprehensive index for finding sections in the text easily. The

Introduction to this Guide

Acknowledgments page is a thank you to some of the resources investigated for inspiration.

CHEMATIX™ Hazardous Waste Database

CHEMATIX™ is a Chemical Inventory Management System (CIMS) and hazardous waste database now implemented campus wide. The CHEMATIX™ hazardous waste database can be accessed at https://chematix.auburn.edu/Chematix/ and the CHEMATIX™ User Guide may be found here: https://cws.auburn.edu/shared/content/files/1306/chematrix-procedures.pdf

How to Contact Us

Occasionally, you may need to contact us for additional information, or for clarification in applying the information in this manual to your specific situation. You may call us at (334) 844-4870 unless another number is specifically listed with the section in question. Email addresses and other contact information for EHS staff is available on the EHS web site at https://cws.auburn.edu/rms/pm/rmsmission.

Visit our web page at https://cws.auburn.edu/rms/pm/environmentalManagement. Find the EHS program section you would like more information from and contact the employees listed. Whenever the text says, "e-mail us", refer to the staff directory section of the EHS web site for a departmental contact.

SPECIAL NOTE ON SOLID WASTE GENERATED IN LABORATORIES

General Laboratory Hygiene Practices

- Laboratory personnel are responsible for regular cleaning and disinfection of laboratory surfaces to maintain good laboratory hygiene. Solid waste (regular trash cans) should be placed outside the lab at the end of each business day for custodial staff to pick for disposal. Custodial staff will have access to labs only for services requested through AU Facilities work management by submitting a work order. Examples of these services include deep cleaning and floor waxing.

- Lab personnel are responsible for transporting autoclaved waste to the trash dumpster located outside of the building. Custodians shall not remove any waste from autoclave rooms.

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Introduction to this Guide

Achieving and Maintaining Compliance

All persons in a supervisory or managerial position are responsible for proper handling and management of wastes in their areas and for ensuring that all University requirements for hazardous wastes, detailed in this manual, are followed by each employee who works for them.

Supervisory and managerial personnel are responsible for ensuring that all employees in their respective areas who handle hazardous materials and wastes are trained and know how to handle hazardous materials and wastes in their individual laboratory or work area.

There are several EHS training programs that provide more in-depth information than is contained within this manual. Consult the training section of the EHS web site to see a listing of training programs available.

Ultimately, it is the individual using these materials who is responsible for following the guidelines contained in this manual. With your cooperation, professional knowledge, and responsible actions, Auburn University can continue to safely and responsibly manage its hazardous waste. If you have any comments or questions concerning these chemical waste handling procedures, please give us a call.

Background

Under the 1976 Federal Resource Conservation and Recovery Act (RCRA), Congress defined hazardous waste as a solid waste, or combination of solid wastes, which because of its quantity, concentration, chemical or infectious characteristics may:

- cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible or incapacitating reversible illness;
- pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.

Although Congress defined hazardous waste, they required the Environmental Protection Agency to develop the regulatory framework that the community could use to identify their wastes. RCRA provided for "cradle-to-grave" control that governs the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also provided a framework for dealing with non-hazardous wastes.

RCRA was amended in 1984 to include the Hazardous and Solid Waste Amendments, or HSWA. These amendments required the phase-out of land disposal of untreated hazardous waste, increased enforcement authority for EPA, and provided more stringent hazardous waste management standards and provisions to deal with underground storage tanks. It required generators to certify that they have a waste minimization program in place for hazardous waste and to identify efforts undertaken to reduce the volume and toxicity of waste. The amendments also regulated federal procurement procedures for products that contain recycled materials, municipal solid waste landfill site criteria and hazardous waste combustion. RCRA was further amended in 1986 to address environmental problems caused by underground storage tanks containing petroleum and other hazardous substances.

On May 30, 2017, The Generator Improvements Rule became effective federally and in those states and U.S. Territories not authorized for the Resource Conservation and Recovery Act (RCRA) program (i.e., Iowa, Alaska, tribal lands and most of the territories). Alabama implemented the Generator Improvements Rule on April 5, 2019. This means that Alabama adopted more stringent aspects of the federal rule but could choose whether to adopt aspects of the rule that are less stringent or equally stringent.

For those revisions that are more stringent, Alabama was required to adopt the rule by July 1, 2019. The more stringent provisions adopted by Alabama that most affect SAAs include:

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- Re-notification every four years by small quantity generators.
- **Incompatible wastes must not be placed in the same containers at a satellite accumulation area.**
- **Satellite accumulation areas are subject to emergency preparedness and prevention requirements.**
- **Labels on waste containers, tanks, and containment buildings must identify the hazards of wastes being accumulated.**
- RCRA waste codes (e.g., F006, D001) must be marked on the waste container prior to shipment off-site. Moreover, Alabama requires large quantity generators (LQGs) to mark RCRA waste codes on each container and/or tank of waste while they are accumulated in the <90-day central accumulation areas (CAA) such as AU's storage facility.
- A generator must submit notification to EPA or the authorized state when preparing to close its facility and when that closure has been completed.
- If an LQG that has accumulated hazardous waste in containers cannot meet standards to clean close its facility at the end of its life, it must close as a landfill.
- If a generator is an LQG any month of the year, it must complete the Biennial Report for all the waste generated in that year, not just the waste generated in the months it was an LQG.
- Recyclers that do not store prior to recycling must complete and submit the Biennial Report.
- LQGs must prepare Quick Reference Guides for their contingency plans and submit them to local responders.

The provisions in the final generator rule that are less stringent than the previous regulations do not have to be adopted by states because state regulations can be more stringent than the federal regulations. These provisions are the following:

- Streamlined provisions to allow generators that experience an event outside of normal production to ship that waste off site with a manifest to a RCRA-designated facility without a change to their normal generator category (referred to as Episodic Generation).
- Allowing LQGs to accept waste from very small quantity generators under the control of the same person for consolidation at the LQG. The consolidated waste then must be shipped from the large quantity generator to a RCRA-designated facility under a hazardous waste manifest, referred to as very small quantity generator (VSQG) to LQG Consolidation.
- Allowing LQGs that cannot meet the requirement to store ignitable or reactive waste 15 meters from the property line to get a waiver from the local fire authorities if appropriate.

The 1980 enactment of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), allowed EPA to identify and cleanup abandoned or uncontrolled hazardous waste sites. It established a federal "Superfund" to finance response actions, established regulations controlling inactive hazardous waste sites, and established generator liability to recover cleanup costs. It also created a National Contingency Plan (NCP) for major releases of hazardous materials, created a priority listing of inactive waste sites, and established reportable quantities (RQs) for release of hazardous substances that must be reported to a National Response Center (NRC).

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Hazardous Waste Determination

A ***solid waste*** is any discarded material that is not excluded by Title 40 of the Code of Federal Regulations. Certain materials are not solid waste if they are recycled in an industrial process as a substitute for raw principle feedstock. Other materials, such as domestic sewage and industrial waste water discharged under Section 402 of the Clean Water Act, are also not considered to be solid wastes. Moreover, a ***discarded material*** is defined as any material that is abandoned, recycled or considered inherently waste-like.

The EPA established a hierarchy for making waste determinations. First, one must determine if the material is excluded from the definition of a solid waste. If the material is not excluded from the solid waste classification, the generator must then determine if the material meets the criteria for being a hazardous waste. **If the discarded material exhibits a *characteristic* of a hazardous waste or is *listed* as a waste, then the material must be managed under the RCRA regulations.**

A waste is not a waste until it is determined to be a waste.

Characteristic Hazardous Waste

The characteristic hazards are ignitability, corrosivity, reactivity, and toxicity. Those chemicals that exhibit a characteristic hazard are assigned an EPA code that begins with the letter “D.”

Ignitable Waste (D001)

A liquid that has a flashpoint of less than 60°C (140°F) is an ignitable waste. A solid is an ignitable waste if it is capable of causing fire through friction or absorption of moisture, or if it can undergo spontaneous chemical change that can result in vigorous and persistent burning. A substance that is an ignitable compressed gas or oxidizer is an ignitable waste.

Corrosive Waste (D002)

An aqueous solution that has a pH less than, or equal to 2 or greater than or equal to 12.5 is a corrosive waste. Also, a liquid is a corrosive waste if it corrodes steel at a rate greater than 6.35 mm (0.25 inches) per year at 55°C (130°F).

Reactive Waste (D003)

A reactive waste is a material that is normally unstable and undergoes violent chemical change without detonating, can react violently with water to form potentially explosive mixtures, or can generate dangerous or possibly lethal gas. Also, any material that is capable of detonation or explosive reaction is a reactive waste.

Toxic Waste (D004 - D043)

A waste that contains one of the constituents listed in Table 1-1 is a toxic waste. A Toxic Characteristic Leaching Procedure (TCLP) is used to simulate how the material would react in a landfill if untreated. A material fails the TCLP test if it contains any listed constituent above the regulatory concentration established by EPA and is assigned the appropriate D-Code for that constituent.

Table 1-1Chemicals determined toxic by TCLP (when above regulatory concentrations-not shown)

Heavy metals	Organic substances	
Arsenic	Benzene	Tetrachloroethylene
Barium	Carbon tetrachloride	Toxaphene
Cadmium	Chlordane	Trichloroethylene
Chromium	Chlorobenzene	2,4,5-Trichlorophenol
Lead	Chloroform	2,4,6-Trichlorophenol
Mercury	o-Cresol	Vinyl chloride
Selenium	m-Cresol	2,4-D
Silver	p-Cresol	2,4,5-TP silvex
	1,4-Dichlorobenzene	1,1-Dichloroethylene
	1,2-Dichloroethylene	2,4-Dinitrotoluene
	Heptachlor	Endrin
	Hexachlorobenzene	Lindane
	Hexachloro-1,3-butadiene	methoxychior
	Hexachloroethane	Methyl ethyl ketone
	Nitrobenzene	Pentachlorophenol
	Pyridine	

Listed Hazardous Waste

About 400 chemicals and chemical wastes, some from specific industrial processes, are listed as hazardous wastes. Listed wastes have EPA codes that begin with “P”, “U”, “F” or “K”.

Wastes on the “P list” and some from the “F list” are classified as ***acute hazardous waste***. The designation of acute hazardous waste indicates that the material is extremely toxic. Besides the substance being regulated as a hazardous waste, the empty container must be managed as a hazardous waste. That is, unless the inside has been triple-rinsed and the rinsate has been properly managed, even the empty container is regulated.

Examples of commercial chemical product hazardous wastes (expiration dated or unused reagents intended for disposal) include products with the generic names listed on the P and U lists from research laboratories, photography laboratories, and analytical

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laboratories. These items become hazardous wastes when the decision has been made by EHS that they must be discarded or disposed. The expiration date on a product is not necessarily indicative of the end of the material's useful life. The expiration date for some products may be extended by testing or other means. If there is another beneficial use for the material, on-campus or off-campus, the material can be used for its intended purpose without being classified as a hazardous waste.

P- and U-Code Waste

The P and U lists refer to discarded commercial chemical products, off-specification species, container residues, and spill residues. After these materials are used for their intended purpose, the U and P codes no longer apply. These materials can be counted as solid wastes instead of RCRA hazardous wastes if no other waste codes apply. Solid wastes are not used to determine the University's generation status (see page 19). The P-Code list of materials is shown on pages 13-16, since the generation of P-Code waste can dramatically alter the compliance status of the University and *especially an off campus unit*. Because the U-Code list is rather extensive, we have not included it with this manual. It is available from Environmental Management; contact Tom Hodges at hodgetf@auburn.edu.

P-list Chemicals
(List of Commercial Chemical Products/Ingredients That Hazardous Waste Generators Are Allowed to Generate Up To 2.2 lbs/month Before They Become Regulated as LQGs)

Note: The listed item must be the main or sole active ingredient for the item to be classified as a P-listed hazardous waste.

Code	CAS #	Chemical Name
P023	107-20-0	Acetaldehyde, chloro-
P002	591-08-2	Acetamide, N-(aminothioxomethyl)-
P057	640-19-7	Acetamide, 2-fluoro-
P058	62-74-8	Acetic acid, fluoro-, sodium salt
P002	591-08-21	Acetyl-2-thiourea
P003	107-02-8	Acrolein
P070	116-06-3	Aldicarb
P203	1646-88-4	Aldicarb sulfone
P004	309-00-2	Aldrin
P005	107-18-6	Allyl alcohol
P006	20859-73-8	Aluminum phosphide (R,T)
P007	2763-96-45	5-(Aminomethyl)-3-isoxazolol
P008	504-24-54	4-Aminopyridine
P009	131-74-8	Ammonium picrate (R)
P119	7803-55-6	Ammonium vanadate
P099	506-61-6	Argentate(1-), bis(cyano-C)-, potassium
P010	7778-39-4	Arsenic acid H3AsO4
P012	1327-53-3	Arsenic oxide As2O3
P011	1303-28-2	Arsenic oxide As2O5
P011	1303-28-2	Arsenic pentoxide
P012	1327-53-3	Arsenic trioxide
P038	692-42-2	Arsine, diethyl-
P036	696-28-6	Arsonous dichloride, phenyl-
P054	151-56-4	Aziridine
P067	75-55-8	Aziridine, 2-methyl-
P013	542-62-1	Barium cyanide
P024	106-47-8	Benzenamine,4-chloro-
P077	100-01-6	Benzenamine, 4-nitro-
P028	100-44-7	Benzene, (chloromethyl)-
P042	51-43-4	1,2-Benzenediol,4-[1-hydroxy-2-(methylamino)ethyl]-, (R)
P046	122-09-8	Benzeneethanamine,alpha,alpha-dimethyl-
P014	108-98-5	Benzenethiol
P127	1563-66-2	7-Benzofuranol, 2,3-dihydro-2,2-dimethy-, methylcarbamate.
P188	57-64-7	Benzoic acid, 2-hydroxy-, compd. with (3aS-cis)-1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethylpyrrolo[2,3-b]indol-5-yl methylcarbamate ester (1:1).
P001	81-81-2	2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1- phenylbutyl)-, & salts, when present at concentrations greater than 0.3%
P028	100-44-7	Benzyl chloride
P015	7440-41-7	Beryllium powder
P017	598-31-2	Bromoacetone
P018	357-57-3	Brucine
P045	39196-18-4	2-Butanone, 3,3-dimethyl-1-(methylthio)-, O-[methylamino)carbonyl] oxime
P021	592-01-8	Calcium cyanide
P021	592-01-8	Calcium cyanide Ca(CN)2
P022	75-15-0	Carbon disulfide
P189	55285-14-8	Carbamic acid, [(dibutylamino)-thio]methyl-, 2,3-dihydro-2,2-dimethyl- 7-benzofuranyl ester
P191	644-64-4	Carbamic acid, dimethyl-, 1-[(dimethyl-amino)carbonyl]- 5-methyl-1H- pyrazol-3-yl ester.
P192	119-38-0	Carbamic acid, dimethyl-, 3-methyl-1- (1-methylethyl)- 1H- pyrazol-5-yl ester.
P190	1129-41-5	Carbamic acid, methyl-,3-methylphenyl ester.
P127	1563-66-2	Carbofuran.
P095	75-44-5	Carbonic dichloride
P189	55285-14-8	Carbosulfan.
P023	107-20-0	Chloroacetaldehyde
P024	106-47-8	p-Chloroaniline
P026	5344-82-1	1-(o-Chlorophenyl)thiourea
P027	542-76-7	3-Chloropropionitrile

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P029	544-92-3	Copper cyanide
P029	544-92-3	Copper cyanide Cu(CN)
P202	64-00-6	m-Cumenyl methylcarbamate
P030		Cyanides (soluble cyanidesalts), not otherwise specified
P031	460-19-5	Cyanogen
P033	506-77-4	Cyanogen chloride
P033	506-77-4	Cyanogen chloride(CN)Cl
P034	131-89-5	2-Cyclohexyl-4,6-dinitrophenol
P016	542-88-1	Dichloromethyl ether
P036	696-28-6	Dichlorophenylarsine
P037	60-57-1	Dieldrin
P038	692-42-2	Diethylarsine
P041	311-45-5	Diethyl-p-nitrophenylphosphate
P040	297-97-2	O,O-Diethyl O-pyrazinyl phosphorothioate
P043	55-91-4	Diisopropylfluorophosphate(DFP)
P004	309-00-2	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a,-hexahydro- (1alpha,4alpha,4abeta,5alpha,8alpha,8abeta)
P060	465-73-6	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-, (1alpha,4alpha,4abeta,5beta,8beta,8abeta)
P037	60-57-1	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro- (1aalpha,2beta,2aalpha,3beta,6beta,6aalpha,7beta, 7aalpha)
P051	72-20-8	2,7:3,6-Dimethanonaphth [2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta,2abeta,3alpha,6alpha,6abeta,7beta,7aalpha)-, &metabolites
P044	60-51-5	Dimethoate
P046	122-09-8	alpha,alpha-Dimethylphenethylamine
P191	644-64-4	Dimetilan
P047	1534-52-1	4,6-Dinitro-o-cresol,&salts
P048	51-28-5	2,4-Dinitrophenol
P020	88-85-7	Dinoseb
P085	152-16-9	Diphosphoramide,octamethyl-
P111	107-49-3	Diphosphoric acid, tetraethyl ester
P039	298-04-4	Disulfoton
P049	541-53-7	Dithiobiuret
P185	26419-73-8	1,3-Dithiolane-2-carboxaldehyde, 2,4-dimethyl- -[(methylamino)- oxime.
P050	115-29-7	Endosulfan
P088	145-73-3	Endothall
P051	72-20-8	Endrin
P051	72-20-8	Endrin,& metabolites
P042	51-43-4	Epinephrine
P031	460-19-5	Ethanedinitrile
P194	23135-22-0	Ethanimidothioc acid,2-(dimethylamino)-N- [[(methylamino)-carbonyl]oxy]-2-oxo-,methyl ester
P066	16752-77-5	Ethanimidothioic acid,N-[[(methylamino)carbonyl]oxy]-, methyl ester
P101	107-12-0	Ethylcyanide
P054	151-56-4	Ethyleneimine
P097	52-85-7	Famphur
P056	7782-41-4	Fluorine
P057	640-19-7	Fluoroacetamide
P058	62-74-8	Fluoroacetic acid, sodium salt
P198	23422-53- 9	Formetanate hydrochloride
P197	17702-57-7	Formparanate
P065	628-86-4	Fulminic acid, mercury(2+) salt(R,T)
P059	76-44-8	Heptachlor
P062	757-58-4	Hexaethyltetraphosphate
P116	79-19-6	Hydrazinecarbothioamide
P068	60-34-4	Hydrazine, methyl-
P063	74-90-8	Hydrocyanic acid
P063	74-90-8	Hydrogen cyanide
P096	7803-51-2	Hydrogenphosphide
P060	465-73-6	Isodrin
P192	119-38-0	Isolan
P202	64-00-6	3-Isopropylphenyl N-methylcarbamate
P007	2763-96-4	3(2H)-Isoxazolone, 5-(aminomethyl)-
P196	15339-36-3	Manganese,bis(dimethylcarbamodithioato-S,S')-,
P196	15339-36-3	Manganese dimethyldithiocarbamate
P092	2-38-4	Mercury, (acetato-O)phenyl-
P065	628-86-4	Mercury fulminate (R,T)
P082	62-75-9	Methanamine,N-methyl-N-nitroso-
P064	624-83-9	Methane, isocyanato-
P016	542-88-1	Methane, oxybis[chloro-
P112	509-14-8	Methane,tetranitro- (R)
P118	75-70-7	Methanethiol, trichloro-
P198	15339-36-3	Methanimidamide,N,N-dimethyl-N'-[3-[[(methylamino)- carbonyl]oxy]phenyl]-, monohydrochloride.
P197	17702-57-7	Methanimidamide,N,N-dimethyl-N'-2-methyl-4- [[(methylamino)carbonyl]oxy]phenyl]-
P050	115-29-7	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide
P059	76-44-8	4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro- 3a,4,7,7a-tetrahydro-
P199	2032-65-7	Methiocarb
P066	16752-77-5	Methomyl
P068	60-34-4	Methyl hydrazine

P064	624-83-9	Methyl isocyanate
P069	75-86-52	2-Methyllactonitrile
P071	298-00-0	Methyl parathion
P190	1129-41-5	Metolcarb
P128	315-18-4	Mexacarbate
P072	86-88-4	alpha-Naphthylthiourea
P073	13463-39-3	Nickel carbonyl
P073	13463-39-3	Nickel carbonyl Ni(CO)4, (T-4)-
P074	557-19-7	Nickel cyanide
P074	557-19-7	Nickel cyanide Ni(CN)2
P075	154-11-5	Nicotine, & salts
P076	10102-43-9	Nitric oxide
P077	100-01-6	p-Nitroaniline
P078	10102-44-0	Nitrogen dioxide
P076	10102-43-9	Nitrogen oxide NO
P078	10102-44-0	Nitrogen oxide NO2
P081	55-63-0	Nitroglycerine(R)
P082	62-75-9	N-Nitrosodimethylamine
P084	4549-40-0	N-Nitrosomethylvinylamine
P085	152-16-9	Octamethylpyrophosphoramide
P087	20816-12-0	Osmium oxide OsO4, (T-4)-
P087	20816-12-0	Osmium tetroxide
P088	145-73-3	7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylicacid
P194	23135-22-0	Oxamyl
P089	56-38-2	Parathion
P034	131-89-5	Phenol, 2-cyclohexyl-4,6-dinitro-
P128	315-18-4	Phenol,4-(dimethylamino)-3,5-dimethyl-, methylcarbamate (ester).
P199	2032-65-7	Phenol, (3,5-dimethyl-4-(methylthio)- methylcarbamate
P048	51-28-5	Phenol, 2,4-dinitro-
P047	1534-52-1	Phenol, 2-methyl-4,6-dinitro-, & salts
P202	64-00-6	Phenol, 3-(1-methylethyl)-, methyl carbamate
P201	2631-37-0	Phenol, 3-methyl-5-(1-methylethyl)-, methylcarbamate.
P020	88-85-7	Phenol, 2-(1-methylpropyl)-4,6-dinitro-
P009	131-74-8	Phenol, 2,4,6-trinitro-, ammonium salt (R)
P092	62-38-4	Phenylmercury acetate
P093	103-85-5	Phenylthiourea
P094	298-02-2	Phorate
P095	75-44-5	Phosgene
P096	7803-51-2	Phosphine
P041	311-45-5	Phosphoric acid, diethyl 4-nitrophenyl ester
P039	298-04-4	Phosphorodithioic acid, O,O-diethyl S-[2- (ethylthio)ethyl]ester
P094	298-02-2	Phosphorodithioic acid, O,O-diethyl S- [(ethylthio)methyl] ester
P044	60-51-5	Phosphorodithioic acid,O,O-dimethyl S-[2-(methylamino)- 2-oxoethyl] ester
P043	55-91-4	Phosphorofluoridic acid, bis(1-methylethyl)ester
P089	56-38-2	Phosphorothioic acid, O,O-diethyl O-(4-nitrophenyl) ester
P040	297-97-2	Phosphorothioic acid,O,O-diethyl O-pyrazinyl ester
P097	52-85-7	Phosphorothioic acid, O-[4- [(dimethylamino)sulfonyl]phenyl] O,O-dimethyl ester
P071	298-00-0	Phosphorothioic acid, O,O,-dimethyl O-(4-nitrophenyl)ester
P204	57-47-6	Physostigmine.
P188	57-64-7	Physostigmine salicylate.
P110	78-00-2	Plumbane, tetraethyl-
P098	151-50-8	Potassium cyanide
P098	151-50-8	Potassium cyanide K(CN)
P099	506-61-6	Potassium silver cyanide
P201	2631-37-0	Promecarb
P203	1646-88-4	Propanal, 2-methyl-2-(methyl-sulfonyl)-, O- [(methylamino)carbonyl] oxime.
P070	116-06-3	Propanal, 2-methyl-2-(methylthio)-, O- [(methylamino)carbonyl]oxime
P101	107-12-0	Propanenitrile
P027	542-76-7	Propanenitrile 3-chloro-
P069	75-86-5	Propanenitrile, 2-hydroxy-2-methyl-
P081	55-63-0	1,2,3-Propanetriol, trinitrate (R)
P017	598-31-2	2-Propanone, 1-bromo-
P102	107-19-7	Propargylalcohol
P003	107-02-8	2-Propenal
P005	107-18-6	2-Propen-1-ol
P067	75-55-8	1,2-Propylenimine
P102	107-19-7	2-Propyn-1-ol
P008	504-24-5	4-Pyridinamine
P075	154-11-5	Pyridine,3-(1-methyl-2-pyrrolidinyl)-, (S)-, & salts
P204	57-47-6	Pyrrolo[2,3-b]indol-5-ol, 1,2,3,3a,8,8a-hexahydro- 1,3a,8-trimethyl-, methylcarbamate (ester), (3aS-cis)-.
P114	12039-52-0	Selenious acid, dithallium(1+)salt
P103	630-10-4	Selenourea
P104	506-64-9	Silver cyanide

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P104	506-64-9	Silver cyanide Ag(CN)
P105	26628-22-8	Sodiumazide
P106	143-33-9	Sodium cyanide
P106	143-33-9	Sodium cyanide Na(CN)
P108	157-24-9	Strychnidin-10-one, &salts
P018	357-57-3	Strychnidin-10-one, 2,3-dimethoxy-
P108	157-24-9	Strychnine, & salts
P115	7446-18-6	Sulfuric acid,dithallium(1+) salt
P109	3689-24-5	Tetraethyldithiopyrophosphate
P110	78-00-2	Tetraethyl lead
P111	107-49-3	Tetraethyl pyrophosphate
P112	509-14-8	Tetranitromethane (R)
P062	757-58-4	Tetraphosphoric acid, hexaethylester
P113	1314-32-5	Thallic oxide
P113	1314-32-5	Thallium oxide Tl2O3
P114	12039-52-0	Thallium(I) selenite
P115	7446-18-6	Thallium(I) sulfate
P109	3689-24-5	Thiodiphosphoric acid, tetraethyl ester
P045	39196-18-4	Thiofanox
P049	541-53-7	Thioimidodicarbonic diamide [(H2N)C(S)]2NH
P014	108-98-5	Thiophenol
P116	79-19-6	Thiosemicarbazide
P026	5344-82-1	Thiourea,(2-chlorophenyl)-
P072	86-88-4	Thiourea, 1-naphthalenyl-
P093	103-85-5	Thiourea, phenyl-
P185	26419-73-8	Tirpate.
P123	8001-35-2	Toxaphene
P118	75-70-7	Trichloromethanethiol
P119	7803-55-6	Vanadic acid, ammonium salt
P120	1314-62-1	Vanadium oxide V2O5
P120	1314-6-1	Vanadium pentoxide
P084	4549-40-0	Vinylamine, N-methyl-N-nitroso-
P001	181-81-2	Warfarin, & salts, when present at concentrations greater than 0.3%
P205	137-30-4	Zinc, bis(dimethylcarbamodithioato-S,S')-,
P121	557-21-1	Zinc cyanide
P121	557-21-1	Zinc cyanide Zn(CN)2
P122	1314-84-7	Zinc phosphide Zn3P2, when present at concentrations greater than 10% (R,T)
P205	137-30-4	Ziram.

F-Code Waste

F-code wastes are solid wastes listed from non-specific sources. In general, these wastes are those that EPA has determined to be hazardous, but are not generated by a particular industry or manufacturing process. The following F-code wastes are generated at the University.

F001 The following spent halogenated solvents used in degreasing: tetrachloroethylene, trichloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and chlorinated fluorocarbons; all spent solvent mixtures/blends used in degreasing containing, before use, a total of ten percent or more (by volume) of one or more of the above halogenated solvents or those solvents listed in F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

F002 The following spent halogenated solvents: tetrachloroethylene, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, chlorobenzene, 1,1,2-trichloro-1,2,2- trifluoroethane, ortho-dichlorobenzene, trichlorofluoromethane, and 1,1,2-trichloroethane; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above halogenated solvents or those listed in F001, F004, or F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

F003 The following spent non-halogenated solvents: xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexanone, and methanol; all spent solvent mixtures/blends containing, before use, only the above spent
nonhalogenated solvents; and all spent solvent mixtures/blends containing, before use one or more of the above non-halogenated solvents, and, a total of ten percent or more (by volume) of one or more of those solvents listed in F001, F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

F004 The following spent non-halogenated solvents: cresols and cresylic acid, and nitrobenzene; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002 and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

F005 The following spent non-halogenated solvents: toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol, and

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2-nitropropane; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, or F004; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

F020 **ACUTE** Wastes (except wastewater and spent carbon from hydrogen chloride purification)from the production or manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tri- or tetrachlorophenol, or of intermediates used to produce their pesticide derivatives. (This listing does not include wastes from the production of Hexachlorophene from highly purified 2,4,5-trichlorophenol.)

F021 **ACUTE** Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production or manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of pentachlorophenol, or of intermediates used to produce its derivatives.

F022 **ACUTE** Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tetra-, penta-, or hexachlorobenzenes under alkaline conditions.

F027 **ACUTE** Discarded unused formulations containing tri-, tetra-, or pentachlorophenol or discarded unused formulations containing compounds derived from these chlorophenols. (This listing does not include formulations containing Hexachlorophene synthesized from pre-purified 2,4,5-trichlorophenol as the sole component.).

K-Code Waste

K-code wastes are solid wastes listed from specific sources involving commercial industry. Because they are industry specific and not generated at the University, only a few examples are provided.

Table 1-2 Typical Specific K-Code Waste Streams	
Waste Code	**Process**
K047	**Pink/red water from TNT operations.**
K104	**Combined wastewater streams generated from nitrobenzene/aniline production.**
K105	**Separated aqueous stream from the reactor product washing step in the production of chlorobenzenes.**
K132	**Spent absorbent and wastewater separator solids from the production of methyl bromide.**

Non-Hazardous Waste

You may safely dispose of many solid chemicals in the normal trash if the containers are tightly capped and of good integrity. These chemicals were selected because they:

- have oral-rat LD50 toxicity values higher than 500 mg/kg
- have no positive determination for carcinogenicity according to the SDS

Although a material is non-hazardous and can be disposed of in the following manner, you should first decide if the substance may be of value to someone else. Recycling saves the University thousands of dollars per year on new product acquisition. Along with your knowledge of the materials, EHS can help to determine if these items are suitable for recycling. Simply submit your pick up request in CHEMATIX™ via the link "Recyclable Materials". If you intend to dispose of more than five pounds of any one of these chemicals, give us a call for further evaluation.

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As a rule, persons who generate chemical wastes should not pour them down the sink or put them in the regular trash unless they have **determined** that the wastes are non-hazardous to humans or the environment. University personnel should consult Safety Data Sheets (SDSs), the manufacturer's container labels, reference manuals, the List of Chemicals Considered Nonhazardous for Disposal or call us for guidance on how to dispose of these materials. Only non-hazardous solids should be disposed of in the regular trash. Non-hazardous free liquids that are water soluble may be disposed of down the sink. Free liquids that are not water soluble and materials with strong or unpleasant odors should be managed as a regulated waste. For any container of non-hazardous material disposed of via normal trash, deface the label beforehand. The List of Chemicals Considered Nonhazardous for Disposal (aka, the “non-haz list”) shows materials suitable for sink or trash disposal in quantities less than a quart or 2 pounds.

Generator Classifications

The generator status for the University is determined by the amount of hazardous waste accumulated at the EHSF in a calendar month. All of the waste generated and collected from the various departments on campus is individually weighed and tallied as it is received. The EPA has developed four classifications for facilities that manage hazardous waste.

Very Small Quantity Generators (VSQG)

All of AU's outlying research and education units are classified as VSQGs. These include Alabama Agricultural Experiment Stations (AAES), EW Shell Fisheries, the National Center for Asphalt Technology (NCAT) and several other sites. A VSQG can generate no more than 220 lbs (100 kg) of hazardous waste and less than 2.2 lbs (1 kg) of acute hazardous waste per month. A VSQG is exempt from many hazardous waste management regulations provided that it complies with three basic waste management requirements that apply to generators of larger quantities (SQGs and LQGs). To remain a VSQG, the facility must:

- Correctly identify and properly mark all hazardous waste generated;
- Never store more than 2,200 pounds (1,000 kg) of waste on site;
- Never generate more than 219 pounds (1,000 kg) of waste in a calendar month. Accumulation logs at VSQGs must be provided to EHS via its Environmental Management System's (EMS) Sharepoint site in order to prove compliance. VSQGs responsible for reporting to EHS receive monthly email notifications asking generators to update their hazardous waste and used oil accumulation.

In addition, a VSQG must ensure proper treatment and disposal of its waste at a facility that is approved by the state to accept hazardous waste. The Generator Improvements Rule ow allows hazardous waste and used oil to be accepted by EHS at its facility on the main campus. EHS is responsible for assisting the University's VSQGs.

If a VSQG exceeds the above generation or storage limits above, it automatically becomes a Small Quantity Generator (SQG) of hazardous waste.

Therefore, all VSQGs are required to submit monthly accumulation logs to EHS via its EMS Sharepoint site.

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Small Quantity Generators (SQG)

A facility is considered a SQG if it generates between 220 and 2,200 lbs (100 and 1,000 kg) per month of hazardous waste and less than 2.2 lbs (1 kg) of acute hazardous waste per month. In addition to the requirements listed above a SQG must:

- Acquire an EPA Identification Number;
- Follow EPA requirements for equipment testing and maintenance, access to communications or alarms, aisle space, and emergency arrangements with local authorities;
- Never accumulate more than 13,228 lbs (6,000 kg) of wastes at the facility;
- Follow the storage and handling procedures required by EPA for SQGs;
- Package, label, and mark its shipment, and placard the vehicle in which waste is shipped as specified by Department of Transportation regulations;
- Prepare a hazardous waste manifest to accompany the shipment;
- Include a notice and certification with each waste shipment on the proper treatment method; and
- Ensure the proper management of any hazardous waste shipped (even when it is no longer at the facility).

Large Quantity Generators (LQG)

At the present time, AU is classified as a LQG because it generates more than 2,200 lbs (1,000 kg) per month of hazardous waste or more than 2.2 lbs (1 kg) of acute hazardous waste per month. LQGs must comply with more extensive hazardous waste rules. In addition to the requirements listed above for VSQGs and SQGs, a LQG must:

- Prepare a written contingency plan and train employees about hazardous waste management and emergency response;
- Include in the contingency plan a quick reference guide identifying all SAA locations on campus for the purpose of emergency response and distributed to local emergency responders like police departments, fire departments, hospitals and State or local response teams;
- Submit Annual and Biennial Reports to their EPA Regional Office (ADEM). Reports submitted for off-site shipping include their EPA identification number, information on the transporter and permitted facility, details about any waste received from VSQGs, a description and quantity of waste, actions they have taken to reduce the volume and toxicity of the waste, and the results of those actions;
- Comply with Land Disposal Restrictions; and
- Comply with other requirements concerning the generation, storage and disposal of regulated waste.

Treatment Storage and Disposal Facilities (TSDF)

Hazardous waste management facilities receive hazardous wastes for treatment, storage, or disposal. These facilities are often referred to as treatment, storage, and disposal facilities, or TSDFs.

- Treatment facilities use various processes (such as incineration or oxidation) to alter the character or composition of hazardous wastes. Some treatment processes enable waste to be recovered and reused in manufacturing settings, while other treatment processes dramatically reduce the amount of hazardous waste.
- Storage facilities temporarily hold hazardous wastes until they are treated or disposed. The University is currently classified as such a storage facility.
- Disposal facilities permanently contain hazardous wastes. The most common type of disposal facility is a landfill, where treated hazardous wastes are stored in carefully constructed units designed to protect groundwater and surface-water resources.

Table 1-3 Hazardous Waste Generator Classifications

	Time you can Accumulate Waste	Amount of Waste Generated per On-Site	Paperwork Requirements Month
Very Small Quantity Generator	365 days	<100 kg and/or 1 kg P-Code	Minimum
Small Quantity Generator	180 days	>100 kg and <1000 kg and/or 1 kg P-Code	Moderate
Large Quantity Generator	90 days	>1000 kg and/or 1 kg P-Code	Extensive
Treatment, Storage and Disposal Facility	Indefinite	Written in Permit	Maximum

Auburn University is in a non-permit status and operates as a large quantity generator. This means we are required to dispose of hazardous waste at least every ninety days. The ninety day "clock" begins once the material is received by our personnel and is processed at the Hazardous Materials Storage Facility (HMSF).

It is possible for the University's generation status to fluctuate between small quantity and large quantity generator from month to month. Our goal is to operate as a small quantity generator every month because of the many advantages. The main advantage is that the University can store waste longer than ninety days, thus reducing disposal costs. The generation of more than one kilogram or 2.2 pounds of a P-code waste in a given month, campus wide, is enough to change the generator status. Until we reach this goal, it is very

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important that you purchase the smallest amount of these materials that your research requires. *See P-Code list on pages 13-16*.

All persons in a supervisory or management position are responsible for proper handling and management of waste in their areas and for ensuring that University guidelines for hazardous wastes are followed. At a minimum, persons generating waste must be able to determine whether their waste is a solid waste or a regulated waste. In addition, many laboratory chemicals not specifically regulated by the EPA can exhibit hazardous properties. These solid wastes are generally shipped off-site to a secure landfill if they are not recycled on campus. Supervisors and management personnel are responsible for ensuring that those persons in their respective areas who handle hazardous waste have read and understand this document.

Ultimately, it is the individual using chemicals who is responsible for following the guidelines contained in this manual. When we receive your hazardous chemical waste, we first decide whether the material is indeed a hazardous waste and whether it is recyclable. If it is a waste, we determine the degree of hazard and the appropriate disposal route. Throughout this process, the University is required to keep records that account for hazardous wastes "from cradle to grave." To reduce disposal costs to the University, we often bulk your waste with that from other departments in 55 gallon drums. The contractor will take our waste and commingle it with another client's compatible waste at their facility. **Therefore, it is extremely important to provide accurate information when submitting waste for disposal to prevent injury to those involved in handling your waste from "cradle to grave".** With your professional cooperation, knowledge, and responsible actions, Auburn University can continue to safely and responsibly manage its hazardous waste. If you have any comments or questions concerning these chemical waste handling procedures, please give us a call.

Remember: Failure to comply with federal and state environmental regulations could lead to civil and possibly criminal penalties against the University and the individual responsible for generating the waste.

Hazardous Waste Satellite Accumulation Areas

Auburn University is inspected annually by state and federal agencies for compliance with hazardous waste regulations. When government officials inspect the Campus for compliance, they examine laboratories and other locations where waste chemicals are generated. Failure to meet hazardous waste accumulation

HAZARDOUS WASTE SATELLITE ACCUMULATION AREA

SAA must be AT OR NEAR THE POINT OF GENERATION and UNDER THE CONTROL OF THE GENERATOR.

All containers must be compatible with the waste stored in them. All waste must be compatible with the other wastes in the container.

CLEAN - Keep the outside of each container clean and uncontaminated. **No drips, smudges, etc.**

CLOSED - Containers must be capped with **tight-fitting, screw-on caps** except when being filled. **Do not leave funnels in containers.** No cracked or leaking containers. **LEAVE ADEQUATE HEAD SPACE.**

LABELED - Label each container with **CHEMATIX Waste Card** and/or the words **"HAZARDOUS WASTE" AND INDICATE** the hazards:

Flammable Corrosive Toxic Reactive

Label containers with "HAZARDOUS WASTE CONTAINER LABEL" while in SAA. When ready, affix completed CHEMATIX Waste Card and submit request for pick up.

LIMIT the entire SAA waste volume to less than **55 GALLONS** or **1 KG/QT of "P-LISTED" waste** at any one time.

SEGREGATE containers of incompatible waste to prevent reactions.

NO BIOHAZARDOUS OR RADIOACTIVE WASTE may be mixed with or stored in the same locations as Hazardous Waste.

Chemical Spill – Simple (1 gallon or less)
1. Wear appropriate PPE.
2. Decontaminate.
3. Dispose of cleanup as Hazardous Waste.

Chemical Spill – Complex (>1 gal)
1. Evacuate & isolate area.
2. Call 911.

Fire, Explosion or Spill threatening life or health
1. Pull Fire Alarm.
2. Evacuate.
3. Call 911.

KNOW LOCATION OF YOUR FIRE ALARM, FIRE EXTINGUISHER, SPILL KIT, EMERGENCY SHOWER & EMERGENCY EXITS.

AFTER HOURS EMERGENCIES: CALL 911

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area regulations can lead to a Notice of Violation (NOV) and possible fines from these agencies. These are violations caused by improper laboratory procedures.

Each laboratory generating hazardous waste on campus is considered a Hazardous Waste Satellite Accumulation Area (SAA). This is the point of generation for hazardous waste. Accumulated hazardous waste must be under the control of those who generate the material. "Control" includes, but is not limited to, keeping containers closed, and visual observation by the operator or the provision of appropriate security measures such as a locking mechanism wherever possible. Hazardous waste awaiting pickup must be stored in the immediate vicinity where it was generated. **Hazardous waste may not be moved to a different room or work area for storage.**

As long as the generator keeps no more than 15 gallons of waste (10 gallons of waste flammable liquids) or one quart of acutely hazardous waste (see EPA P-Codes) in the area where satellite waste is being *accumulated*, it will remain a SAA. While the EPA allows for up to 55 gallons of waste storage in an accumulation area the University has set a lower threshold for two reasons:

(1) A 55 gallon drum of water weighs approximately 459 pounds which is very close to 1/4 of the entire hazardous waste stream monthly limit for a small quantity generator. Last minute and end-of-the-month generation of large amounts of waste play havoc with our ability to schedule waste disposal and minimize total cost to the University.

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(2) Except for laboratory cleanouts there is no good reason to have more than 15 gallons of waste in the laboratory. The risk of accident is greater, floor and storage space is reduced, and creative measures in waste minimization are reduced when one accumulates a large amount of a specific waste for disposal. The National Fire Code also prohibits the unprotected storage of more than 10 gallons of flammable liquids. Flammable liquids constitute a substantial portion of the University's waste stream.

If waste containers exceed 15 gallons, use CHEMATIX™ to properly request a waste pick up or notify EHS for a pickup immediately.

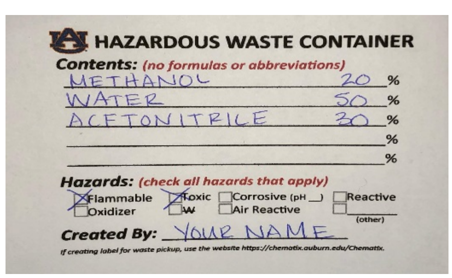
The following nine steps will help ensure that your location is in compliance with accumulation area regulations. The first four steps are extremely important and are addressed by the Alabama Department of Environmental Management (ADEM) whenever that office inspects our campus. If you keep in mind that an inspector's task is to identify non-compliance, which triggers notices of violations and often criminal and/or civil penalties, then it should be easy to maintain regulatory compliance at all times.

1. IDENTIFY the waste container contents accurately. Each constituent in each waste container must be marked legibly on the container and the percentage of the constituents inside quantified.

2. CLEAN the outside of each waste container. Use containers free of leaks, cracks or chemical residue. Leave adequate headspace for the contents inside the container. Use only content compatible containers.

3. CLOSE each container stored in the SAA. All chemical waste containers must be closed except when actually being used for the addition or removal of wastes. You must demonstrate that the container will not leak if tipped over in the secondary containment. Avoid using temporary closures such as parafilm or aluminum foil. The most common regulatory violations found are funnels left in containers and waste containers left open in fume hoods.

4. LABEL all containers. While waste is being accumulated within the SAA, hazardous waste containers **MUST** be clearly and legibly marked with the exact words **"HAZARDOUS WASTE"** and an indication of the hazard(s) within. To aid each generator of hazardous waste, RMS provides labels with the words **"HAZARDOUS WASTE"** on them and indications of hazards within. You may download these labels from the RMS web site. However, you **MUST** manually check the appropriate box indicating the hazard.



For **EACH** waste container to be collected and be disposed of by this office, you must complete a CHEMATIX™ Waste Card and submit a waste pick up request worksheet. Labeling all chemical containers is required under state and federal regulations and obviously good laboratory practice. Remember, **ALL** hazardous waste containers must have the words **"HAZARDOUS WASTE"** in the descriptive label AND the indication(s) of the hazards within. Like the Hazardous Waste Container label, the CHEMATIX™ Waste Card satisfies this regulatory requirement. General labels such as "Waste", "Organic Waste", and "Toxic Waste" are NOT acceptable. **See Chapter 5 regarding "Unknowns."**

5. Store chemical waste in designated Satellite Accumulation Area (SAA). All chemical waste containers must be stored in your laboratory's designated SAA. A standardized SAA sign, provided by this office, must be posted in this area. This will allow for easy inspection by regulatory authorities and clearly separates waste materials from products in use. It also helps EHS personnel to locate the waste when a pickup request is received.

6. Avoid excessive accumulations of waste. Do not let excessive amounts of chemical waste accumulate at your SAA location. EHS personnel will pick up any amount of waste upon request. Less waste in your laboratory means safer working conditions for you. If you must accumulate a large amount of chemical waste, notify EHS and assist us in arranging a suitable schedule for removal.

7. Inspect your area. Generators must inspect their accumulation areas at least monthly but preferably weekly or whenever you use the SAA for storing your waste to make certain that waste containers are clean, closed, properly labeled, segregated, and not leaking.

8. Post a copy of the Chemical Waste Management Guide. Notify all personnel of the location of the Chemical Waste Management Guide and CHEMATIX™ Waste Guide. **Hazardous waste must never be moved to a different room or work area for storage.**

9. Good housekeeping. Good housekeeping is the most important thing you can do to improve safety and minimize wastes. It also makes a good impression on inspectors. Do not store or leave chemicals, empty containers or cylinders in the hallways. Clean up all chemical spills immediately or call us for assistance.

SAAs are inspected by RMS to ensure compliance with basic safety and environmental regulations. Laboratories which request a chemical pickup and are not on an inspection list are added for future inspections. Inspections are conducted in a manner similar to those conducted by the regulatory agencies. A multipart checklist is used and the person(s) in the laboratory at the time of inspection are asked questions. Upon completion of the inspection,

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any necessary materials needed for laboratory compliance (i.e. labels, guides, etc.) are provided to the person in the laboratory. A subsequent written report is issued to the PI of the laboratory. The majority of deficiencies can be handled at the time of inspection within a few minutes. The requirements may seem trivial but the regulators view a one gallon waste container in the laboratory SAA in much the same way as a 10,000 gallon tank at an industrial site. An open container of waste is an open container of waste and it is in violation of 40 CFR 173 Subpart A . Laboratories with deficiencies are usually re-inspected within 30 days of the initial audit. For uncorrected items found during follow-up inspections, a Notice of Deficiency report is sent to the Department Head, with a copy to the Principal Investigator, noting the continuing deficiencies. If requested, these inspection forms are available for state and federal agencies to review.

RMS is only responsible for aiding in laboratory compliance. Ultimately, each laboratory is responsible for its own compliance. Laboratory personnel should take time during inspections to ask questions. It is also an opportune time to request compliance materials (i.e., SAA signs, guidance documents, etc.)

Containers

Materials that are to be discarded as hazardous waste should be placed in containers of one gallon or less with adequate closures. **Corks, stoppers or parafilm are NOT acceptable adequate closures.** Use of containers larger than 5 gallons must be pre-approved by this office. EPA requires containers larger than 26 gallons and which are used to store hazardous waste to comply with 40 CFR Subpart CC Air Emission Standards for Containers. Containers greater than 5 gallons may be approved by the Department of Transportation (DOT) for a commercial product but not for a hazardous waste. Often the original container is acceptable; however, more investigation is warranted for each particular waste stream. Contact EHS for a consultation.

Containers must be kept closed when not actually pouring waste into or out of the container. **Do not leave funnels in containers.** The only exception to this rule is for "process wastes", such as HPLC, which run and add waste to the properly labeled container continuously. However, when the process is not running---i.e., at the end of the day---the top must be on the properly labeled container. Please do not embarrass yourself by forgetting to close each waste container.

Container Requirements

IDENTIFY – CLEAN – CLOSE - LABEL

- All containers must be compatible with the specific chemical waste stored in them.
- Keep the outside of container clean and uncontaminated.
- All waste chemical containers must be capped with a tight-fitting, screw-on cap. Corks and stoppers are unacceptable. Please take extra care when matching glass

bottles and screw-on caps. There are many similar designs which are not interchangeable.

- Containers that are improperly sealed, cracked or leaking can not be collected.
- Containers must be kept closed except when being filled.
- Containers must be properly labeled.
- Do not overfill containers. Leave 2 inches of headspace in all containers greater than 1 quart holding liquid waste. Overfilled containers can not be accepted.

Labeling

NOTE: Refer to the CHEMATIX™ Waste Management Guide.

Like the Hazardous Waste Container labels, CHEMATIX™ Waste Cards have been specially designed to ensure that the University complies with the container labeling regulations established by existing regulations. Only materials with these Waste Cards can be accepted for disposal. The Waste Card should be used with all chemical wastes, *including those for recycling*. This includes off-specification reagents, spent solvents and commingled waste. For recyclables, Waste Cards are to be placed on chemicals that are good quality, in original containers and have the original manufacturer's label, which could be used by someone else on-campus.

Containers cannot be picked up until a completed Waste Card is attached and a Waste Pick Up Worksheet is submitted online.

Why Label Waste?

- It ensures safety.
- It prevents waste from being identified as "unknown".
- It meets or exceeds regulatory compliance.
- EHS will not pick up waste that is not properly labeled.

Completing CHEMATIX™ Waste Card Information

The Waste Card must be completed in full.

1. Log into CHEMATIX™.
2. Choose "Waste" from the orange banner.
3. Click on "Create Waste Card".
4. Scan the "Hot List" of common chemical wastes. If you do not see the name of your waste chemical, scroll down to the bottom of the page and choose from
   a. Chemical Mixture by Percentage

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   a. Pure Chemicals in Individual Containers
   b. Recyclable Materials
   c. Paint and Paint Related Materials
   d. Oil and Antifreeze
   e. Aerosols
   f. Contaminated Materials
   g. Bioactive Material
6. Fill in all appropriate fields.
7. Click on “Generate Waste Card”, print the Waste Card and attach it to your waste container.
8. Click on “Finished”
9. From the main Waste page, click on “Create Pickup Worksheet”.
10. Select the appropriate Waste Card(s) from the list. Make sure a check mark is displayed.
11. Click “Add Selection(s) to Worksheet.
12. Select the Waste Card you wish to submit for pickup and click “Save and Submit for Pickup”.

- When attaching the Waste Card to the container, do so in a way that it can easily be removed by EHS. Scotch tape will suffice.
- Completely deface old labels which do not represent the container’s contents to avoid identity confusion.

Incompatible Materials

The University has experienced incidents which resulted from mixing incompatible materials. Fortunately, injuries to laboratory workers have been minor; however, property damage has been another matter. Fume hoods, specialized containment vessels and laboratory equipment have been damaged due to these explosions. Incompatible chemicals must never be mixed or stored adjacent to one another. Incompatible chemicals (e.g., waste acids and waste organic solvents) when mixed together can produce effects that are harmful to human health and the environment - such as; (1) heat or pressure, (2) fire or explosion, (3) violent reaction, (4) toxic dusts, mists, fumes, or gases, or (5) flammable fumes or gases. You should consult other sources of data to help determine waste compatibility such as Safety Data Sheets (SDS).

Chemical waste segregation has several advantages: the prevention of unwanted or potentially dangerous reactions, the protection of personnel (including EHS) from potentially unsafe working environments, and ease of disposal. Segregation and characterization simplifies the waste stream thus minimizing the cost of disposal.

The Chemical Compatibility Table 2-1 lists chemical combinations known or believed to be dangerously reactive in the case of accidental mixing. The table provides a broad grouping of chemicals with an extensive variety of possible binary combinations.

Generally speaking, an "X" on the table indicates two groups which can be considered dangerously reactive with one another. However, since there may be some combination between the groups that would not be dangerously reactive, the table should not be considered infallible. For letters other than "X", refer to the footnote at the bottom of the chart for detailed information.

The following procedure explains how the table should be used in determining compatible information.

- Determine the reactivity group of a particular waste.
- Find the reactivity group on the top of the chart and then follow down the chart to discover which cargo group forms unsafe combinations with the chemical in question.

For example, crotonaldehyde is an aldehyde in group 19. The table shows that chemicals in this group should be segregated from sulfuric acid, nitric acid, caustics, ammonia and all types of amines (aliphatic, alkanol and aromatic) and amides. According to note A, crotonaldehyde is also incompatible with non-oxidizing mineral acids.

Table 2-1

Chemical Compatibility Table

CARGO GROUPS \ REACTIVE GROUPS	1 NON-OXIDIZING MINERAL ACIDS	2 SULFURIC ACID	3. NITRIC ACID	4. ORGANIC ACIDS	5 CAUSTICS	6 AMMONIA	7. ALIPHATIC AMINES	8 ALKANOLAMINES	9 AROMATIC AMINES	10. AMIDES	11. ORGANIC ANHYDRIDES	12 ISOCYANATES	13. VINYL ACETATE	14. ACRYLATES	15. SUBSTITUTED ALLYLS	16. ALYKENE OXIDES	17. EPICHLOROHYDRIN	18. KETONES	19. ALDEHYDES	20. ALCOHOLS, GLYCOLS	21. PHENOLS, CRESOLS	22 CAPROLACTAM SOLUTION	
1. NON-OXIDIZING MINERAL ACIDS		x			x	x	x	x	x	x	x	x	x			x	x		A	E			1.
2 SULFURIC ACID	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	2
3. NITRIC ACID		X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		3.
4. ORGANIC ACIDS		X			X	X	X	X	C			X				X	X			X			4.
5 CAUSTICS	X	X	X	X							X	X				X	X			F			5
6 AMMONIA	X	X	X	X						X	X	X	X			X	X		X		X		6
7. ALIPHATIC AMINES	X	X	X	X						X	X	X	X	X	X	X	X	X	X	X	X	X	7.
8 ALKANOLAMINES	X	X	X	X							X	X	X	X	X	X	X	B	X				8
9 AROMATIC AMINES	X	X	X	C							X	X							X				9
10. AMIDES	X	X	X			X						X							X				10.
11. ORGANIC ANHYDRIDES	X	X	X			X	X	X	X														11.
12 ISOCYANATES	X	X	X	X	X	X	X	X	X	X					D					X		X	12
13 VINYL ACETATE	X	X	X			X	X	X															13.
14. ACRYLATES		X	X				X	X	X														14.
15. SUBSTITUTED ALLYLS		X	X				X	X				D											15.
16. ALKYLENE OXIDES	X	X	X	X	X	X	X	X															16.
17. EPICHLOROHYDRIN	X	X	X	X	X	X	X	X															17.
18. KETONES		X	X				X	B															18.
19. ALDEHYDES	X	X	X		X	X	X	X	X														19.
20. ALCOHOLS, GLYCOLS	E	X	X	F	X		X					X											20.
21. PHENOLS, CRESOLS		X	X		X		X			X													21.
22 CAPROLACTAM SOLUTION		X			X		X					X											22
30. OLEFINS		X	X																				30.
31. PARAFFINS																							31.
32 AROMATIC HYDROCARBONS			X																				33.
33. MISC. HYDROCARBON MIXTURES			X																				34.
34. ESTERS		X	X																				35.
35. VINYL HALIDES			X																			X	36.
36. HALOGENATED HYDROCARBONS		G			H		I																37.
37. NITRILES		X																					38.
38. CARBON DISULFIDE							X	X															39.
39. SULFOLANE																							40
40. GLYCOL ETHERS		X										X											41
41. ETHERS		X	X																				42
42 NITROCOMPOUNDS					X	X	X	X	X														43.
43. MISC. WATER SOLUTIONS		X										X											43.
	1	2	3.	4.	5	6	7.	8	9	10.	11.	12	13.	14.	15.	16.	17.	18.	19.	20.	21.	22	

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Reactivity Differences (Deviations) Within Chemical Groups

A. Formaldehyde (19), Acrolein (19), Crotonaldehyde (19) and 2-Ethyl-3 Propyl Acrolein (19) are not compatible with group 1, Non-Oxidizing Mineral Acids.
B. Isophorone (18) and Mesityl Oxide (18) are not compatible with group 8, Alkanolamines.
C. Acrylic Acid (4) is not compatible with group 9, Aromatic Amines.
D. Allyl Alcohol (15) is not compatible with group 12, Isocyanates.
E. Furfuryl Alcohol (20) is not compatible with group 1, On-Oxidizing Mineral Acids.
F. Furfuryl Alcohol (20) is not compatible with group 4, Organic Acids.
G. Dichloroethyl Ether (36) is not compatible with group 2, Sulfuric Acid.
H. Trichloroethylene (36) is not compatible with group 5, Caustics.
I. Ethylenediamine (7) is not compatible with Ethylene Di-Chloride.

Waste Collection

Risk Management & Safety is a centrally funded unit. Auburn University spends a significant amount of contractual fees per year to properly dispose of hazardous chemical waste (not including radioactive waste). The costs of routine disposal are absorbed by the University rather than being charged to you. This should eliminate any incentive for improper disposal by the generator. However, we do charge departments for the costs associated with disposal of unknown chemicals and peroxide-formers; these are discussed in Chapter 5.

The various waste streams on campus are collected, transported, stored, and disposed of in full compliance with local, state, and federal regulations. These operations are conducted by trained personnel using specialized equipment.

Each waste item collected is provided with a unique number. Wastes are tracked by this number using the CHEMATIX™ databases. This allows us to follow the course of each item through the collection, storage and disposal process. Materials are collected from the various areas on campus and brought to the EHS Facility. Here they are researched, marked, segregated and stored according to their hazard. A reputable waste vendor is contracted to ship these wastes, every ninety days, to one or more RCRA-permitted facilities for proper treatment and disposal.

A CHEMATIX™ Waste Card must be completed for the disposal of every waste stream. Hazardous waste regulations allow for two methods of verifying waste content: chemical analysis and generator knowledge. As it would be extremely cost prohibitive to analyze every container produced at the University, we have the approval of EPA/ADEM to use the generator's knowledge of the waste composition during the waste determination process by EHS. The signature required on the Waste Card demonstrates to regulatory authorities that a responsible person has identified the contents of each container. This signature is only used for the internal transfer of chemicals on campus. When waste must be shipped off-site, an authorized member of Risk Management and Safety will provide the required signature on the Uniform Hazardous Waste Manifest.

In addition to identifying the waste, your signature indicates that you have made a good faith effort to reduce waste generation, substitute less toxic products, provide laboratory destruction on the end product as part of the experimental framework and separate difficult to dispose of products, such as mercury, to the degree possible as part of the University's EPA-mandated hazardous waste reduction program.

Arrange to have waste picked up as soon as it is generated. **EPA regulations prohibit the accumulation of greater than 55 gallons of hazardous waste and/or 2.2 pounds of P-Code waste at any one location. The University has lowered this storage limit to 15 gallons (or 10 gallons of flammable liquid) to comply with fire and life safety codes.** Therefore, adequate time to meet the pickup requirements prior to reaching this quantity must be allowed. Contact RMS before starting any new research project that will generate large quantities of waste. If your lab is off-campus, refer to VSQG information in Chapter 1.

Wastes can not be picked up if any of the following discrepancies are noted:

- Area was locked and no one was present.
- Material was not located in the designated area.
- CHEMATIX™ Waste Card was not complete or signed.
- Container was not otherwise labeled.
- Container was not compatible with contents.
- Container had broken cap or closure was inadequate.
- Container was too full.
- Quantity of containers exceeded pickup request.

Laboratory Cleanouts

It happens all the time. A new researcher arrives on campus and is given laboratory space, which previously was occupied by someone who is no longer here for whatever reason. Or an abandoned laboratory, with hundreds of old chemicals and strange concoctions, has now become valuable. You are asked to get rid of everything and clean it up. You don't know what half the stuff is, what it was used for or how it was generated. What do you do?

Before you do anything, call us for assistance. Then, download the list of non-hazardous chemicals at the EHS web site. We can't do the work for you but we can lessen the load. We will come to the laboratory and assist you in identifying materials which are non-hazardous or recyclable as well as those which can be neutralized - a process which will eliminate the paperwork for these items. You will be required to complete CHEMATIX™ Waste Card for each of the remaining wastes. Be prepared for the project to take up to several weeks if the cleanout is a large one (i.e., over 100 containers).

To minimize the possibility of this scenario becoming reality, do not abandon laboratories containing chemical wastes. Call EHS before leaving, so a mutually convenient schedule can be worked out to properly handle the materials. The following procedures should be

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completed before the responsible individual leaves the University or transfers to a different location on or off campus.

- Ensure that all containers of chemicals are correctly labeled. **All containers must be clean, securely closed, and properly labeled.** Beakers, flasks, evaporating dishes, etc., should be emptied into closeable containers. Hazardous chemical wastes must not be sewered or trashed; they must be collected for disposal.
- Clean your glassware and make sure that proper waste disposal guidelines are followed. **Never pour chemical residues down the sink** unless you consult EHS and verify it is the safe and preferred method of disposal.
- Check refrigerators, freezers, fume hoods (especially the cabinets under the hood - unknown chemicals often live and work under the hood), storage cabinets and bench tops for chemical containers and thoroughly clean these locations.
  - If another room or facility (such as a freezer or refrigerator, stock room, etc.) is shared with other researchers, remove, transfer or dispose of items used by the departing researcher.
  - **For gas cylinders, remove regulators, replace cap and return to supplier**. If cylinders are non-returnable, call us for guidance. Gas cylinders used in a containment area must have the exterior decontaminated prior to return.

Ultimate Disposal of Chemicals

Proper identification of your waste is extremely important when it comes to the ultimate disposal of chemicals. A tremendous amount of time is spent evaluating waste once it is received at the EHS Facility. Care is taken to recycle as much of the material as possible to eliminate off-site disposal costs and liabilities. We rely heavily on your information when we bulk waste. Bulking waste involves taking smaller containers of compatible material from all over campus and commingling it into fifty-five gallon drums. These drums are removed by a contractor who will commingle it with waste from other generators around the country prior to further treatment and disposal. A misidentified substance could cause serious injury to those performing this process. This is one reason why you must make every effort to completely **identify** your waste.

Materials that go off-site for disposal are sent to Treatment, Storage and Disposal facilities (TSDFs) in various states. Flammable liquids are either incinerated or fuel-blended while corrosive materials are neutralized. Oxidizers, poisons, heavy metals and hazardous substances are treated in a specific manner, under the RCRA Land Disposal Restrictions.

Auburn University is still responsible for these materials even after their "disposal." Liability never ends when it comes to hazardous waste.

Introduction

The purpose of this section is to provide information about the correct steps to take when chemicals are spilled or released. Environmental Health & Safety along with local Emergency Response Agencies (i.e., AU Department of Campus Safety & Security (AUDCSS), Auburn Fire Department, and Opelika Haz Mat Response Unit) are the primary entities that respond to releases and accidents involving hazardous materials. **All laboratories should develop and practice their own emergency plans**; these should be readily accessible and include all emergency contact numbers and evacuation procedures. Contact EHS directly for updates of this information.

For general information on managing emergencies at the University, go to the Department of Campus Safety & Security's web page. Materials that are generated as a result of spill cleanup are considered to be hazardous waste if the original material when disposed of would have been a hazardous waste. These materials must be managed as described in Chapter 3.

There are **two general types of spills**:

- **Complicated spills**, which require assistance from outside the laboratory, and

- **Simple spills**, which you can clean up yourself.

Complicated Spills

A spill of any material should be treated as a complicated spill if the result might be fire, explosion or a situation immediately dangerous to life and health. These are considered to be high hazard emergencies. High hazard chemical spills or releases are handled by the University's Hazardous Materials Response Team (HMRT) with assistance by local Emergency Response Agencies. Your call to the City of Auburn Police (911) will summon them. They stock self-contained breathing apparatus and other protective equipment that allows them safe entry into the hazardous area.

Evacuate the immediate area of a complicated spill. At a safe location, call 911 and stay on the line until told to hang up by the police dispatcher. Then, call AUDCSS at 844-8888 to assure that the HMRT is alerted. In larger incidents, evacuate the entire building, either personally or with the assistance of the building authority. All personnel leaving the building or area should gather upwind from the spill at a safe distance away from the spill. Laboratory managers should verify that all persons are accounted for. Those persons involved in the incident should remain in the area outside the involved building to assist the emergency response agencies when needed. Information, such as the chemicals or biohazardous agents involved, will be needed by the various responding agencies. After

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relaying the vital information, laboratory personnel should notify the principal investigator and the department head.

If any emergency involves personal injury or chemical contamination, call 911 from any available phone and ask for an ambulance to be sent to the area. Be sure to state your name, telephone number, your exact location and the type of contaminant on the victim. In cases where corrosive chemical exposure to the eyes or body of an individual occurs, carefully assist the injured person to an eyewash station, deluge shower or combination unit, then call 911. For other chemical exposures, consult the SDS for that chemical and follow the recommendations in the first aid section as you wait for emergency personnel to arrive. A copy of the SDS should be available for the ambulance crew and should accompany the victim to the hospital.

Simple Spills

A simple spill is defined as one that:

- Generally is less than one gallon;
- Does not spread rapidly;
- Does not endanger people or property except by direct contact; and
- Does not endanger the environment.

Only chemical spills that meet **all four** of these criteria can be defined as “simple”. Everything else is a complicated spill. If you have any doubt about whether a spill can be classified as “simple”, contact 911 immediately.

A simple spill can and should be neutralized, absorbed, or otherwise managed by the user of the chemical. Important factors that help you to determine whether you have a simple spill are:

- The amount of chemical spilled
- Which chemical has spilled
- The hazardous characteristics of the chemical
- Where the spill has occurred
- The proper method for cleaning up the spill
- Whether suitable personal protective equipment is readily available

Spill Prevention

Prepare for emergency control of chemical spills. Experience has shown that the accidental release of hazardous substances is sufficiently common to require pre-planning for procedures that will minimize exposure of personnel and property. Personnel protection is of primary importance and cleanup of spills is secondary.

Pre-planning: Consult the SDS.

Pre-planning is the best way to prevent spills or to control them when they do happen. In order to be prepared for an emergency, know the hazards of each compound with which you work. Assess the risks before using any chemical, and have a laboratory emergency plan for all procedures with hazardous materials on file and posted in a conspicuous area for employees and emergency responders. Post emergency phone numbers and home phone numbers of laboratory supervisors, so they are immediately available.

When using a hazardous substance, consider the toxicity, reactivity, corrosivity, and flammability of the compound, the amounts involved, the expected duration of your exposure to the compound, and potential routes of entry for the chemical (i.e., inhalation, ingestion, skin contact).

Listed below are some basic spill prevention steps that apply to storage, transportation and transfer of chemicals.

General precautions

- Reduce clutter and unnecessary materials in your work areas.
- Eliminate tripping hazards and other obstructions.
- Have all needed equipment readily available before starting work.

Storage precautions

- Use sturdy shelves.
- Larger containers should be stored closer to the floor.
- Containers on shelves should be stored away from the edge to reduce the danger of falling.
- Storage shelves should have lips to further reduce the danger of falling.
- Chemicals should be stored by hazard and compatibility class.
- Inspect the storage area regularly for leaking or defective containers.
- Use appropriate storage containers.
- Use engineering controls such as trays, bottle carriers, break- resistant containers in laboratories and stock rooms.

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Transportation precautions

- Use carts, where appropriate.
- Use safety containers, where appropriate.
- Use bottle carriers for 2.5 and 4.0 liter bottles.
- Use straps to secure containers, where appropriate.
- Think about potential hazards before transporting chemicals.
- Consider purchasing plastic coated “shatter resistant” bottles.

Precautions in transferring chemicals

- Pay careful attention to the size of container to avoid overfilling
- Use pumps or other mechanical devices rather than simple pouring
- Provide containment to capture leaks and spills

Spill Response Equipment

Laboratories should keep an inventory of basic chemical spill equipment on hand in each area where hazardous material/waste is used or stored. These materials should be capable of at least stopping the spread of spilled chemicals to drains or other areas. Prior to starting any work with chemicals, make sure that you have all the necessary personal protective devices, safety equipment, and containment/cleanup materials listed in the SDS readily available.

Each individual who may be involved in spill response or cleanup must know the purpose and limitations of each item in the spill kit. You may buy prepackaged spill kits from preferred or other vendors; however, these kits tend to be expensive. Many chemical users prefer to stock their own. The next section lists items that should always be readily available in your laboratory for cleaning up spills.

Spill Kits

Most of the contents of a spill kit are common items which may be dispersed throughout your lab. These should be consolidated and readily available in an emergency. Assign someone to be responsible for inspecting and restocking the contents on a scheduled basis. Post the list of contents and the inspection schedule near or in the kit. Laboratories that use only small amounts of chemicals can use lab towels or paper towels when these are compatible with the spilled material. Other areas, such as chemical store rooms and maintenance shops will require more extensive supplies. The contents of your spill kit need not be limited to this list. For more detailed information regarding spill kits for particular chemicals and/or processes, contact EHS.

Eye protection
Safety glasses are the absolute minimum for working in a laboratory or cleaning up spills of hazardous materials; for corrosive and/or reactive materials, chemical splash goggles or a face shield are also necessary.

Skin protection
All personnel in laboratories should at least be wearing a lab coat. If splashing is a possibility, an apron should be worn as well.

Gloves
Chemical resistant gloves; such as heavy nitrile, butyl, or neoprene gloves and one box of disposable polyethylene gloves are recommended for each person involved in a cleanup. Plan on involving at least two people per cleanup.

Shoes
Closed-toed, non-porous shoes which cover the entire foot are a must when working with chemicals.

Respiratory Protection

We do not recommend that you use respirators because if your spill results in the generation of toxic vapors, it is a high-hazard emergency (i.e., a complicated spill). You should evacuate and let the trained professionals of the Hazardous Materials Response Team and/or local emergency agencies handle the spill. **You must not use a respirator unless you have been trained, medically evaluated and fit-tested.** Contact the Office of Safety & Health at 844-4870 for more information on respirator usage.

Spill Cleanup Agents

General use absorbents

- Calcium bentonite can be used on just about any kind of spill except Hydrofluoric Acid.
- Kitty litter, sand and vermiculite can be used on less hazardous spills and applied for traction in slippery areas.
- Paper towels and spill pads can be used to quickly absorb spills. Specialized spill pillows which can neutralize, and reduce the flammability, reactivity, and toxicity of liquid acids, caustics, and solvents are commercially available through preferred vendors.

Specific use absorbents
- Stock sodium bisulfate (to neutralize bases) and sodium bicarbonate (to neutralize acids)

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- A 1:1:1 mixture of sand, soda ash, and kitty litter can be applied to solvent spills.
- A dilute sodium thiosulfate solution is recommended for spills involving cyanides.

Disposable Tools

- Non-metallic scoops should be used to sprinkle absorbents onto spills and to mix the absorbent into the spill.
- A chemical resistant sponge mop and bucket are needed for cleaning the floor after neutralization and absorption. These must be made out of non-sparking materials. (These are not provided by Building Services. Contact EHS for more information.)
- A chemical resistant dust pan and brush are needed to collect absorbent material. These must be made out of non-sparking materials.
- A 5-gallon bucket with lid or other similar container types should be used to contain these supplies.

Materials for Spill Collection

- Heavy duty plastic bags are needed to collect the spilled material and contaminated cleanup materials for disposal.
- Stock Hazardous Waste Container labels to properly label the material for disposal. Include the name of the contaminant.

Location of the Spill Kit

Spill control kits should be clearly marked, highly visible and located near an exit so that you won't have to enter the contaminated area to have access to the kit. Make sure all personnel know the kit's location, are familiar with the kit's contents, and understand its limitations.

Spill Reporting

Spills and releases of hazardous materials in significant amounts should be reported to Auburn Police (911). No notification of emergency responders is necessary for simple spills. However, EHS is always available for advice.

Even a small amount of spilled flammable liquid or reactive substance can present a significant fire hazard. There are many ignition sources in laboratories. Remove all potential sources of ignition, when possible. If, however, the vapors from a flammable spill are in the vicinity of an ignition source, such as a pump, it may be advisable to shut off power from a remote circuit breaker box. Do not hesitate to evacuate, notify Auburn Police (911) and AUDCSS, and pull the fire alarm if you are unsure of the spill's fire potential.

Any uncontained chemical that can disperse fumes, gases, or dust may be hazardous to your health and the health of those around you. If you suspect that the spilled or released chemical is toxic, evacuate the area. If others in the area could be exposed to the chemical, evacuate the area or building and follow the high hazard emergency procedures for reporting complicated spills shown below.

Reporting a complicated spill

From a safe place, call both Auburn Police (911) and AUDCSS (844-8888). Report that this is a chemical spill emergency and give:

- Location of the spill
- Name and amount of material spilled
- Extent of injuries
- Safest route to the spill
- Your name
- Telephone number and your present location
- Stay on the line until told to hang up by the dispatcher

Spill Response Procedures

Persons involved with a spill or release of any hazardous material should evaluate the potential danger to themselves, others and the environment before attempting any action. If the situation allows, extinguish all open flames, leave the fume hood on and open windows if possible.

After you report a complicated spill

- Alert all persons nearby
- Close the door to the laboratory
- Contact the Laboratory Manager or Principal Investigator
- Evacuate the entire building for extremely toxic spills if necessary
- Post personnel by commonly used entrances to the area to direct people to use other routes
- Arrange for someone to meet the emergency responders

Persons causing simple spills of known materials are responsible for the cleanup to the extent of their abilities. These should be cleaned up immediately. Appropriate personal protective equipment should be used.

REMEMBER…

A simple spill

- Generally is less than one gallon
- Does not spread rapidly

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- Does not endanger people or property except by direct contact
- Does not endanger the environment

Always err on the side of caution. When in doubt, get out!

CONTROL THE SPREAD of the liquid. The object of this initial step is to contain the spill. Make a dike around the liquid by placing absorbents or pillows at the outside edges of the spill.

Supplies Needed

- Absorbent material (e.g. paper towels, kitty litter, spill booms and/or pillows.

PREVENT THE SPREAD of fumes and vapors. If the substance is volatile or can produce airborne dusts, close the laboratory door to prevent the spread of fumes and vapors to other areas. **Keep fume hoods on.**

NEUTRALIZE acids and bases. Spills of most acids or bases should be neutralized unless toxic vapors are present. Use caution when neutralizing spills. Wear recommended protective equipment. The neutralization process often is vigorous, and can result in splashes and the generation of large amounts of heat. Once neutralized, acids and bases can be mopped up and rinsed down the drain. A neutralizing spill absorber greatly simplifies cleanup and disposal.

NOTE: Some spill pillows can not be used with hydrofluoric acid (HF). If you use hydrofluoric acid in your work, it is advisable to buy the spill kits specially made for hydrofluoric acid or to use a neutralizing agent for cleanup. Sodium carbonate, sodium bicarbonate and sodium hydroxide are suitable neutralization agents for hydrofluoric acid.

Supplies Needed

- For **acids**: sodium bicarbonate, sodium carbonate or calcium carbonate.
- For **bases**: sodium bisulfate or monosodium phosphate.
- **pH paper** to indicate when spills of acids and bases have been neutralized.
- **Specific agent**: call EHS for advice.

ABSORPTION OF LIQUIDS Add the absorbents to the spill, working from the outer edges toward the center. Never use a vacuum cleaner or shop vacuum to collect flammable liquids.

Supplies Needed

- Absorbent material such as paper towels, oil-dry, or vermiculite, are relatively inexpensive and work well, although they are messy. A 25 pound bag of oil-dry will be sufficient for a one gallon solvent spill.

- Spill control pillows are an alternative way to absorb solvents, acids, and bases and are available from commercial suppliers.
- Activated carbon is an excellent adsorbent for solvents and especially odorous organic chemicals.

RECOVERY AND CONTAINMENT FOR DISPOSAL Spill residues and cleanup materials should be collected and placed into a wide-mouth plastic container or large plastic bag. For dry powders or liquids absorbed to dryness, you can double bag the residue into plastic bags (clear bags are best) and place the sealed bags into a box. Place a completed Hazardous Waste Container label and/or CHEMATIX™ Waste Card on each container.

Supplies Needed

- Plastic bag, jar, bottle, jug, plastic pail or plastic bag.
- Forceps (to pick up broken glass), broom, shovel, dust pan.
- Mop and bucket.

DECONTAMINATION Decontaminate the area and affected equipment. For most hard surfaces, conventional cleaning with soap and water is appropriate. Ventilate the area if necessary. Open windows or use a fan. In some instances, we can test the air in the vicinity of the spill location to determine if air concentrations of the chemical have been lowered to an acceptable level.

Supplies Needed

- For most spills, conventional cleaning products applied with a mop or sponge will decontaminate satisfactorily.
- For more toxic chemicals, use a suitable solvent and call us for advice.

Management of Materials from Spill Cleanup

Materials that are generated as a result of spill cleanup are considered to be hazardous waste if the original material when disposed of would be a hazardous waste. **These materials must be managed as described in Chapter 3.**

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Introduction

Due to the diverse research and work of the University, we often encounter waste streams which are expensive and difficult to manage. The disposal costs and safety concerns associated with unknowns, peroxide-forming materials, gas cylinders, lecture bottles and mercury could be avoided completely by following the requirements established in this Chemical Waste Management Guide.

Currently, disposal costs for unknowns and peroxide-forming materials are the only waste streams which are charged to the generating department. However, depending on the condition of certain chemicals such as legacy chemicals, Departments could be charged for the disposal of certain materials because improper storage, labeling and dating of materials.

This chapter concentrates on specific waste streams that fall into three groups: unknowns, expensive and difficult to dispose of wastes or easily disposed of wastes. Examples of expensive or difficult to dispose of waste streams include peroxide-forming materials, explosives, gas cylinders, lecture bottles, controlled substances and heavy metal wastes. Easily disposed of materials include universal waste, used oil, used antifreeze, broken glassware and empty containers.

Unknown Wastes

All waste material picked up by EHS must be completely and accurately identified. Materials which are not identified are referred to as "*unknown*." The following are examples of "unknowns": bottles without labels, containers labeled with only codes, generic process labels that do not specifically list chemicals contained, and obviously mislabeled chemicals. Maintenance of labels, periodic inspections of chemical stocks, satellite accumulation areas and good chemical hygiene practices will prevent the occurrence of unknowns.

When an unknown is discovered, you must make every effort to provide an accurate description of the contents. Usually the contents can be identified by persons who work in the area where the material was used. If this fails to positively identify the material, then some elementary analysis of the material must be performed.

If the container is not identifiable, the following characteristic screening procedure should be used. If laboratory personnel can not perform this procedure due to time constraints or if they are uncomfortable performing the analysis on the unknown, the University's hazardous waste contractor will perform the analysis. However, **the cost of this analysis and the disposal fee will be charged to the department.**

Pre-screening Notices

Peroxidizable compounds such as ethers, dioxanes, tetrahydrofuran, etc., tend to absorb and react with oxygen over time to form potentially explosive compounds. Exposure to air and light accelerates this process. Therefore, if your unlabeled LIQUID has partially or fully evaporated and crystals are present or the liquid has become cloudy, label the container as "POSSIBLE PEROXIDE." **DO NOT** follow the screening procedure for this material. You should request assistance from EHS.

On occasion, unlabeled chemicals could contain radioactive and/or biological materials. If you any have reason to think that the material is radioactive, have it screened by personnel in the Radiological Safety Office. They can be reached at 4-4870. If radioactivity is found, **DO NOT** follow the screening procedures for this bottle. If you have reason to suspect a biohazard, **DO NOT** perform the screening procedures. Request assistance from EHS.

Safety Considerations

For your safety, you should utilize at a minimum chemical resistant gloves, goggles, a face shield and/or a polycarbonate work shield. All screening work should be performed in a functioning fume hood. Since the procedure tests items for flammability, you should have a Class ABC fire extinguisher be available in case of unexpectedly violent reactions. Prior to the test, you should also locate the nearest safety shower in case of an emergency.

Characteristic Screening Procedures

This simple four step procedure will enable us to remove practically any container from your laboratory. Steps one and two must be performed on all samples regardless of the result. Remember: if you are uncomfortable performing these procedures, ask your supervisor to find a qualified individual in your department who can perform them.

Description of Screening Procedures for Unlabeled Containers

Each unlabeled material is screened for the following four characteristics: air reactivity, water reactivity, corrosivity and flammability. Because of the small sample size used for analysis, a rigorous sampling method is not required. One container (aluminum dish, watch glass, petri dish, etc.) can sometimes be used for all four steps of the procedure. Residues from this procedure can be discarded down the sanitary sewer and/or in the normal trash. When labeling, do not deface the original label or any markings with a CHEMATIX™ Waste Card.

1 - Air Reactivity

Pour a small amount (a few drops or crystals) of the material into your container in the hood. If the material is air reactive, a reaction will be apparent within 30 seconds and should be labeled "Characterized Waste—Air Reactive" and manually check the CHEMATIX™ Waste Card as "Air Reactive". Proceed to step 2.

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2 - Water Reactivity

Pour a small amount (a few drops or crystals) of the material into your container in the hood. Using a wash bottle filled with water, add a few drops of water to the compound. If the material is water reactive, a reaction will be apparent within a few seconds. If reactive, label the container “Characterized Waste—Water Reactive” by manually checking the CHEMATIX™ Waste Card as “~~W~~”; if not, proceed to step 3. Note: Steps 3 and 4 should both be performed if a classification is not determined in steps 1 and 2.

3 - Corrosivity

Obtain the pH of the sample using pH paper or a pH meter. For solids which do not test positive for water reactivity, add a small amount of water to the sample. Record the pH to the nearest whole number on the container label.

4 - Flammability

While performing flame tests with solids, use a small spatula to minimize potential reactions. Hold the spatula a few centimeters above the flame of a Bunsen burner for a few seconds. If the solid does not start burning, move the material into direct contact with the flame. If the material does not start burning after 10 seconds of direct contact with the flame, it is considered not flammable. For liquids, use cotton tipped applicators to dip into the liquid before igniting.

Labeling Containers

If steps 1 or 2 are positive, label container as instructed above.

If steps 1 and 2 are negative, label the container according to the following:

- If flammable and pH = 3-11: “Characterized Waste—Flammable”
- If flammable and pH = 2 or less: “Characterized Waste—Flammable, Acid”
- If flammable and pH = 12 or more: “Characterized Waste—Flammable, Base”
- If not flammable and pH = 3-11: “Characterized Waste—Other” and note pH result on the label.
- If not flammable and pH = 2 or less: “Characterized Waste—Acid”
- If not flammable and pH = 12.5 or more: “Characterized Waste—Base”

Any additional information about the contents of the container also should be shown on the CHEMATIX™ Waste Card.

Disposal of Screened Containers

Label containers according to the preceding guidelines and submit CHEMATIX™ Waste Cards.

Expensive and Difficult to Dispose of Materials

AU Guidelines for Peroxide-forming Chemicals

Many commonly used chemicals; organic solvents in particular, can form shock, heat, or friction sensitive peroxides upon exposure to oxygen. Once peroxides have formed, an explosion can result during routine handling, such as twisting the cap off a bottle – if peroxides are formed in the threads of the cap. Explosions are more likely when concentrating, evaporating, or distilling these compounds if they contain peroxides.

When these compounds are improperly handled and stored, a serious fire and explosion hazard exists. In general chemicals from List A, B, and C should be submitted for waste pick up after 18 months of receiving, even if unopened, unless you are following the additional storage requirements below. You will receive an email alert from RMS to remind you to submit expired containers for waste pick up. The following guidelines should be adhered to when using peroxide forming chemicals:

- Each peroxide-forming chemical container MUST be dated when received and opened. A list of common peroxide forming chemicals is provided in Table 5-1. See the University's "Guidelines for Storage and Handling of Peroxide-Forming Materials".

- The results of the peroxide test and the test date must be marked on the outside of the container. You must send a list of the containers tested (i.e., bar code numbers) and the date tested to Catherine Situma of RMS to have the expiration date reset. If no test results are received and the 18 month expiration date arrives, you may be required to submit the waste for pick up. Contact Catherine Situma for more information.

- Peroxide test strips can be purchased from a variety of safety supply vendors, such as VWR and Laboratory Safety Supply. References such as Prudent Practices in the Laboratory and the American Chemical Society booklet Safety in Academic Chemistry Laboratories outline ways to test for peroxides and ways to remove them if discovered in addition to the University guidelines mentioned

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above. Due to sunlight's ability to promote formation of peroxides, all peroxidizable compounds should be stored away from heat and sunlight.

- Peroxide forming chemicals should not be refrigerated at or below the temperature at which the peroxide forming compound freezes or precipitates as these forms of peroxides are especially sensitive to shock and heat. Refrigeration does not prevent peroxide formation.

- As with any hazardous chemical, but particularly with peroxide forming chemicals, the amount of chemical purchased and stored should be kept to an absolute minimum. Only order the amount of chemical needed for the immediate experiment.

- Ensure containers of peroxide forming chemicals in class A and B are tightly sealed after each use and consider adding a blanket of an inert gas, such as Nitrogen, to the container to help slow peroxide formation. Inhibited class C chemicals require O_2 for proper stabilization.

- A number of peroxide forming chemicals can be purchased with inhibitors added. Unless absolutely necessary for the research, labs should never purchase uninhibited peroxide formers.

- Before distilling any peroxide forming chemicals, always test the chemical first with peroxide test strips to ensure there are no peroxides present. Never distill peroxide forming chemicals to dryness. Leave at least 10-20% still bottoms to help prevent possible explosions.

Compounds that are suspected of having very high peroxide levels because of age, unusual viscosity, discoloration, or crystal formation should be considered extremely dangerous. If you discover a container that meets this description, DO NOT attempt to open or move the container. Notify other people in the lab about the potential explosion hazard and notify EHS at 844-4870 immediately.

For those compounds that must be handled by an outside environmental "bomb squad" company, the cost for such an operation can result in charges of >$1000 per container. However, if laboratory staff follow the guidelines listed above, the chances for requiring special handling for these types of containers or for an explosion to occur is greatly diminished.

Explosive Materials

Some materials, such as metal azides, benzoyl peroxide, or picric acid become potentially explosive upon aging or drying. The most commonly found of these is picric acid and is discussed in greater detail below. Other dinitro compounds, such as 2,4-dinitrophenyl hydrazine and 2,4- dinitrophenol carry manufacturer explosive warnings. When disposed, the University's Hazardous Waste Contractor must schedule a specialized transport vehicle to haul the material to a permitted disposal facility. The current transportation fee for explosive materials is significant, even if the material is less than one pound. This fee does not include the actual cost of disposal. This example demonstrates how buying bulk

material may not be cost effective. **Once again, we stress that you buy these materials only in quantities appropriate for the research to be conducted.** You should check with us before buying these materials to determine whether they are already available on campus.

Picric acid is normally wet with >10% water and is relatively safe in this form. However, picric acid can become explosive if dried or combined with metals. If dry picric acid is found, immediately notify EHS.

• Never store in containers with metal caps.
• Check frequently to insure dampness. Add water if necessary.
• Keep cap tight and seal with parafilm to keep moisture in.

Gas Cylinders, Lecture Bottles and Aerosols

Compressed gases are defined by the Interstate Commerce Commission as any material or mixture in containers having an absolute pressure in excess of 40 psi at 70°F or in excess of 104 psi at 130°F. Gas cylinders are widely used at the University in teaching and research laboratories and in maintenance and construction operations.

Renting gas cylinders, which can be returned to gas vendors when no longer needed, is the recommended practice for the management of cylinders. Discharged gas cylinders should be returned promptly to the vendor to regain the deposit on the cylinder and minimize rental charges. This practice eliminates the creation of a hazardous waste. The purchase of non-returnable lecture bottles or other non-returnable pressurized gas cylinders is strongly discouraged because of the difficulty and cost of disposing of the empty containers. Few suppliers of lecture bottles are willing to take back their cylinders. Matheson Gas Products, Inc. will take back their cylinders and lecture bottles for a fee, plus shipping and handling fees. Disposal of lecture bottles with unknown contents will cost thousands of dollars. Color-coding of cylinders for identification of the gas is not universal so you can not rely on color codes for identification. **DO NOT store unneeded lecture bottles of hazardous gases for possible future use.** Old bottles can pose a significant hazard, both to lab personnel and others. Small leaks in storage can damage nearby equipment. Costs associated with the disposal of leaking hazardous cylinders are phenomenal.

To eliminate the generation of lecture bottles of unknown contents and those with known contents which cannot be economically disposed, researchers should comply with the following guidelines:

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- **Do not buy lecture bottles or compressed gas cylinders from suppliers who are not willing to accept back cylinders that still have contents**. Save the shipping container and call us for packing and shipping regulations before you return bottles to the supplier.

- The cylinder should be marked by stenciling, stamping, or labeling with at least the chemical or commonly accepted name of the gas.

- Do not destroy identification tags or labels.

- If it is not possible to return the empty cylinder to the supplier, plan to use all contents or develop procedures to destroy any hazardous constituents remaining.

- Comply with all safety recommendations from the supplier of the lecture bottle and supplier of the regulator or manual control.

- Insure that any fixtures attached to the lecture bottle comply withthe manufacturer's recommendations.

- When the lecture bottle is empty, mark it as such with an indelible marker.

- If the bottle contained a poison gas or liquid, contact Environmental Health & Safety personnel as soon as it is empty for disposal instructions. Some bottles are still hazardous when "empty."

- Contact EHS for disposition instructions when lecture bottles are no longer needed.

- Insure that purging procedures shown below are complied with, when applicable.

Venting of Atmospheric and Inert Gases

Non-returnable cylinders of atmospheric and inert gases may be disposed of after venting in a properly functioning fumehood. Gases suitable for venting include: argon (Ar), carbon dioxide (CO_2), helium (He), krypton (Kr), neon (Ne), nitrogen (N_2), and xenon (Xe). Oxygen (O2) may be vented, but slowly. **DO NOT** vent nitrogen dioxide (NO_2) as it is extremely toxic.

Do not attempt this procedure unless you are confident that you can do it safely. If you are uncomfortable venting the gas contact EHS.

Follow this procedure to vent gas cylinders:

- Call EHS to verify that the gas can be vented in your laboratory fume hood.

- Check your hood to make sure that it is functioning properly.
- Verify that the valve is working and slowly vent the cylinder in the back of the hood.
- When the cylinder is empty, flush it repeatedly with compressed air or an inert gas.
- Remove the valve stem of non-returnable empty cylinders and bottles that contained atmospheric and inert gases. These will be picked up by EHS.

Aerosol Cans

Ideally, aerosol cans should be emptied by using the contents for their intended purpose. Aerosol cans may be sprayed empty and safely disposed of in the normal trash. This venting procedure should be done slowly and in a fume hood.

Water soluble, biodegradable chemicals (such as ninhydrin fixer) can be sprayed in a hood sink into a stream of water until it is empty. Solvent-based products can be sprayed into an organic solvent collection container. We will pick up and dispose of aerosol cans of hazardous substances that contain material but have no propellant. Visit http://www.adem.alabama.gov/programs/land/landforms/AerosolContainers.pdf for ADEM's rules regarding aerosols disposal.

Controlled Substances

Pharmaceuticals, chemotherapy agents and other controlled medications should be managed in the same manner as any other hazardous waste **BUT ONLY** by the AU pharmacies that dispense them or the PI who possesses the appropriate licensure. If you are approved by the US Drug Enforcement Agency (DEA) to purchase controlled substances, you should be familiar with the record keeping and disposal requirements and be able to dispose of those materials according to the regulations. For a list of controlled substances, visit the U.S. Drug Enforcement Administration's web site at http://www.deadiversion.usdoj.gov/schedules/index.html.

Heavy Metal Wastes

Wastes containing heavy metals, (arsenic, barium, cadmium, chromium, lead, mercury, silver and selenium) are more difficult to dispose of than wastes not containing heavy metals. Permitted disposal facilities must treat these waste streams according to strict regulatory treatment standards prior to disposal.

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Mercury Waste and Spills

Mercury's toxicity and unique physical properties make its disposal costs among the highest of all substances. Elemental mercury and mercury compounds are expensive to dispose of due to the limited number of facilities which are permitted to accept it. It is imperative that mercury bearing waste not be mixed with other wastes unless it is part of the experimental procedure or research project. Elemental mercury can be recycled, but it must be sent to a permitted reclaimer which is costly.

The majority of the mercury waste generated on campus comes from broken thermometers. Alternatives to mercury thermometers include electronic digital thermometers and thermometers filled with alcohol or mineral spirits; these now meet the calibration standards of the National Institute of Standards & Technology. The price of switching to non-mercury thermometers is less expensive than the current disposal price for mercury waste. In an effort to reduce the number of mercury spill responses on campus, this office strongly encourages all schools and departments to phase out, to the extent possible, the use of mercury thermometers and mercury filled devices and replace them with environmental friendly alternatives. If you must purchase a mercury thermometer, use one with a Teflon® coating to help prevent breakage.

There are digital electronic versions of most mercury dials and switches. Pressure transducers can substitute for manometers. Moreover, manometers can be filled with almost any liquid, although the less dense the liquid, the larger the manometer must be.

Many less hazardous chemicals can be substituted for mercury compounds. For example, sodium hypochlorite (household bleach) may be used as a biocide instead of mercuric chloride. When disposing of free flowing mercury and thermometers with mercury, place them in a wide mouth polyethylene or glass jar with a screw top cap.

Broken thermometers without free flowing mercury and mercury-contaminated debris may be packaged by double bagging them in plastic bags and carefully placing the bag in a sturdy cardboard box or metal can. Label the Waste Card and container as "broken thermometer and elemental mercury".

MERCURY SPILLS

Mercury is the single most spilled chemical on campus. It presents a special problem because of the difficulty in picking up the tiny droplets and the hazards of undetected residues. Metallic mercury remaining in cracks and crevices may give off toxic vapors for years.

Prevention is the best way to handle mercury spills. Trays should be used under equipment wherever a mercury spill is possible. Once again, when mercury thermometers must be used, plastic coated, shatter resistant thermometers should be purchased.

Remove jewelry and wear gloves when cleaning up mercury spills. Although the main exposure route is through inhalation, mercury also can be absorbed through the skin.

Small Mercury Spills

Small mercury spills are those spills of less than 5 milliliters. First, pick up glass or other large debris using forceps or tongs, then clean up the spilled metallic mercury. You can use a side arm flask connected to a vacuum pump or sink aspirator to vacuum up small beads. Alternatively, you can consolidate the spill by using a thin piece of cardboard or plastic. The mercury can be pushed onto another thin piece of cardboard or plastic and transferred into the disposal container. Use mercury spill powder, mercury absorbent paper or mercury sponges to decontaminate the area and clean up spill residues.

Commercial kits and equipment are available for mercury spills. Put the mercury into an airtight container labeled "Hazardous Waste - Mercury" and complete the necessary waste cards.

Material heavily contaminated with mercury should be placed in an appropriate container. Glassware and other debris that are clean (no visible mercury) may be discarded in the normal trash.

When dealing with broken thermometers carefully wrap the sharp ends of the broken thermometer with tape and place in a plastic bag, wide mouth jar or other puncture resistant container.

Large Mercury Spills

For mercury spills greater than 5 ml, including spills from manometers and barometers, call EHS at 4-4870. EHS personnel will help clean the spill. Close off the area and post warning signs to prevent mercury and vapors from spreading. We can also meter the air after a large spill to verify that airborne levels of mercury do not exceed an acceptable level.

PCBs

Polychlorinated biphenyls (PCBs) are highly regulated materials, and disposal is difficult and costly. PCBs in concentrations of less than 50 parts per million will be managed by EHS as hazardous waste. Any waste over 50 ppm is regulated as a "PCB waste" and will require special handling and disposal; please contact EHS for instructions on handling this material. The use of PCBs in concentrations >50 ppm in research should be carefully reviewed.

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Do NOT mix PCB waste with other waste whenever possible. Collect PCB liquids in a metal or polyethylene container. Items such as gloves, clothing, and lab ware or utensils/tools that become contaminated with PCBs must be managed as hazardous waste.

Collect PCB contaminated debris, rags, etc. in a 4-6 mil plastic bag or (if sharp objects are present) in a box lined with a 4-6 mil plastic bag. Always indicate the level of PCBs on Waste Cards.

Radioactive Waste

The disposal of radioactive wastes, other than those classified below as mixed radioactive, are handled exclusively by the Radiological Safety Office. For additional information, contact the Radiological Safety Office at 4-4870.

Mixed Waste

Mixed waste is both a hazardous waste (as defined by the Environmental Protection Agency) and a radioactive waste (as defined by the Nuclear Regulatory Commission). The creation of mixed waste is strongly discouraged. For some types of mixed waste, there are currently no permitted disposal facilities in the United States. **You must discuss creation of mixed waste with EHS and the Radiological Safety Office prior to commencing such research.**

Household Hazardous Waste

EHS often gets inquires from the community and from University employees about what to do with hazardous waste generated at home. Household hazardous waste usually includes old cleaning agents, paints, batteries, pesticides and herbicides used around the house and yard. Unfortunately, Auburn University is not permitted to accept off-site hazardous waste for disposal. If you need assistance contact ADEM at (334) 271-7700, or see ADEM's *Household Hazardous Waste* guidance document.

Occasionally, the City of Auburn and a hazardous waste transportation company will jointly provide "Household Hazardous Waste" (HHW) days. HHW Days is a program whereby the City or State contracts a disposal company in various municipalities and sets up a central collection point for the community to safely and environmentally dispose of their household hazardous waste. In some states each community can vote to increase monthly garbage collection fees to cover disposal costs. If you would like to see this program increased in this state, contact your local representatives, state legislators and Governor.

Easily Disposed of Materials

Universal Waste

Universal Waste is a category of hazardous waste created by the federal government. In 1993, the EPA proposed to add to the hazardous waste regulations a set of streamlined requirements for collecting certain widely dispersed hazardous waste, which were coined "universal wastes." These wastes share several characteristics:

- they are frequently generated in a wide variety of settings
- they are generated by a vast community
- they may be present in significant volumes in municipal
- waste management systems

The proposal included two specific types of wastes: batteries and cancelled or suspended and recalled pesticides that are hazardous wastes. The 1995 final rule included thermostats containing mercury. This rule was designed to reduce the amount of hazardous waste items in the municipal solid waste stream, encourage recycling and reduce the regulatory burden on businesses that generate these wastes. The University already had management plans in place to handle pesticides and mercury-containing equipment; however, a program had to be created to cover batteries. In 1997 fluorescent lamps containing mercury were added to the Universal Waste list. It is the intent of the EPA to expand this list again in the future.

Batteries

Many batteries contain one or more chemicals which classify them as hazardous waste. We have placed battery recycling containers at various locations on campus to make it easy to properly manage these items. A separate guidance document for battery management is available from this office.

All battery types, regardless of their hazards, must be recycled by EHS.

- Mercury (any form)
- Silver
- Lithium
- Nickel Cadmium/NiCad
- Lead Acid

Many more types of batteries have entered the market in recent years. Common alkaline batteries (i.e., Duracell or Energizer batteries) are exempt but are recyclable and should be routed to EHS. If you are not sure which type of battery you have, manage it as hazardous. Contact us or Waste Reduction and Recycling Department at 844-4810 for the location of your nearest battery recycling container.

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Fluorescent Lamps

Some fluorescent lamps still contain elemental mercury. Although the actual amount in the lamps is minimal, there is enough to allow them to be categorized as hazardous waste. If you change your own fluorescent lamps, you are responsible for recycling those lamps, and there are strict rules governing the collection and storage of used fluorescent lamps.

A separate guidance document for fluorescent lamp management is available from this office.

If you need to set up a recycling program, give us a call.

Used Oil

Used oils and petroleum lubricants are not classified as hazardous wastes by EPA if they are properly recycled. **Motor oil, transmission fluid, lubricating oil, cutting oil, hydraulic oil and mineral oil fall into this classification.** Collect used oils in 1 gallon or 5 gallon containers depending on the volume of material generated. Call us for approval before using a 55 gallon drum. The container must be labeled USED OIL ONLY and must be closed except to add used oil to the container. For proper disposal, please request a waste chemical pickup. A representative of EHS will pick up the waste lubricants as part of their pickup schedule. A separate guidance document for used oil management is available from this office. Also see ADEM's Used Oil Guidance Document.

Antifreeze

Currently, the ingredients which make up antifreeze (primarily ethylene or propylene glycol) are not regulated as hazardous waste. This material is classified as a solid waste and is considered to be non-hazardous. As long as the material is not poured out on the ground to evaporate, where animals or children could come into contact with it, there exists no significant danger to human health or the environment. If you are generating small quantities, (less than five gallons), we recommend that you dispose of it via the sanitary sewer. For larger quantities, give us a call for disposal arrangements.

Broken Glassware

Discarded glassware **must not** contain any hazardous waste, medical waste or radioisotopes. If the glassware contains any of these items, please call this office for information on disposal.

Broken glassware, pipettes or other sharp-edged materials must not be discarded with normal trash. Building Services personnel, contracted services and others have been injured when carrying trash bags containing broken glassware.

At a minimum, broken glassware must be contained in a small, heavy-grade, corrugated cardboard box lined with plastic. Small boxes minimize the potential for excessive accumulation in the laboratory and are easier to handle. The Scientific Supply Store located in the Science Center Laboratory Building stocks ready-made broken glass boxes. If a heavy-grade box is not available, you should "double box" the glassware. Place a plastic liner between the boxes to reduce the potential for tearing. The container must be properly labeled. When it is 3/4 full, the box should be sealed with strong tape. Indicate with a sign or marker that the box is "for removal". **Custodial staff no longer disposes of broken glass. Therefore, it is the responsibility of the generator to place containers of broken glass in solid waste receptacles.**

Empty Containers

Chemical containers (not containing P-Code waste residues) that have been emptied (generally this means drained of their contents by normal methods including pouring, pumping, aspirating, etc.) are not regulated as hazardous waste. Containers that have held hazardous materials should have their labels defaced, be triple rinsed with water and then disposed of in the regular trash. Designate the rinsate as hazardous waste. The empty containers should have their caps removed prior to disposal. Punch holes in the bottom of metal containers and plastic jugs before disposing of them in the regular trash or appropriate recycling unit, so they cannot be reused. It is not necessary to break empty glass containers when placed in a dumpster or recycling unit. For volatile organic solvents (e.g. acetone, ethanol, ethyl acetate, ethyl ether, hexane, methanol, methylene chloride, petroleum ether, toluene, xylene, etc.), the emptied container can be air-dried in a ventilated area (e.g. a chemical fume hood) without triple rinsing and then discarded. Please consider recycling! Contact Waste Reduction and Recycling Department or the City of Auburn's Environmental Services Division at 334-501-3080 for more information.

For containers containing a P-Code material (See Chapter 1), the generator must collect and dispose of rinsate as hazardous waste. If not rinsed, the "empty" container is a hazardous waste and you must schedule a chemical waste pickup.

Contact us when you have an empty 55 gallon drum or several 5 gallon metal containers. We bulk several waste streams into empty drums to minimize disposal costs. EHS also has a hydraulic drum crusher for metal containers that are not in good condition. Do not place drums into the dumpster. Instead, contact the Facilities Division for the location of its scrap metal recycling unit.

Paint and Paint Thinner

Keep oil- and water-based paints separated. Separate the solid paint sludge from paint thinners by pouring off thinners into a separate waste container.

Water-based paints are not considered hazardous unless the pigment contains a heavy metal. Consult the product SDS. The rinsate from water base paint cleanup is also non-

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hazardous and can be discarded down the sanitary sewer. **Please note that disposal of water-based paint and cleanup water via the storm sewer is illegal.** Small amounts (i.e., 1 gallon containers or less) of non-hazardous paints may be dried and disposed of in the general trash.

Oil-based paints and thinners are hazardous wastes and should be collected in either their original containers (when in small quantities) or in a larger 5 gallon container. Call for approval before using a 55 gallon drum. Containers must be labeled using the Hazardous Waste Container label and managed in accordance with the hazardous waste program requirements.

Stench Chemicals

Chemicals that emit a stench such as thiols (sulfur containing compounds) and mercaptans should be disposed of in containers with **tight** fitting lids. In addition to tight fitting lids, the container should be sealed with parafilm, taped or over packed in a slightly larger container. Please let us know at the time you request a pickup if the consignment contains such materials.

Trace Contaminated Laboratory Waste

In general, chemically contaminated items, such as dried residues, can be put into the normal trash if they are non-reactive, non-ignitable, non-infectious, non-radioactive and if the contaminant is not highly toxic (consult the SDS). "Lab ware" pertains to disposable non-chemical items, such as gloves, bench top coverings, pipettes, test tubes, aprons, etc. If the debris contains any of the constituents listed as acute hazardous waste (Chapter 1), you must manage it is a hazardous waste. If you feel that the normal trash is not an appropriate disposal route for your chemically contaminated items, submit a CHEMATIX™ Waste Card and we will determine the appropriate management procedure.

NOTE: If the lab ware is regulated medical waste, do not dispose of in the normal trash. See more information on the next page and refer to the University's *Medical Waste Management Guide*.

Photographic Waste

Photographic waste is a hazardous waste if it contains silver in concentration greater than 5 mg/L after undergoing TCLP analysis, if it is corrosive or ignitable. Always use separate containers for developer and photo fixer. Most spent developer is non-hazardous and can be poured into the sanitary sewer. Photo fixer, which normally contains silver, may have to be managed as a hazardous waste. Consult the manufacturer's SDS and/or call us to evaluate your photographic waste.

Agricultural Chemicals

Return unused pesticides, herbicides, fungicides and other related agricultural chemicals to the manufacturer for disposal. Most companies will accept them. Alternatively, retain the material and use it as it was intended, consistent with the label instructions. If the manufacturer will not accept the material, include the manufacturer's contact person, phone number and any paperwork verifying their non-acceptance of the material with the CHEMATIX™ Waste Card. Some pesticides may be managed as Universal Waste. **Experimental agricultural chemicals must be identified with a chemical name.**

Asbestos

Asbestos-containing materials in the laboratory have been used in gaskets, sealants, laboratory gloves, oven materials and acid-resistant cabinet liners. You should replace asbestos items in your laboratory with commercially available alternatives such as Zetex.

Asbestos should be packaged wet in a minimum of two, 6-mL plastic bags or a rigid container that is dust and sift-proof. Sharp or blunt edges likely to cause puncture or tears in the shipping container must be adequately protected to prevent container failure. Follow the disposal guidelines in Chapter 3.

Medical Waste

The disposal of medical wastes, other than materials classified above as hazardous waste, is handled under a separate program. Download a copy of the Medical Waste Management Guide.

An Important Note About Sharps

All hypodermic needles and syringes, intravenous needles and tubing, scalpel blades, lances, and other such devices are regulated as medical waste. Even if these materials are unused and still in their original packaging, they are still regulated. All sharps **MUST** be placed in an approved sharps container. **Sharps that have been exposed to human disease agents should be autoclaved prior to pickup by Risk Management and Safety.**

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Introduction

Waste is a natural by-product of research, teaching and outreach extension. Effective hazardous waste management requires not only safe, sound practices, but also requires extensive **efforts to reduce the volume and toxicity of hazardous wastes**. Resources saved from efficient waste management can be used to improve the University's teaching, research and outreach programs. In addition, the University is required by law to develop strategies to reduce its hazardous waste and must be able to provide documentation of waste minimization efforts.

It can be difficult to minimize the production of waste in the laboratory. By its very nature, research is often the process of studying something and throwing it away. Unlike larger industrial processes, the multitudes of irregular laboratory operations in a university setting are intrinsically more difficult to control. Still, there are many things you can do to prevent pollution and minimize hazardous waste production.

One of the most important things you can do is to purchase only the amount of material that you can use in a reasonable length of time. Although it may seem less expensive to buy chemicals in larger quantities, it is in fact more expensive when the cost for disposal is taken into consideration. Overall, it is more economical to purchase only quantities of chemicals which will be used when disposal costs are considered. A report prepared by the American Chemical Society indicates that unused chemicals can constitute as much as 40% of the hazardous wastes generated from laboratories. Although improvement continues to occur, our experience within Auburn University is consistent with that report.

Departments are encouraged to develop and implement a policy of reducing chemical purchases to the lowest practical limit. Many chemicals degrade over time, so labs should purchase quantities accordingly. Also, risk of accidental exposure to the chemical is lessened when handling a smaller container. Storage needs also are reduced when a smaller or single size container is inventoried.

Substitution

One of the best ways to prevent pollution is by substitution of a hazardous chemical with a less hazardous chemical. For many laboratory methods, an environmentally sound alternative exists.

One of Auburn University's most successful pollution prevention practices has been the substitution of non-ignitable liquid scintillation cocktail (LSC) for toluene-based cocktails. This change was initiated by the RMS Radiological Safety Office and the University Radiological Safety Committee. This reduced the risk of laboratory fire and personnel exposure to toluene. The toluene-based cocktails had been incinerated as a hazardous waste.

The non-ignitable, water-emulsifiable LSC cocktail can be discarded via the sanitary sewer.

Citrus-based cleaners are used to replace trichloroethane and mineral spirits for degreasing and cleaning glassware and parts. In addition, there are many commercially available alternatives for the chromic acid solutions which are commonly used to clean laboratory glassware. Table 6-1 below lists some of these alternatives. **EHS strongly encourages you to stop using chromic acid solutions.**

Table 6-1 Alternates to Using Chromic Acid Solution for Cleaning Glassware

Ultrasonic baths Alconox or similar detergents Pierce RBS-35 or similar detergents Biodegradable surfactants	Non-hazardous solutions
Potassium hydroxide/ethanol solutions (also flammable) Dilute hydrochloric acids	Corrosive Solutions
Potassium persulfate/sulfuric acid (sold commercially as No-Chromix) Aqua regia (mixture of hydrochloric and nitric acids)	Strong oxidizing acid solutions

In one study, the Division of Environmental Health and Safety of the University of Illinois at Urbana-Champaign, explored laboratory waste minimization opportunities. (Ashbrook, Peter C., Cynthia Klein-Banay and Chuck Maier, *Determination, Implementation and Evaluation of Laboratory Waste Minimization Opportunities*, 1992.) Table 6-2 includes some common chemical substitutes identified from that study.

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Table 6-2 Many hazardous materials commonly used in the laboratory have less toxic alternatives

Original Material	Substitute	Comments
Acetamide	Stearic acid	In phase change and freezing point depression
Benzene	Alcohol	
Benzoyl peroxide	Lauryl peroxide	When used as a polymer catalyst
Chloroform	1,1,1-tricloroethane	
Carbon tetrachloride	Cyclohexane	In test for halide ions
Carbon tetrachloride	1,1,1-trichloroethane 1,1,2-trichlorotrifluoroethane	
Formaldehyde	Peracetic acid I	In cleaning of kidney dialysis machines
Formaldehyde	"Formaltemate"(Flinn Scientific)	For storage of biological specimens
Formaldehyde	Ethanol	For storage of biological specimens
Formalin	See Formaldehyde	
Halogenated Solvents	Nonhalogenated Solvents	In parts washers or other solvent process
Mercuric chloride reagent	Amitrole (Kepro Circuit Systems)	Circuit board etching
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 LSC	Water based LSC	
Mercury salts	Mercury-free catalysts	Kjeldahl digests

We understand that substitution is not always possible. Some substitutions do not work as well and may not be as safe as desired. Substitution often requires successive trials and evaluations. However, every successful product substitution to a less toxic substance saves the University money and potential environmental liability in the future, and reduces the risk of accident.

Microchemistry

Pollution can be prevented by changing the laboratory process in which the pollution is created. Modern extraction techniques, (such as those that use a solid phase or supercritical fluid) minimize waste by using much smaller volumes of organic solvents. Innovative laboratory glassware and microscale techniques are available that reduce quantities used from kilograms to milligrams. Reducing the scale of laboratory processes not only prevents pollution, but has many other benefits:

• Small scale experiments cost less because they use less chemicals;
• Small scale experiments usually run more quickly;
• Heating and cooling is easier with smaller volumes;
• Exposure to chemicals is reduced; and
• The amount of fugitive emissions (evaporative losses) will be reduced.

Computer simulations and modeling eliminate environmental impacts when they are substituted for wet laboratory experiments. In the classroom, computer and multimedia simulations often allow students to observe more complex procedures than would be available by a traditional laboratory exercise.

Redistillation

In-lab distillation has been successfully used by several laboratories at the University to recycle waste organic solvents. Modern stills can produce a very pure product. Microprocessor controllers make stills easy and safe to use. Simple gas chromatography can be used for quality assurance.

EHS currently does not operate redistillation units. However, this office continues to evaluate newer redistillation units that will be able to save the University on disposal and new product acquisition costs. Future acquisition of any redistillation equipment by EHS will be communicated to the campus.

Chemical Surplus Program

Not all the chemicals destined for disposal or that are picked up by EHS are hazardous wastes. Many are abandoned, obsolete, or otherwise unwanted containers of chemicals generated by over-purchase, relocation or change of research emphasis. In many cases, these unwanted, or "legacy", chemicals can be used by someone else at the University. To help determine if your inventory includes legacy chemicals, ask yourself the following questions:

- **Do I know the name of the chemical?**
- **Do I know the intended purpose of the chemical?**
- **Can I use the chemical?**

If you cannot answer, "Yes" to any of the above questions, you have a legacy chemical and should generate a CHEMATIX™ Waste Card and submit a waste pick up.

If you know the name of the chemical but no longer have a use for it, use CHEMATIX™ to initiate transfer from one lab to another lab. Otherwise, submit a CHEMATIX™ Waste Card to arrange for a pickup of the container(s).

Conversely, some chemicals are often only partially used and have not exceeded their shelf life or been altered in any way. Others are still in the original sealed container. Contact EHS to find out if RMS has any of these items in stock. To the best of our knowledge, these chemicals are as labeled. If the requested chemical is in stock, we will deliver it to your door. There is no charge for these chemicals or delivery. Each chemical should be reviewed prior to acceptance. Tests to determine purity are your responsibility. If you are not satisfied with the material we will gladly pick it up from you when submitted via CHEMATIX™ Waste Card. Please, only request chemicals that you intend to use during

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the next three months. "Recycling" does not occur if we pick the container up again in six months because you really did not need it.

Chemical recycling and redistribution results in real cost savings for the University in two ways. First, utilizing chemicals decreases the amount of new chemicals purchased. Secondly, chemicals which are redistributed may not require disposal; therefore the University avoids the extremely high cost associated with that service. Since the early 1990s, the University has saved tens of thousands of dollars in the cost of chemical disposal and chemical purchases.

Introduction

If the waste chemical compound can not be recycled or a non-hazardous substitute is not available, the generator must determine if the material can be detoxified within the laboratory **as part of the process which generates the waste**. Some chemicals can be neutralized or made exempt from hazardous waste regulations by their destruction in the laboratory. An example of laboratory destruction would be neutralizing a strong acid or alkaline with a buffering solution. This should be done as part of the protocol and must be done according to documented methods. Waste can not be accumulated for neutralization or destruction at a later date. We do not have the materials available for your use, so it is expected that you purchase them yourself.

At this time there are six waste streams that are allowed to be treated by the generator:

Acid and Base Neutralization
Acetonitrile
Potassium Dichromate
Ethidium Bromide
Formaldehyde
Cyanides (Water Soluble)

We have tried to make these procedures as simple as possible so as not to burden the generator with time consuming and expensive processes.

EHS encourages generators to incorporate chemical destruction procedures into their research activities. In-laboratory chemical treatment reduces transport and handling risks, and reduces the cost of collecting and storing chemical waste. In many cases, the treatment product can be safely disposed of in the sanitary sewer. If you are uncertain about a destruction procedure, contact the Risk Management and Safety office prior to attempting a new process so it will be safe and the end result will meet regulatory requirements. Laboratory destruction is considered a less desirable strategy than substitution or microchemistry.

University faculty and staff with ideas or suggestions on ways to safely decrease the amount and/or toxicity of waste generated are encouraged to contact EHS personnel so that the information can be passed on to other University operations. An internet search of chemical destruction can be easily accomplished and information downloaded that focuses specifically on the reduction of laboratory waste.

Acid/Base Neutralization

Neutralization is the most efficient and least costly way of managing waste acids and bases. Unless the acid or base is unused and suitable for recycling, you will need to neutralize it

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in the laboratory. After neutralization, waste liquids can be disposed of in the sanitary sewer.

However, the solution you plan to neutralize should not contain heavy metals such as arsenic, barium, cadmium, chromium, lead, mercury, selenium or silver. Wastes containing high levels of other metals may be of concern, as well. Call us to find out if these wastes can be neutralized and sewered.

Safe Neutralization Requires Care and Proper Equipment

- Plan your neutralization.
- Perform all steps SLOWLY.
- Take special care when neutralizing strongly oxidizing acids, such as nitric or perchloric.
- **Caution**: Vapors and heat are generated. Perform procedures in a hood, behind a shield. Wear acid-resistant hand and clothing protection.
- Carry out neutralizations in a well-ventilated fume hood. Use the sash or a safety shield for protection against vigorous reactions.
- Wear a chemical-resistant apron, splash-proof goggles and a full-face shield and the appropriate gloves (some glove material may not provide proper protection). Long gloves or gauntlets protect forearms from splashes. Consult the relevant SDS beforehand.
- A five-gallon polyethylene bucket is recommended for neutralizing 1 to 10 liters. A large container is needed for addition of ice and base, and to safely stir the reaction.

Do Not Neutralize these Acids

The following acids are very reactive with water. Do not attempt to neutralize them unless you are expert in handling and using these acids. Dispose of these waste acids following procedures in Chapter 3.

- Acid anhydrides and chlorides
- Chlorosulfonic Acid
- Fuming Nitric Acid
- Fuming Sulfuric Acid
- Liquid halides of boron, silicon, tin, titanium and vanadium
- Liquid halides and oxyhalides of phosphorus, selenium and sulfur.

Planning for Neutralization

- Before starting the procedure, calculate quantities of acid or base needed for neutralization. The relative strengths of commonly used acids and bases are summarized in Tables 7-1 and 7-2.
- Add the maximum amount of concentrated acid or base solution listed in the following tables to 10 L water in a 5 gallon bucket. A rule of thumb is to dilute up to 20 moles of acid protons per 10 L of water.
- Try a small batch first. Measure a few milliliters of waste acid solution into a beaker and gradually add a measured amount of base while testing its pH and observing its reaction. Assess the amount of heat and fumes generated, and the amount of base needed. Use these observations for scaling up your neutralization. Remember, when scaling up, the lower ratio of surface area to volume may make heat dissipation a problem. Use ice, go slow and stir often.

Table 7-1 Strengths of Concentrated Acids

Concentrated Acid	Amount to furnish one mole of acid protons	Maximum Volume per neutralization in 5 gallon Bucket
Acetic Acid (Glacial)	57.1 ml	1.50 L
Formic Acid (88%)	43.6 ml	1.20 L
Hydrochloric Acid	83 ml	2.20 L
Hydrofluoric Acid (50%)	34.6 ml	0.75 L
Nitric Acid	67 ml	1.00 L
Perchloric Acid	83 ml	1.00 L
Phosphoric Acid (85%)	45.6 ml	1.20 L
Sulfuric Acid	27.7 ml	0.75 L

Table 7-2 Strengths of Bases Used for Neutralizations

Base	Amount to furnish one mole of base protons	Notes
Ammonium Hydroxide	67 ml	Must be used in a fumehood. (15 Molar)
Calcium Hydroxide	37 g	Add as a powder to neutralize acids.
Magnesium Hydroxide	29 g	Add as a powder to neutralize acids.
Potassium Hydroxide	56 g	Dissolve 336 g KOH per liter of water to make 6 N solution.
Sodium Bicarbonate	84 g	This is best used as a spill neutralizer due to foaming.
Sodium Carbonate	53 g	This is best used as a spill neutralizer due to foaming.
Sodium Hydroxide	40 g	Dissolve 240 g NaOH per liter of water to make 6 N solution.

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Acetonitrile

Acetonitrile (methyl cyanide, cyanomethane) is a widely used solvent for HPLC analyses and extractions. It is classified by EPA as a toxic waste and by DOT as a flammable liquid and poison. It is slightly toxic by acute exposure through oral intake, skin contact and inhalation. However, acetonitrile can be converted to cyanide by the body.

Laboratories using acetonitrile perform the detoxification procedure described below.

Detoxification of Acetonitrile

WARNING!

The reaction must be carried out in an open system to allow the ammonia to escape. This procedure should therefore be performed inside a fume hood.

Overall Reaction

$$CH_3CN \quad \underset{OH}{\underline{+H20}} \quad CH_3CONH_2 \quad \underline{+NaOH} \quad CH_3COO\text{-}Na+ \quad + \quad NH_3$$

Procedure

Dilute acetonitrile waste with water to a concentration of ~ 10% (v/v).

- This step must be done first to prevent a two-phase system from occurring upon addition of the sodium hydroxide.

Add in excess 10 M sodium hydroxide in water (400 g/L).

- Use 2.5 mol of sodium hydroxide per 1 mol acetonitrile.
- The mixture should be strongly basic and should be stirred occasionally.

The mixture should then be heated to 80°C for 70 minutes.

Allow the solution to cool, then neutralize with hydrochloric acid to a pH between 5 and 9.

The resulting by-product, dilute acetic acid (vinegar) and salt can safely be flushed down the sanitary sewer.

Example Data

Beginning with 30% acetonitrile waste

250 ml of acetonitrile plus 750 ml of water were added together to make ~7.5% solution of acetonitrile waste.

475 ml of 10 M sodium hydroxide was added to 1 L of 7.5% waste.

Heated to 80°C for 70 minutes. Approximate concentration of acetonitrile is now 0.025% or 0.25 ml.

Cooled solution was neutralized with hydrochloric acid to pH 7 and poured down the drain with excess water.

Potassium Dichromate

Potassium dichromate (K2Cr2O7) is an oxidizer and listed as a heavy metal (D007) waste by EPA. Its characteristic bright orange-red crystals are used on campus by various departments for a variety of reasons. Potassium dichromate dust is listed as a possible human carcinogen. Contact with combustible material may cause fire.

Potassium dichromate waste generators are required to perform the following end-of-process treatment on their waste before submitting it to EHS for disposal. This procedure reduces the volume of material to be sent off-site. We ask that you call us before purchasing potassium dichromate because we may be able to provide it at no cost.

Overall Reaction

$$Cr_2O_7^{2-} + 3S_2O_3^{2-} + 2H_3O^+ \longrightarrow \underbrace{2Cr(OH)_3}_{\text{Chromium hydroxide (insoluble)}} + 3SO_4^{2-} + 3S$$

Waste Disposal (small quantities)

Working in the fume hood, put 875 ml of potassium dichromate waste into a pail. The pH should be around 1.

While stirring, add 160 g of sodium thiosulfate* to pail. The solution will become cloudy and blue-green in color.

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The solution should then be neutralized with diluted sodium hydroxide. This will take approximately the same volume as the potassium dichromate waste.

A precipitate will begin to form. The solution should be left for one week.

After one week, the supernatant can be decanted and poured down the drain, followed by excess water. The remaining solid/water mixture should be poured into a properly labeled container for pickup and disposal by EHS. For 150 ml of waste solution, add about 13.5 g of sodium thiosulfate.

Ethidium Bromide

Ethidium bromide (EtBr) is a powerful mutagen widely used for visualizing nucleic acids in DNA work. Many laboratories used Clorox (sodium hypochlorite 5%) to render ethidium non-hazardous; however, recent studies have proven that this method does not completely oxidize EtBr to non-mutagenic compounds.

All laboratories using EtBr are asked to either purchase the S&S Extractor for EtBr or perform destruction procedures at the end of each experiment. Both of these alternatives are provided here.

GVS EtBr Waste Reduction System

The GVS EtBr Waste Reduction System provides for rapid removal of EtBr from gel staining solutions with a one-step filtration method. This limited reuse disposable unit removes >99% of EtBr from a liter of electrophoretic buffer in about one minute. The Extractor device will maintain this removal efficiency for up to 10 successive liters. After filtration, the decontaminated solution can safely be discarded down the laboratory drain. Once the charcoal filter is spent, submit the bagged filter to EHS via CHEMATIX™ for a pickup. The extractor funnel fits most standard laboratory flasks, and the unit includes a cap for easy storage between filtrations. Prices range from $86.64 to $241.69/system depending on quantity.

For product information and how to purchase the product, contact your VWR Scientific representative for more information on GVS products.

Chemical Destruction and Decontamination of Ethidium Bromide Solutions and Surfaces Contaminated with EB

The following procedure for the destruction and decontamination of EtBr can render it safe for disposal down the sanitary sewer and minimize the amount of hazardous waste generated in the laboratory. It was based on studies by Lunn and Sansone and originally published by the Howard Hughes Medical Institute.

WARNING: EtBr is toxic and mutagenic.
Hypophosphorous acid and its solutions are corrosive.
Decontamination solutions give off a small amount of nitrogen dioxide, a toxic gas, when initially mixed.
This procedure has been validated for solutions of EtBr (0.5 mg/ml) in water, TBE buffer, Mops buffer and cesium chloride.

LABORATORY SAFETY PRACTICES AND EQUIPMENT

• Prepare decontamination solution in a fume hood.
• Wear rubber gloves, lab coat and safety glasses.
• Turn off electrical equipment before decontamination.

PREPARATION OF DECONTAMINATION SOLUTION

• Add 20 ml of hypophosphorus acid (50%) to a solution of 4.2 g of sodium nitrite in 300 ml of water.
• Stir briefly.
• Prepare fresh solution the day of use.

DECONTAMINATION OF EtBr SOLUTIONS

• For EtBr solutions with concentrations of EtBr greater than 0.5 mg/ml, dilute with water to 0.5 mg/ml.
• Add decontamination solution to EtBr solution to final concentration of 25% decontamination solution (i.e., add 25 ml decontamination solution to 75 ml EtBr solution).
• Stir briefly and let stand for 20 hours.
• Test mixture for fluorescence; repeat procedure with fresh decontamination solution if fluorescence is present.
• Neutralize with sodium bicarbonate and discard as non-hazardous aqueous waste.

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DECONTAMINATION OF SURFACES CONTAMINATED WITH EtBr
Procedure has been validated for EtBr-contaminated stainless steel, formica, glass, vinyl floor tile surfaces, and filters of transilluminators.

- Soak paper towel in decontamination solution, place on contaminated surface, and scrub.
- Scrub another five times with paper towels soaked in water, using fresh towel each time.
- Place all towels in a large container and soak in fresh decontamination solution for one hour.
- Test squeezings from final towel scrub and mixture for fluorescence; repeat procedure with fresh decontamination solution if fluorescence is present.
- Neutralize with sodium bicarbonate and discard as non-hazardous aqueous waste.

SYBR Safe® DNA Gel Stain

This revolutionary product is specifically developed to enhance lab safety without compromising staining performance. Compared to ethidium bromide, it is less mutagenic, less toxic, more environmentally friendly, yet still works with traditional gel staining methods. In contrast, ethidium bromide, a widely used staining product on the University campus, is highly toxic, a possible carcinogen, and a known mutagen.

SYBR Safe® DNA Gel Stain is not classified as corrosive, ignitable, or reactive under EPA guidelines. Additionally, SYBR Safe® DNA Gel Stain is not classified as hazardous waste under U.S. Federal regulations. It meets the requirements of the Clean Water Act and the National Pollutant Discharge Elimination System (NPDES) requirements. Therefore it is not necessary to submit it to EHS as a hazardous waste.

There are several products in the SYBR Safe® line that can be utilized depending on your lab's requirements for gel staining.

The Green Bag

Another simple charcoal filtration method is the Green Bag® Kit which allows rapid and trouble-free concentration of ethidium bromide from large volumes of solutions into a small "tea" bag containing activated carbon which is then conveniently disposed along with other solid hazardous wastes. One kit has the capacity to remove 500 mg of ethidium bromide from solutions (10mg EtBr/bag).

- Place the Green Bag into the ethidium bromide solution.
- Allow to sit for the allotted time.
- Pour filtrate down the drain.
- Dispose of the Green bag in the biohazardous waste box for incineration.

Green Bags are available through VWR.

Formaldehyde

Formaldehyde (methyl aldehyde) and formalin (37 - 40% solution in 5 - 12% methanol) is widely used as a disinfecting, sterilizing and embalming agent. It is classified by EPA as a toxic waste and by DOT as a flammable liquid and corrosive depending on the concentration of the solution. It is moderately toxic by skin contact and inhalation.

Waste formaldehyde and formalin solutions can be easily treated in the laboratory and rendered non-hazardous by purchasing and utilizing Formalin Neutralizing Powder from VWR. The antimicrobial ability of formaldehyde originates from its reaction with various microorganisms containing amino groups. All microorganisms contain amino acids and thus contain reactive amino groups for potential reaction with formaldehyde. The principle of the treatment of formaldehyde with Formalin Neutralizing Powder from VWR is related to that of the antimicrobial ability of formaldehyde. Formalin Neutralizing Powder is able to convert formaldehyde to a non-toxic, water soluble polymer.

Sakura Products® markets a similar aldehyde control product called Tissue-Tek® FormaGo Formalin Neutralizer.

Cyanides (Water Soluble)

Cyanides of alkali metals such as sodium and potassium cyanide are highly toxic by ingestion or skin absorption. These materials are freely soluble in water. However, most metal cyanides present a serious hazard by forming extremely toxic hydrogen cyanide when coming into contact with acids. The EPA classifies most cyanides as toxic wastes and many appear on the P code list which is acute hazardous waste. Remember, P code listed materials greatly influence the University's generation status, see Chapter 1.

Laboratories doing research with cyanides should first contact this office before purchasing, in the event the material can be acquired at no cost. However, if it is not available, the researcher should purchase the smallest quantity possible. Cyanides can be destroyed through oxidization to form nonhazardous cyanates. All laboratories using cyanides must manage them in accordance with the procedure described below.

https://cws.auburn.edu/rms/pm/wastemanagement
844-4870 fax: 844-4197
Email Address: hodgetf@auburn.edu
Mailing Address: 1161 W. Samford Avenue, Building 9
Auburn University, AL 36849

Detoxification of Cyanides

Warning:
The reaction must be carried out in a fumehood while wearing nitrile gloves, a laboratory coat and proper eye protection.

Overall Reaction

$$CN^- + ClO^- \longrightarrow \underset{\text{cyanate}}{CNO^-} + Cl^-$$

Procedure

Dilute the solution of cyanide with water to a concentration not greater than 2%.

For each 50 ml of solution, slowly add, by stirring, 5 ml of 10% sodium hydroxide solution, and 60 - 70 ml of household bleach. Test the solution for continued presence of cyanide as follows.

Test Procedure for the Presence of Cyanide

Remove about 1 ml of the solution and place in a test tube.

Add two drops of a freshly prepared 5% aqueous ferrous sulfate solution.

Boil the mixture for 30 seconds, cool to room temperature, and add two drops of 1% ferric chloride solution.

Acidify the mixture to litmus with 6 M hydrochloric acid (slowly add concentrated acid to an equal volume of cold water). If cyanide is still present, a deep blue precipitate forms.

Note: If the test is positive, more bleach is added to the cyanide solution and the test is repeated. When the blue precipitate no longer forms, the solution can be washed down the drain.

Definitions and Terms

ADEM	Alabama Department of Environmental Management.
Characteristic Waste	A material that is regulated as a hazardous waste if it is ignitable, corrosive, reactive or fails the TCLP.
Complicated Spill	A spill defined as one that may result in fire or explosion or immediately dangerous to life and health.
Container	A waste receptacle that is capable of being securely sealed, and transported. The container must be compatible with the waste stored in it.
Corrosive Waste	Waste that has a pH less than, or equal to, 2 or greater than, or equal to, 12.5.
EPA	Environmental Protection Agency.
Generator	A person or institution that creates hazardous waste.
Hazardous Material	A material capable of causing harm to humans or the environment.
Hazardous Waste	A waste material that meets one or more of the characteristics identified in state and federal regulations or listed as a regulated waste when discarded.
EHS	Environmental Health & Safety.
HMSF	Hazardous Materials Storage Facility.
SAA	Hazardous Waste Satellite Accumulation Area is a designated place in the laboratory or work area where hazardous wastes are stored until they are ready for pickup. There must be less than 15 gallons of hazardous waste (10 gallons for flammable liquid waste) at any one time in the Hazardous Waste Satellite Accumulation Area.
Ignitable Waste	Waste that has a flashpoint less than 60°C (140°F).
In-Laboratory	Chemical Procedure that involves simple treatment and disposal.
Management	Methods performed in your laboratory; such as bleach

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deactivation, detoxification, filtration and neutralization.

IUPAC International Union of Pure and Applied Chemistry Label Required wording on each container of hazardous waste. It must state the word Waste and the name of all chemicals contained within.

LQG Large Quantity Generator.

Listed Waste A solid waste that is identified on any of the lists in 40 CFR 261 Subpart D. These include hazardous waste from non-specific sources (F-Code), hazardous waste from specific sources (K-Code), characteristic hazardous waste (D-Code) and discarded commercial chemical products, off-specification species, container residues and spill residues thereof (P-Code and U-Code).

Mixed Waste Waste that is both hazardous and radioactive.

SDS Safety Data Sheet.

Product A commercial chemical which is properly labeled as to its identity, is in the original container or a container which maintains the chemical's integrity while affording safe storage and is being used for the purpose generally associated with the chemical. Residues of commercial products may require disposal through EHS.

Reactive Waste Waste that can explode or react violently with air or water and some chemicals like cyanides and sulfides that may produce toxic gases.

RCRA Resource Conservation and Recovery Act. Federal legislation which regulates generation, storage, transportation and disposal of hazardous wastes.

Simple Spill A spill defined as one that does not spread rapidly, does not endanger people or property except by direct contact and does not endanger the environment outside the building. A simple spill can be neutralized, absorbed, or otherwise managed by the user(s) of the chemical.

SQG Small Quantity Generator.

Solid Waste Any garbage, refuse, sludge or other discarded material which is abandoned, recycled, or considered inherently waste-like and is not excluded under Title 40 of the Code of Federal Regulations.

TCLP Waste — Toxic Characteristic Leaching Procedures. Material that is listed toxic by a test that mimics the acidic condition within a sanitary landfill. It measures the concentration of the toxic material(s) which would most likely leach into the ground water (see Table 1-1 for a list of the chemicals.)

Toxic Waste — Chemicals that are on specific lists because they are carcinogens, mutagens, teratogens, or toxic compounds. These lists only cover pure chemicals (not solutions or mixtures!) that are discarded and spills of these pure chemicals. See Chapter 1.

TSDF — Treatment, Storage and Disposal Facility.

Unknown Chemical — Any substance whose chemical properties or chemical components can not be identified by the generator without analytical testing.

VSQG — Very Small Quantity Generator

Waste Card — A CHEMATIX™ label that contains the required information for classifying the waste for proper storage and disposal and must accompany each container of waste to the Hazardous Waste Storage Facility. Unlabeled wastes cannot be processed by EHS.

Waste Minimization — An effective method for reducing and or eliminating the generation of hazardous waste through substitution, source reduction, recycling and treatment.

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Resource Documents

For manuals and guidance documents provided by this Department, visit RMS's Chemical Safety Guides, Tools and Resources.

Recommended Reading

Armour, Margaret-Ann, *Hazardous Laboratory Chemicals Disposal Guide, Third Edition*; CRC Press, Inc., 2003.

Kelly, Richard, *"Review of Safety Guidelines for Peroridizable Organic Chemicals"* Chemical Health & Safety, September/October, 1996.

National Research Council, *Prudent Practices in the Laboratory: Handing and Disposal of Chemicals,* Washington, D.C., National Academy Press, 2011.

Acknowledgments

Sources of information, inspiration, innovation and incidental taking behind this guide. Michigan State University Environmental Health & Safety University of Kentucky Environmental Health and Safety University of Wisconsin at Madison Environment, Health & Safety Department Eastern Illinois University Department of Environmental Health and Safety Florida State University Environmental Health and Safety Sonoma State University Environmental Health and Safety Princeton University Environmental Health & Safety	Auburn University Department of Chemistry and Biochemistry University of Iowa Environmental Health & Safety University of Vermont Risk Management & Safety Oklahoma State University Environmental Health and Safety University of California at Berkeley The Office of Environmental Health and Safety Princeton University Environmental Health and Safety University of Virginia Environmental Health and Safety University of Colorado Environmental & Radiological Health Services University of Illinois at Urbana-Champaign Division of Division of Research Safety

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