PART I: MANAGEMENT OF HAZARDOUS CHEMICAL WASTES AT UT MEMPHIS

The management of hazardous chemical waste at UT Memphis consists of the coordination and direction of the waste generated in hundreds of laboratories and other campus facilities. To manage this large program effectively, it is necessary to use the services and technical expertise of the University Committee on Safety, Security and Occupational Health, faculty, and staff members. This section describes the functions and responsibilities for hazardous chemical waste management.

A. SAFETY OFFICER

The Safety Officer is responsible for the administration of policy pertaining to institutional safety and health related matters. The Safety Officer oversees the administration of safety policies reporting through the Vice Chancellor for Administration.

B. COMMITTEE ON SAFETY, SECURITY AND OCCUPATIONAL HEALTH

The Committee on Safety, Security and Occupational Health advises the Safety Officer and Deans on matters pertaining to chemical safety within the University. The Committee periodically reviews safety guidelines and the chemical safety educational activities of the University. The Committee also advises the Safety Officer on issues relating to the criteria for development and implementation of new chemical and biological safety programs.

C. SAFETY OFFICE

Safety Office is responsible for surveillance of all laboratory activities involving the use of toxic agents and all additional chemical and biological problem areas within the confines of UT Memphis. Specific duties of the department include:

1. Implementation of policies set by UT Memphis.

2. Design and improvement of disposal procedures for chemical waste materials.

3. Preparation, submission and maintenance of records, reports, and manifests as required by government regulations.

4. Preparation of applications for state and federal permits to generate and properly dispose of hazardous chemical waste.

5. Assuring that University policy and guidelines regarding proper disposal of hazardous chemical waste are followed.

D. PRINCIPAL INVESTIGATOR, CLASSROOM INSTRUCTOR, OR SUPERVISOR

The principal investigator, classroom instructor, or supervisor has the primary responsibility for assuring that the policies, guidelines or directives established herein are followed by all personnel, including other researchers, under their jurisdiction.

E. THE LABORATORY WORKER AND OTHER INDIVIDUALS

The success of the UT Memphis hazardous chemical waste management program is dependent upon the conscientious efforts of the individual laboratory worker and staff employee. Since the laboratory worker frequently handles hazardous chemicals, it is essential that he or she follow the advice, policies and procedures of the Safety Office. The individual staff member is expected to:

1. Dispose of all chemical wastes in accordance with established procedures set forth in this disposal guide.

2. Make a concerted effort to identify all unknown surplus chemicals, utilizing the technical knowledge of faculty members or the Safety Office, if necessary.

3. Package and label surplus and waste chemicals in accordance with established procedures set forth in this disposal guide.

4. Seek the advice, when necessary, of the Safety Office concerning the proper handling and disposal of hazardous chemicals.

PART II: MANAGING CHEMICAL WASTES AND SURPLUS CHEMICALS

A. CHEMICAL WASTE MANAGEMENT AT UT MEMPHIS

The significant amount of chemical wastes generated at the University each month presents a serious and complex problem for the entire University community. Unless it is understood that chemical waste is everyone's problem and responsibility, teaching and research efforts may be severely compromised. The key to solving this problem lies in recognizing the responsibility, understanding the management system, and reducing the volume of surplus and waste chemicals.

1. Your Problems and Responsibilities

Surplus and waste chemicals are your problem. When hazardous chemicals are mishandled or mismanaged, they have the potential to contaminate the environment and threaten human health. Whether your waste chemicals are generated in organic synthesis or biomedical research, understanding your responsibility for those wastes or unwanted chemicals is the most important first step in sound chemical waste management. See Part I, Section E for the responsibilities of the laboratory worker and individual staff member.

2. UT Memphis Chemical Waste Management System

The success of the management system depends upon cooperation between you and the Safety Office. You are to use this disposal guide to identify chemical waste and determine the appropriate route of disposal for that waste. This guide outlines three routes of disposal for your surplus or waste chemicals.

a. disposal to the normal trash or sanitary sewer system;

b. chemical treatment, followed by disposal to the sanitary sewer system; and

c. delivery to the Safety Officer recycling, incineration or landfilling in accordance with local, state and federal regulations.

When your surplus or waste chemicals are given to the Safety, we first check to see if the chemical is a waste or can be recycled. We then determine the degree of hazard and appropriate route of disposal. Non-hazardous waste are disposed of in the sanitary sewer or local sanitary land fill. Waste solvents and other hazardous wastes are disposed through a commercial hazardous waste disposal company.

Due to the nature and type of chemical wastes, this is a very costly procedure.

Throughout this process, the University is required to keep complete records which account for hazardous wastes "from the cradle to the grave," a concept which holds the generator of the waste liable for that waste, essentially forever.

3. Your Job In Waste Reduction

The act of Congress which makes it illegal to improperly manage hazardous wastes is entitled "The Resource Conservation and Recovery Act," or RCRA. The emphasis of this act is on waste reduction, hazardous waste identification and recycling. Of the disposal methods described above, hazardous waste landfilling is the least desirable. The Safety Office embraces this philosophy and has designed its management system around waste reduction and recycling methods. This makes sense because the handling, transport, treatment and disposal of chemical waste is expensive.

The RCRA Re authorization Act of 1984 mandates that hazardous waste generators institute waste minimization procedures into their waste management programs. As of September 1, 1985, disposal manifests must contain "generator certification that the volume or quantity and toxicity of the waste has been reduced."

To Assist in Waste Reduction, Please:

a. Order only what is needed. The economy of larger sizes may cost the University in disposal of your excess, often more than the original cost.

Be sure to check current stock before ordering chemicals. It may also be possible to borrow small amounts of chemicals from other laboratories. Take the time to check.

b. Substitute non-hazardous or less hazardous materials for hazardous ones whenever possible. There are many non-hazardous substitutes for chromic acid (see Section E.4). Dichloromethane is much less toxic than carbon tetrachloride and can be substituted satisfactorily in most cases.

Investigate other possible substitutions through the literature or call the Safety Officer assistance.

c. Chemicals that can be safely disposed of in the normal trash (Section C) or in the sanitary sewer system (Section D) should not be given to the Safety Office, put into solvent collecting bottles or mixed with hazardous chemicals.

d. Minute quantities need not be disposed of as hazardous waste. Small quantities or low concentrations of hazardous chemicals may be disposed of with the normal trash or in the sanitary sewer system. With some hazardous chemicals this is a difficult decision: It is important that small quantities of very hazardous chemicals not be mixed with non hazardous waste, as this may cause the entire waste to be listed as hazardous. If you need assistance, please call the Safety Office.

e. Use recycled chemicals whenever possible. The Safety Office is developing a program of recycling usable, but unwanted chemicals.

All chemicals are in their original container and may still have their factory seals. Periodically, the Safety Office will distribute a list of available, recyclable chemicals to all departmental business managers. Additionally, if you are interested in obtaining a specific chemical, call the Safety Office first, as we may be able to locate the substance for you on campus.

Before you dispose of an unwanted but usable chemical, please check to see if other laboratories in your department or building can use it.

f. Treat chemicals in your laboratory. When you order a chemical, the responsibility for disposal accompanies the order. Don't give the Safety Office a chemical you can safely treat in your laboratory. Acids and bases should be neutralized and put into the sewer system. Appropriate procedures are given in this guide (Section E). Other treatments which can be performed in your laboratory are metal precipitations and safe reduction of strong oxidizers. Please call Safety Office for the proper procedures for carrying out these and other chemical treatments, and don't hesitate to call if you have any questions regarding treatment procedures.

g. Waste solvents are most properly disposed of by incineration. The solvent collection in your laboratory is for the disposal of flammable organic solvents.

4. Other Waste Volume Reduction Methods

a. When planning experiments, consider the disposal of leftover starting materials and the products and by-products which will be generated.

Consider the following questions in your planning:

i. Can any material be recovered for reuse?

ii. Will the experiment generate any chemical that should be destroyed by a laboratory procedure? If so, what procedure?

iii. Can any unusual disposal problems be anticipated? If so, inform the Safety Office before disposal procedures are implemented.

iv. Are chemicals being acquired only in needed quantities?

v. Is there a possibility of replacing a hazardous reagent or solvent with one that is less hazardous and easier to dispose of?

b. Reduction of the Scale of Experiments

The use of micro technology in the study of chemical and biochemical reactions can lead to significant savings in costs of chemicals, energy, apparatus, and space. It is now technically feasible to run many reactions with much smaller quantities of chemicals than were needed 25 years ago.

Some of the technical advances that have made this possible include:

i. Fast, microprocessor-based, top-loading balances that are sensitive to 01. mg.;

ii. Chromatographic techniques, such as high performance liquid, gas, size exclusion, and ion exchange, that can cleanly separate and purify milligram quantities of substance;

iii. Sensitive spectrometers that can analyze milligram quantities of substance;

iv. Microscale glassware, including pipettes, burettes, syringes, reactors, and stills for handling reagents and reagent products;

v. Flow and transfer systems based on small internal diameter metal and plastic tubing that make it possible to study flow type reaction, catalysts, and multi-step reactions on a very small scale, even under pressure.

In addition to reduction of waste volumes, today's economics dictate investigation of these micro techniques for use in laboratory operations.

c. Control of Reagents That Can Deteriorate

Indefinite and uncontrolled accumulation of excess reagents create storage problems and safety hazards. These problems can be alleviated, and purchase costs saved, by instituting an excess- chemicals store to which laboratory workers can go for chemicals instead of ordering new material.

Reagents that react readily with oxygen or water are prone to deteriorate when stored for long periods of time after the original container has been opened. A laboratory labeling program for chemicals which deteriorate over time (such as water reactive chemicals and pyrophoric chemicals) or which can create severe hazards (such as peroxide forming chemicals) should be instituted to prevent accumulation of dated chemicals which pose an increased risk to the laboratory and personnel.

d. Prevention of Orphan Reaction Mixtures

All reaction mixtures stored in laboratory glassware should be labeled with the chemical composition, the date they were formed, the name of the laboratory worker responsible, and a notebook reference.

This procedure can provide the information necessary to guide the disposal of the mixture if the responsible laboratory worker is not available.

Departments may need to initiate a checkout procedure which requires departing laboratory workers and faculty to identify any reaction mixtures that they have not disposed of and to provide the information necessary for their safe disposal. It may also be necessary for departments to require a financial deposit from incoming graduate students, to be refunded at the time of their departure, after it has been determined that no orphan reaction mixtures have been left behind.

Individual departments will be responsible for the costs associated with the identification, removal, and any extraordinary clean up of orphan reaction mixtures and unknown chemicals left behind by departing investigators or graduate students.

B. WHAT IS HAZARDOUS CHEMICAL WASTE?

The information in this section will aid the laboratory worker in determining the hazards associated with chemicals which are encountered either during instructional classes or research at the University. The State Department of Conservation Division of Solid Waste Management, the agency responsible for the regulation of hazardous chemical waste generated in this state, uses the following criteria to determine if a waste should be listed as hazardous waste:

- it exhibits any of the characteristics of hazardous waste identified in Section B-1 below.

- it has been found to be fatal to humans in low dose or, in the absence of data on human toxicity, it has been shown in studies to have an oral LD50 toxicity (rat) of less than 50 milligrams per 50 kilogram, an inhalation LC50 toxicity (rat) of less than 2 milligrams per liter, or a dermal LD50 toxicity (rabbit) of less than 200 milligrams per kilogram, or is otherwise capable of causing or significantly contributing to an increase in serious irreversible, or incapacitating reversible, illness. (Waste listed in accordance with these criteria will be designated Acute Hazardous Waste.)

- it contains any of the toxic constituents listed in Section B-2 (below).

There is some overlap between the chemicals included in Sections B-1 and B-2, as some chemicals fit the criteria of both sections. A list of chemicals which may be disposed of in the normal trash or the sewer system are given in Sections C and D. If, after reading these sections, you are in doubt about the proper method of disposal or hazard associated with a specific substance, contact the Safety Office for assistance.

1. Hazardous Characteristics

Chemicals which have any of the following four characteristics are considered to be hazardous by the state Department of Public Health.

a. Ignitability

A liquid, other than an aqueous solution, containing less than 24 percent alcohol by volume, which has a flash point of less than 60 C is considered ignitable. This category includes almost all organic solvents. Some examples are:

acetone	methanol	ethanol
toluene	benzene	pentane
hexane	xylenes	heptane
ethyl acetate	dioxane	petroleum ethers

This is only a small number of examples. Instructions for the disposal of organic solvents are given in Section F.

b. Corrosivity

An aqueous solution that has a pH of less than or equal to 2, or greater than or equal to 12.5, is considered corrosive. Corrosive materials also include substances such as thionyl chloride, solid sodium hydroxide and some other non-aqueous acids or bases.

c. Reactivity

Chemicals which react violently with air or water are considered hazardous.

Examples are sodium metal, potassium metal, phosphorus, etc. Reactive materials also include strong oxidizers such as perchloric acid and chemicals capable of detonation when subjected to an igniting source, such as dry, crystalline picric acid, benzoyl peroxide or sodium borohydride.

Instructions for the disposal of these reactive materials are given in Section I. Solutions of certain cyanides or sulfides which could generate toxic gases are also classified as reactive. Disposal instructions for these types of compounds are given in Section G.6.

d. Toxicity Characteristic Leaching Procedure (TCLP)

Chemicals characterized as TCLP are those that may leach hazardous concentrations into the groundwater if their wastes are improperly managed. TCLP wastes include concentrated toxic metal solutions (see Section G.2 for disposal instructions) and the following list of pesticides:

Endrin	Lindane	2,4,D
Methoxychlor	Toxaphene	2,4,5-TP Silvex

Disposal instructions for pesticides are given in Sections F, G, or H depending on their physical form.

2. List of Hazardous Constituents

This section presents a list of substances which have been shown in scientific studies to have toxic, carcinogenic, mutagenic or teratogenic effects on humans or other life forms and are designated as Toxic Wastes. Materials containing any of the toxic constituents listed in this section are to be considered hazardous waste, unless, after considering the following factors it can reasonably be concluded that the waste will not pose a substantial present or potential hazard to public health or the environment when properly treated, stored, transported or disposed of, or otherwise managed.

a. The nature of the toxicity presented by the constituent;

b. The concentration of the constituent in the waste;

c. The potential of the constituent or any toxic degradation product of the constituent to migrate from the waste into the environment under the types of improper management considered in item (g) below;

d. The persistence of the constituent or any toxic degradation product of the constituent;

e. The potential for the constituent or any toxic degradation product of the constituent to degrade into non-harmful constituents and the rate of degradation;

f. The degree to which the constituent or any degradation product of the constituent bioaccumulates in ecosystems;

g. The plausible types of improper management to which the waste could be subjected;

h. The quantities of the waste generated at individual sites or on a regional or national basis;

i. The nature and severity of the public health and environmental damage that has occurred as a result of the improper management of wastes containing the constituent;

j. Actions taken by governmental agencies or regulatory programs based on the health or environmental hazard posed by the waste or waste constituent; and

k. Such other factors as may be appropriate.

HAZARDOUS CONSTITUENTS

Acetaldehyde (Ethanal)
Acetonitrile (Ethanenitrile) (Methyl Cyanide)
3-(alpha-Acetonylbenzyl)-4-hydroxycoumarin and salts
2-Acetylaminofluorene (Acetamide,N-(9H-fluoren-2-yl)-)
Acetyl chloride (Ethanoyl chloride)
1-Acetyl-2-thiourea (Acetamide,N-(aminothioxomethyl)-1-1)
Acrolein (2-Propenal)
Acrylamide (2-Propenamide)
Acrylonitrile (2-Propenenitrile)
Aflatoxins
Aldrin (1,2,3,4,10:0-Hexachloro-1,4,4a,5,8,8a-hexahydro-1,4:5,8-dimethanonaphthalene)
Allyl alcohol (2-Propen-1-o1)
Aluminum phosphide
4-Aminobiphenyl ((1,1'-Bipenyl)-4-amine)
6-Amino-1,1a,2,8,8a,8b-hexahedro-8-(hydroxymethyl)-8a-methoxy-5-methyl-carbamate azirino(1',3':3,4)pyrrolo(1,2-a)indol 4,7-dione (ester) (Mitomycin C)
5-(Aminomethyl)-3-isoxazolol
4-Aminopyridine (4-Pyridinamine)
Amitrole (1H-1,2,4-Triazol-3-amine)
Ammonia, liquid
Aniline (Benzeneamine)
Antimony and compounds, N.O.S.*
Aramite
Arsenic and compounds, N.O.S.*
Arsenic acid (Orthoarsenic acid)
Arsenic pentoxide (Arsenic(V)oxide)

Arsenic trioxide (Arsenic(III)oxide)
Auramine
Azaserine (L-Serine, diazoacetate(ester))
Barium and compounds, N.O.S.*
Barium cyanide
Benz(c)acridine (3,4-Benzacridine)
Benz(a)anthracene (1,2-Benzanthracene)
Benzene (Cyclohexatriene) (Benzol)
Benzenearsonic acid (Arsonic acid, phenyl-1)
Benzenethiol (Thiophenol)
Benzidine ((1,1'-Biphenyl)-4,4'diamine)
Benzo(a)anthracene
Benzo(b)fluoranthese (2,3-Benzofluoranthene)
Benzo(j)fluoranthese (7.8-Benzofluoranthene)
Benzo(a)pyrene (3,4-Benzpyrene)
p-Benzoquinone (1,4-Cyclohexadienedione)
Benzotrichloride (Benzene, trichloromethyl-)
Benzyl chloride (Benzene, (chloromethyl)-)
Beryllium and compounds, N.O.S.*
Bis(2-chloroethoxy)methane (Ethane, 1,1-methylenebis(oxy))bis(2-chloro-))
Bis(2-chloroethyl)ether (Ethane, 1,1'oxybis(2-chloro-)) N.N-Bis(2-chloroethyl)-2-naphthylamine
Bis(2-chloroisopropyl)ether (Propane, 2,2'-oxybis(2-chloro-))
Bis(chloromethyl)ether (Methane, oxybis(chloro-))
Bis(2-ethylhexyl)phthalate (1,2-Benzenedicarboxylic acid, bis(2-ethyl-hexyl)ester)
Bromoacetone (1-Propanone, 1-bromo-)
Bromomethane (Methyl bromide)
4-Bromophenyl phenyl ether (Benzene, 1-bromo-4-phenoxy-)
Brucine (Strychnidin-10-one, 2,3-dimethoxy-)
2-Butanone peroxide (Methyl ethyl ketone peroxide)
Butyl benzyl phthalate (1,2-Benzenedicarboxylic acid, butyl phenyl-methyl ester)
2-sec-buty1-4,6-dinitrophenol (DNBP) (Phenol, 2,4-dinitro-6-(1-methyl-propyl)-)
Cadmium and compounds, N.O.S.*
Calcium chromate (Chromic acid, calcium salt)
Calcium cyanide
Carbon disulfide (Carbon bisulfide)
Chlorambucil (Butanoic acid, 4-bis(2-chloroethyl)aminobenzene-)
Chlordane (alpha and gamma isomers)
Chlorinated benzenes, N.O.S.*
Chlorinated ethane, N.O.S.*
Chlorinated fluorocarbons, N.O.S.*
Chlorinated naphthalene, N.O.S.*
Chlorinated phenol, N.O.S.*
Chloroacetaldehyde
Chloroalkyl ether, N.O.S.*
p-Chloroaniline (Benzenamine, 4-chloro-)
Chlorobenzene
Chlorobenzilate (4,4'-dichlorobenzilic acid ethyl ester)
1-(p-Chlorobenzoyl)-5-methoxy-2-methylindole-3-acetic acid
p-Chloro-m-cresol (Phenol, 4-chloro-3-methyl)
1-Chloro-2,3-epoxybutane
2-Chloroethyl vinyl ether (Ethene, (2-chloroethoxy)-)
Chloroform (Trichloromethane)
Chloromethane (Methyl chloride)

Chloromethyl methyl ether (CMME) (Methane, chloromethoxy-)
2-Chloronaphthalene
2-Chlorophenol (Phenol, o-chloro-)
1-(o-Chlorophenyl)thiourea (Thiourea,(2-chlorophenyl)-)
3-Chloropropionitrile (Propanenitrile, 3-chloro-) alpha-Chlorotoluene (see benzyl chloride)
Chromium and compounds, N.O.S.*
Chrysene (1,2-Benzphenanthrene)
Citrus red No. 2 (2-Naphthol, 1-(2,5-dimethoxphenyl)azo-)
Coal tars
Copper cyanide
Creosote
Cresols (Cresylic acid) (Phenol, methyl-)
Cresylic acid
Crontonaldehyde
Cyanides (soluble salts and complexes), N.O.S.*
Cyanogen (Ethane dinitrile)
Cyanogen bromide (Bromine cyanide)
Cyanogen chloride (Chlorine cyanide)
Cycasin (beta-D-Glucopyranoside, (methyl-ONN-azoxy)methyl-)
2-Cyclohexyl-4,6-dinitrolphenol
Cyclophosphamide
Daunomycin
DDD (Dichlorodiphenyldichloroethane)
DDE (Ethylene, 1,1-dichloro-2,2-bis(4-chlorophenyl)-)
DDT (Dichlorodiphenyltrichloroethane)
Diallate (S-(2,3-Dichloroallyl)diisopropylthiocarbamate)
Dibenz(a,h)acridine (1,2,5,6-Dibenzacridine)
Dibenz(a,j)acridine (1,2,7,8-Dibenzanthracene)
Dibenz(a,h)anthracene (1,2,5,6-Dibenzanthracene)
7H-Dibenzo(c,g)carbazole (3,4,5,6-Dibenzcarbazole)
Dibenzo(a,e)pyrene (1,2,4,5-Dibenzpyrene)
Dibenzo(a,h)pyrene (1,2,5,6-Dibenzpyrene)
Dibenzo(a,i)pyrene (1,2,7,8-dibenzpyrene)
1,2-Dibromo-3-chloropropane (DBCP)
1,2-Dibromoethane (Ethylene Dibromide) (EDB)
Dibromomethane (Methylene bromide)
Di-n-butyl phthalate (1,2-Benzenedicarboxylic acid, dibutyl ester)
Dichlorobenzene, N.O.S.*
3,3'Dichlorobenzidine
1,1-Dichloroethane (Ethylidene dichloride)
1,2-Dichloroethane (Ethylene dichloride)
trans-1,2-Dichloroethene (1,2-Dichloroethylene)
trans-2,3-Dichloroethene
Dichloroethylene, N.O.S.* (Ethene, dichloro-,N.O.S.)
1,1-Dichloroethylene (Ethene, 1,1-dichloro-)
Dichloromethane (Methylene chloride)
2,4-Dichlorophenol
2,6-Dichlorophenol
2,4D (2,4-Dichlorophenoxyacetic acid, salts and esters)
Dichlorophenylarsine (Phenyl dichloroarsine)
Dichloropropane, N.O.S.*
1,2-Dichloropropane (Propylene dichloride)
Dichloropropanol, N.O.S.*
Dichloropropene, N.O.S.*
1,3-Dichloropropene
Dieldrin

Diepoxybutane
Diethylarsine
N,N-Diethylhydrazine (Hydrazine, 1,2-diethyl)
O,O-Diethyl S-methyl ester of phosporodithioic acid
O,O-Diethylphosphoric acid, O-p-nitrophenyl ester (Phosphoric acid, diethyl p-nitrophenyl ester)
Diethyl phthalate (1,2-Benzenedicarboxylic acid, diethyl ester)
O,O-Diethyl-0-2-pyrazinyl phosphorothioate (Phosphorothioic acid, O,O-diethyl-Opyrazinyl ester)
Diisopropyl flurophosphate
Ethyl flurosulfonate
Ethyleneimine (aziridine)
Formaldehyde (Methylene oxide)
Glycidylaldehyde (1-Propanol,2,3-epoxy)
Halomethane, N.O.S.*
Heptachlor
Heptachlor epoxide (alpha, beta and gamma isomers)
Hexachlorobenzene
Hexachlorobutadiene (1,4-Butadiene, 1,1,2,3,4,4-hexachloro-)
Hexachlorocyclohexane (all isomers)
Hexachlorocyclopentadiene (1,2-cyclopentadiene, 1,2,3,4,5,5-hexa-chloro-)
Hexachloroethane (Ethane, 1,1,1,2,2,2-hexachloro-)
1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-haxahydro-1,4:5,8-endo,endo-dimethanonaphthalene
Hexachlorophene (2,2'-Methylenebis(3,4,6-trichlorophenol-))
Hexachloropropene (1-Propene, 1,1,2,3,3,3-hexachloro-)
Hexaethyl tetraphosphate (Tetraphosphoric acid, hexaethyl ester)
Hydrazine (Diamine)
Hydrofluoric acid (Hydrogen fluoride)
Hydrogen cyanide (Hydrocyanic acid)
Hydrogen sulfide (Sulfur hydride)
Indeno(1,2,3-cd)pyrene (1,10-(1,2-phenylene)pyrene)
Indomethacin
Iodomethane (Methyl iodide)
Iron dextran (Ferric Dextran)
Isocyanic acid, methyl ester (Methyl isocyanate)
Isobutyl alcohol (1-Propanol, 2-methyl-)
Isosafrole (Benzene, 1,2-methylenedioxy-4-allyl-)
Kepone (Chlordecone)
Lasiocarpine
Lead and compounds, N.O.S.*
Lead acetate (Acetic acid, lead(II) salt)
Lead phosphate (Phosphoric acid, lead salt)
Lead subacetate (Lead, bis(acetato-O)tetrahydroxytri-)
Lead tetraacetate (Acetic acid, lead(IV) salt)
Maleic anhydride (2,5-Furandione)
Malononitrile (Propanedinitrile)
Mechlorethane
Melphalan (Alanine, 3-(p-bis(2-Chloroethyl)amino)phenyl-,L-)
Mercury and compounds, N.O.S.*
Methapyrilene
Methomyl
Methoxychlor
2-Methylaziridine
3-Methylcholanthrene
4,4'-Methylene-bis-(2-chloroaniline)
Methyl ethyl ketone (MEK)

Methyl flurosulfanate
Methyl hydrazine
2-Methyllactonitrile
Methyl methacrylate
Methyl methanesulfonate
2-Methyl-2-(methylthio)propionaldehyde-o-(methylcarbonyl)oxime
N-Methyl-N'-nitro-nitrosoguanidine
Methyl parathion
Methylthiouracil
Mustard gas
Naphthalene
1,4-Naphthoquinone
1-Naphthylamine
2-Naphthylamine (beta-Naphthylamine)
1-Naphthyl-2-thiourea
Nickel carbonyl
Nickel cyanide
Nicotine and salts
Nitric oxide
p-Nitroaniline
Nitrobenzene
Nitrogen dioxide (Nitrogen (IV)oxide)
Nitrogen mustard compounds N.O.S.*
Nitrogen mustard and hydrochloride salt (Ethanamine, 2-chloro, N-(2-Chloroethyl)-N-methyl-,
and hydrochloride salt)
Nitrogen mustard N-Oxide and hydrochloride salt (Ethanamine, 2-chloro-ethyl)-N-methyl-, and
hydrochloride salt)
Nitrogen peroxide
Nitrogen tetroxide
Nitroglycerine (1,2,3,-Propanetriol, trinitrate)
p-Nitrophenol (4-Nitrophenol)(Phenol, 4-nitro-)
4-Nitroquinoline-1-oxide (quinoline, 4-nitro-1-oxide-)
Nitrosamine, N.O.S.*
N-Nitrosodi-n-butylamine (1-Butanamine, N-butyl-N-nitroso-)
N-Nitrosodiethanolamine (Ethanol,2,2'-(nitrosoimino)bis-)
N-Nitrosodiethylamine (Ethanamine, N-ethyl-n-nitroso-)
N-Nitrosodimethylamine (Dimethylnitrosamine)
N-Nitroso-N-ethylurea (Carbamide, N.-ethyl-N-nitroso-)
N-Nitrosomethylethylamine (Ethanamine, N-methyl-N-nitroso-)
N-Nitroso-N-methylurea (Carbamide, N-methyl-N-nitroso-)
N-Nitroso-N-methylurethane (Carbamic acid, methylnitroso-, ethyl ester)
N-Nitrosomethyl vinylamine (Ethenamine, N-methyl-N-nitroso-)
N-Nitrosomopholine (Morpholine, N-nitroso-)
N-Nitrosonornicotine (Nornicotine, N-nitroso-)
N-Nitrosopiperidine (Pyridine, hexahydro-, N-nitroso-)
Nitrosopyrrolidine (Pyrrole, tetrahydro-,-nitroso-)
N-Nitrososarcosine
5-Nitro-o-toluidine (Benzenamine, 2-methyl-5-nitro-)
Octamethylpyrophosphoramide (Diphosphoramide, octamethyl-)
Osmium tetroxide
7-Oxabicyclo(2.2.1)heptane-2,3-dicarboxylic acid
Parathion
Pentachlorobenzene
Pentachloroethane
Pentachloronitrobenzene (PCNB)

Pentachlorophenol
Phenacetine (Acetamide, N-4ethoxphenyl)-)
Phenol (Carbolic acid)
Phenyl dichloroarsine
Phenylenediamine (Benzenediamine)
Phenylmercury acetate (Mercury, (acetato)phenyl-)
N-Phenylthiourea
Phosgene (Carbonyl chloride)
Phosphine (Hydrogen phosphide)
Phosphorothioic acid,O,O-dimethyl ester, O-ester with N,N-dimethyl benzene sulfonamide
Phthalic acid esters N.O.S.* (Benzene, 1,2-dicarboxylic acid, esters, N.O.S.*)
Phthalic anhydride (1,2-Benzenedicarboxylic acid anhydride)
2-Picoline (Pyridine, 2-methyl-)
Polychlorinated biphenyl, N.O.S.*
Potassium cyanide
Potassium silver cyanide (Argentate(1,-), potassium dicyano-)
Pronamide (3,5-Dichloro-N-(1,1-dimethyl-2-propynyl benzamide)
1,3-Propanesulfone (1,2-Oxathiolane, 2,2-dioxide)
Propionitrile
n-Propylamine (1-Propanamine)
Propylthiouracil
2-Propyn-1-o1 (Propargyl alcohol)
Pyridine and salts
Reserpine
Resorcinol (1,3-Benzenediol)
Saccharin and salts
Safrole (Benzene, 4-ally-1,2-methylenedioxy)
Sarin
Selenious acid (Selenium dioxide)
Selenium and compounds, N.O.S.*
Selenium sulfide (Sulfur selenide)
Selenourea (Caramimidoselenoic acid)
Silver and compounds, N.O.S.*
Silver cyanide
Sodium cyanide
Soman
Streptozotocin (D-Glucopyranose, 2-dioxy-2-(3-methyl-3-nitrosoureido)-)
Strontium sulfide
Strychnine and salts (Strychnidin-10-one, and salts)
Tabon
1,2,4,5-Tetrachlorobenzene
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
Tetrachloroethane, N.O.S.*
1,1,1,2-Tetrachloroethane
1,1,2,2-Tetrachloroethane
Tetrachloroethylene (Ethene, 1,1,2,2-tetrachloro-)
Tetrachloromethane (Carbon tetrachloride)
2,3,4,6-Tetrachlorophenol
Tetraethyldithiopyrophosphate (Dithiopyrophosphoric acid, tetraethyl-ester)
Tetraethyllead (Plumbane, tetraethyl)
Tetraethylpyrophosphate (Pyrophosphoric acid, tetraethyl ester)
Thallium and compounds, N.O.S.*
Thallic oxide (Thallium(III)oxide)
Thallium(I)acetate (Acetic acid, thallium(I)salt)
Thallium(I) carbonate (Carbonic acid, dithallium(I)salt)

Thallium(I)chloride
Thallium(I)nitrate (Nitric acid, thallium(I)salt)
Thallium selenite
Thallium(I)sulfate (Sulfuric acid, thallium(I)salt)
Thioacetamide (Ethanethioamide)
Thiosemicarbazide (Hydrazinecarbothioamide)
Thiourea (Carbamide, thio-)
Thiuram (Bis(dimethylthiocarbamoyl)disulfide)
Toluene (Benzene, methyl-)
Toludenediamine (Diaminotoluene)
Toluene diisocyanate
O-Toluidine hydrochloride (Benzenamine, 2-methyl, hydrochloride)
Tolylene diisocyanate (Benzene, 1,3-diisocyanatomethyl-)
Toxaphene (Camphene, octachloro-)
Tribromomethane (Bromoform)
1,2,4-Trichlorobenzene
1,1,1-Trichloroethane (Methyl chloroform)
1,12-Trichloroethane
Trichloroethene (Trichloroethylene)
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
2,4,5-Trichlorophenoxyacetic acid (2,4,5-T)
2,4,5-Trichlorophenoxypropionic acid (2,4,5-TP) (Silvex)
Trichloropropane, N.O.S.*
1,2,3-Trichloropropane
0,0,0-Triethyl phosphorothioate (Phosphorothioic acid, 0,0,0-triethylester)
Trifluoromethanesulfonic acid and derivatives N.O.S.*
syn-Trinitrobenzene (Benzene, 1,3,5-trinitro)
Tris(1-azidinyl)phosphine sulfide
Tris(2,3-dibromopyopyl)phosphate (1-Propanol, 2,3-dibrom-,phosphate)
Trypan blue
Uracil mustard (Uracil 5-(bis(2-chloroethyl)amino)-)
Vanadic acid, ammonium salt (Ammonium vanadate)
Vandadium pentoxide (Vanadium(V)oxide)
Vinyl chloride (Ethane, chloro)
Vinylidene chloride
Zinc cyanide
Zinc phosphide

* NOT OTHERWISE SPECIFIED

C. CHEMICALS FOR THE NORMAL TRASH

Many chemicals can be safely disposed of in the normal trash in solid form if the containers are tightly capped and of good integrity. Examples are given on the following list. These chemicals were selected because they are generally used in laboratories and have oral-rat LD 50 values higher than 500 mg/Kg (a ten-fold safety factor for toxicity over values for determining risk for hazardous constituents), have no positive determination for carcinogenicity according to the National Institute of Occupational Safety and Health (NIOSH) 1979 Registry of Toxic Effects of Chemical Substances, and have no other negative determinations for environmental toxicity.

If you intend to dispose of more that five pounds of any one of these chemicals, call the Safety Office for an evaluation.

Acid, Ascorbic
Acid, Benzoic
Acid, Boric
Acid, Casamino
Acid, Citric
Acid, Lactic
Acid, Oleic
Acid, Phosphotungstic
Acid, Phthalic
Acid, Salicylic
Acid, Silicic
Acid, Stearic
Acid, Succinic
Acid, Tartaric
Agar
Albumen
Aluminum chloride
Aluminum hydroxide
Aluminum metal
Ammonium bicarbonate
Ammonium chloride
Ammonium phosphate
Ammonium sulfate
Ammonium sulphamate
Base, blood agar
Beef extract
Brain heart infusion
Brom phenol blue
Broth, nutrient
Buffer solution
Calcium carbonate
Calcium chloride
Calcium lactate
Calcium phosphate
Methyl red
Methyl salicylate
Methylene blue
Napthalene
Napthol, beta
Paraffin
Pepsin
Peptone
Petroleum jelly
Potassium acetate
Potassium bicarbonate
Potassium bisulphate
Potassium bitartrate
Potassium bromate
Potassium bromide
Potassium carbonate
Potassium chloride
Potassium citrate
Potassium ferricyanide
Potassium iodide
Potassium nitrate
Potassium phosphate

Calcium sulphate
Celose, dextrose
Charcoal, animal
Crystal violet
Dextrose
Drierite
Extract, malt
Extract, yeast
Ferric chloride
Ferric nitrate
Ferric sulphate
Ferrous sulfate
Galactose
Gelatin
Graphite
Gum, Arabic
Gum, Guaic
Hematoxylin
Kaolin
Lactose
Lithium carbonate
Lithium chloride
Lithium sulphate
Litmus
Magnesium carbonate
Magnesium chloride
Magnesium nitrate
Magnesium oxide
Magnesium sulphate
Maltose
Manganese acetate
Manganese chloride
Manganese dioxide
Manganese sulphate
Sodium bisulfite
Sodium borate
Sodium bromide
Sodium carbonate
Sodium chloride
Sodium citrate
Sodium formate
Sodium iodide
Sodium lactate
Sodium nitrate
Sodium phosphate
Sodium phorophosphate
Sodium salicylate
Sodium silicate
Sodium succinate
Sodium sulphate
Sodium sulphite
Sodium tartrate
Sodium thioglycollate
Sodium thiosulphate
Sodium tungstate
Stannous chloride

Potassium sodium tartrate	Sucrose
Potassium sulphate	Sulphur
Potassium sulphite	Talcum powder
Potassium sulphocyanate	Thymol
Pumice	Tin metal
SDS(Sodium dodecyl) sulphate)	Trypticase
Sodium acetate	Tryptone
Sodium ammonium phosphate	Urea
Sodium benzdate	Wax, bee's
Sodium bicarbonate	
Sodium bisulphate	

D. CHEMICALS FOR THE SANITARY SEWER SYSTEM

Persons generating chemical waste as the result of experimentation must consider that waste an integral part of the experiment. If a procedure exists whereby the initial chemical by-product can readily be converted to a less hazardous chemical, or can be neutralized, this procedure must also be a part of the experimental process.

Many chemicals can be safely deposited into the sanitary sewer system. Some University facilities have dual sewage disposal systems; however, all discharge from the University facilities eventually flow, into the sanitary sewer leading to the sewerage system of the City of Memphis. Accordingly, the University is regulated by the City of Memphis Sewer Ordinance as to the types and quantities of effluents which may enter the sanitary sewer system from any University facility.

The following lists comprise compounds that are suitable for disposal down the drain only in quantities less that 100 grams at a time with adequate dilution (20 to 50 fold. Compounds on both lists are water soluble to at least 3% and present low toxicity hazard. Those on the organic list are readily biodegradable and amenable to treatment by the wastewater treatment process. As always,if you have any question regarding the proper procedure, call the Safety Office for advice.

1. Organic Chemicals

Alcohol's

Alkanols with less than 5 carbon atoms
t-Amyl alcohol
Alkanediols with less that 8 carbon atoms
Glycerol
Sugars and sugar alcohol
Alkoxyalkanols with less than 7 carbon atoms
n-C4 H9 OCH2 CH2 OCH2 CH2 OH
2-Chloroethanol

Aldehydes*

Aliphatic aldehydes with less that 5 carbon atoms

Amides

RCONH and RCONHR with less than 5 carbon atoms
RCONR with less than 11 carbon atoms

Amines*

Aliphatic amines with less than 7 carbon atoms
Aliphatic diamines with less than 7 carbon atoms
Benzylamine

Carboxylic Acids

Alkanoic acids with less than 6 carbon atoms*
Alkanedioic acids with less than 6 carbon atoms
Hydroxyalkanoic acids with less than 6 carbon atoms
Aminoalkanoic acids with less than 7 carbon atoms
Ammonium, sodium and potassium salts of the above acid classes with less than 21 carbon atoms
Chloroalkanedioic acids with less than 4 carbon atoms

Esters

Esters with less than 5 carbon atoms
Isopropyl acetate

Ketones

Ketones with less than 6 carbon atoms

Nitriles

Acetonitrile
Propionitrile

Sulfonic Acids

Sodium or potassium salts of most are acceptable

*Those with a disagreeable odor, such as pyridine, dimethylamine, 1,4-butanediamine, butyric acids, and valeric acids should never be disposed of down the drain, regardless of the amount.

2. Inorganic Chemicals

This list comprises water-soluble compounds of low-toxic-hazard cations and low-toxic-hazardanions. Compounds of any of these ions that are strongly acidic or basic must be neutralized before disposal down the drain. Procedures for neutralization of concentrated acids or bases are given in Section E immediately following:

Cations	Anions
A13+	BO33-
Ca2+	B4072-

Cu2+	Br-
Fe2+,3+	CO32-
H+	C1-
K+	HSO3-
Li+	OCN-
Mg2+	OH-
Na+	I-
NH4+	NO3-
Sn2+	PO43-
Sr2+	SO42-
Ti3+,4+	SCN-
Zn2+	
Zr2+	

PLEASE REMEMBER, ONLY LIMITED AMOUNTS OF THESE SUBSTANCES SHOULD BE ALLOWED TO ENTER THE SYSTEM AT ANY ONE TIME.

E. CONCENTRATED SOLUTIONS OF ACIDS OR BASES

Surplus concentrated solutions of acids and bases should be neutralized to within a pH range of 6 to 9 and then disposed of into the sanitary sewer system, followed by twenty (20) parts of water.
This pH range, although narrow beyond most practical applications, is mandated by the City of Memphis Sanitary Sewer Ordinance as the acceptable range allowable. Special care should be taken when neutralizing strongly oxidizing acids such as perchloric acid and fresh chromic acid. Additionally, corrosive solutions should never be stored in metal containers. Please call the Safety Office for proper instructions and precautions.

1. General Neutralization Procedures

CAUTION: FUMES AND HEAT ARE GENERATED

a. Neutralization procedures should take place in a well ventilated hood and behind a safety shield.

b. Keep containers cool while neutralization is being carried out.

c. The person performing the neutralization procedure should be properly equipped with an apron, goggles or face shield, and gloves.

d. All steps should be performed SLOWLY.

2. Acid Neutralization

While stirring, add acids to large amounts of an ice solution of base such as sodium carbonate (soda ash), calcium hydroxide (slaked lime), or 8M sodium hydroxide (for concentrated acids). When a pH of 6.0 is achieved, dispose of the solution into the sewer system followed by 20 parts water.

3. Base Neutralization

Neutralize by first adding the base to a large vessel containing water. Slowly add a 1M solution of hydrochloric acid (HCL). When a pH of 9 is achieved, dispose of the neutralized solution into the sewer system followed by 20 parts water.

4. Chromic Acid

a. Alternatives to Chromic Acid Cleaning Solutions

The use of sodium or potassium dichromate dissolved in concentrated sulfuric acid as a cleaning solution presents special handling and disposal problems. Chromic acid is a powerful oxidizing agent, and as such, has the potential to explode on contact with certain oxidizable organic materials.

In addition, it is both toxic and corrosive. Instances of burns to both skin and clothing due to spillage of chromic acid cleaning solutions have occurred. The Safety Office urges you to consider the following list of alternate cleaning agents that have been proven to be satisfactory as cleaners and significantly less toxic and less hazardous.

i. American Scientific Products
Alconox (powder)
S/P Contrad 70 (concentrate (powder)
S/P Laboratory Detergent Concentrate (powder)

ii. Fisher Scientific Co.
Alconox (powder)
Fisher brand Sparkleen (powder)
F1-70 Concentrate (concentrated liquid)
Liquinox Liquid Detergent (liquid)

iii. Godax Laboratories

No Chromix (powder, to be mixed with five pints of sulfuric acid; it is as powerful an oxidizer, and as corrosive as chromic acid, but without toxic chromium)

iv. Lab Safety Supply Co.
Isoclean (concentrated liquid)

v. New England Nuclear Corp.
Count-Off (concentrated liquid)

vi. Research Products International Corp.
Lift Away Concentrated Decontaminant (liquid)

vii. Pierce Chemical Company

RBS 35 Concentrate (concentrated liquid)
RBS Solid (solid)

b. Disposal of Chromic Acid Solutions

Spent Chromic Acid solution should be adjusted to pH 6.0 by slowly pouring it into a stirred 8M NoOH/ice solution in a large container.

CAUTION: FUMES AND HEAT ARE GENERATED! Upon neutralization, reduce Cr(VI) to blue-green Cr(III) by addition of saturated sodium bisulfite solution. (Hexavalent chromium is highly oxidizing, toxic, and strictly regulated in wastewater.) The neutralized, reduced solution should then be disposed of into the sewer system followed by twenty (20) parts of water.

F. ORGANIC SOLVENTS

Waste organic solvents that are free of solids and corrosive or reactive substances may be collected in a common can or bottle, preferably in original container, which then must be properly labeled
(See page 28).

Separated and well-defined waste is easier and also less expensive to dispose. High levels of halogens in the organic solvents cannot readily be handled in most incinerators and are not acceptable for incineration. Therefore, it is essential to indicate the composition of the waste liquid and, if a mixture, the approximate percentage by volume of each constituent. The percentage composition must be clearly indicated on the "Hazardous Chemical" form on each container, as well as the hazards associated with the waste (most original container labels provide this information).

1. Separation of Halogenated and Non-Halogenated Wastes

The objective of the solvent separation program is to keep the halogen content of the organic solvents for incineration below 1.0% by volume. The following provide guidelines for placing waste in the differing waste solvent containers.

a. Acceptable as non-halogenated waste solvents

i. Non-halogenated organic solvents

ii. Small amounts of halogenated solutes are OK

b. To be placed in halogenated waste solvent containers

i. Halogenated organic solvents

ii. Solvent mixtures with more than 1% halogenated solvent by volume

iii. Organic solvents with large amounts of halogenated solute

2. Substances Which Should Not Be Put In Waste Organic Solvent Bottles

The following substances are inappropriate for incineration and should not be put in containers with organic solvents:

Solutions of Acids or Base (See Section E)
Aqueous Solutions of Toxic Organic Chemicals (G.1)
Metals (e.g. Ag, As, Ba, Cd, Cr, Hg, Ni, Pb, Sb, Se; see Section G.2)
Vacuum Pump Oil (G.5)
Sulfides or Inorganic Cyanides (G.6)
Strong Oxidizers or Reducers (I.2)
Water Reactive Substances (I.3)
Unknowns (L)
Large Amounts of Water

3. Waste Solvent Storage Precautions

The acids formed when halogenated solvents are left moist can corrode metal containers, as can any dissolved corrosive in a discard mixture. It is necessary to assure proper storage containers are used for waste solvents.

To avoid unnecessary exposure to toxic fumes, waste containers should be tightly capped when in storage. Heated solvents must be cooled to room temperature before being placed in a closed container. The transfer of highly toxic waste materials should be done in a chemical fume hood. However, storage of closed containers in fume hoods is not advised as this can impede the protection performance of the hood.

REMEMBER: IF IN DOUBT, CALL THE SAFETY OFFICE!!

G. OTHER LIQUIDS

For liquids not covered by Sections E, F, and G, use Section B, What is Hazardous? To determine if the liquid is hazardous. Package hazardous liquids according to Section N and give to Safety Office. Dispose of non-hazardous, water soluble liquids into the sanitary sewer.

1. Aqueous Solutions of Toxic Organic Chemicals

The decision as to whether an aqueous solution should be incinerated, treated in some way, or put into the sanitary sewer depends upon the toxicity and concentration of the solute. This decision is made by the Safety Office through consultation with its resources, including the Chemical Safety Committee and other appropriate faculty and staff.

If you feel that the sanitary sewer is not an appropriate route of disposal for an aqueous solution (because the organic solute is highly toxic), package according to Section N. The Safety Office will evaluate the solution for its appropriate route of disposal.

In general, aqueous solutions of organic chemicals can be put into the sanitary sewer if they are neutral, non-reactive, non-ignitable and the organic solute is not highly toxic. Call the Safety Office if you have any questions.

2. Aqueous Solutions to Toxic Metals

The following toxic metals are regulated in the sanitary sewer above the concentrations given below. Faculty and staff should understand that these metals require special precautions for disposal. Discharge of these metals, their compounds or aqueous solutions into the sanitary sewer must be negligible. It is preferred that concentrated aqueous solutions of these metals be treated to precipitate the metal prior to filtering discharge to the sanitary sewer.

The filtered precipitate is then disposed as hazardous waste.

Substances	Negligible Concentrations That May Be Discharged Into the Sanitary Sewer
Iron	15.0 milligrams/liter
Chromium	5.0 "
Copper	3.0 "
Zinc	5.0 "
Lead	1.0 "
Cadmium	1.0 "

Arsenic, lead, mercury, and silver are especially important pollutants, and filtering, precipitation or some other type of collection must be routine procedure for laboratories using them. Even when silver recovery units are employed, it has been found that instances of high discharge result from poor maintenance.

For treatment procedures, testing or more information, please contact the Safety Office.

3. Solutions of Non-Metallic Pesticides

Solutions of non-metallic pesticides should be placed in five gallon cans and given to the Safety Office.

4. Free Flowing Metallic Mercury

The Safety Office will accept and recycle metallic mercury in the free flowing form. Package according to Section N. Individual broken thermometers with small amounts of metallic mercury should be placed in a closed container of good integrity and given to the Safety Office.

5. Vacuum Pump Oil

Vacuum pump oil can be recycled and should not be mixed with organic solvents or other chemicals. Package according to directions in Section N. Silicon based diffusion pump oil should be segregated for separate disposal.

6. Solutions of Cyanide of Sulfide Compounds

Solutions containing cyanide or sulfide compounds will release toxic gas under acidic conditions. These solutions must be packaged separately from acids and given to the Safety Office.

Instructions for chemical detoxification of cyanide or sulfide solutions are available upon request.

H. SOLID CHEMICALS

Package tightly capped containers of hazardous solid chemicals according to the instructions given in Section N. To determine whether or not a chemical is hazardous see Sections B.1 and B.2.
Section C lists chemicals that may be disposed of in the normal trash. Call the Safety Office if you need assistance.

Small amounts of hazardous organic solids can be dissolved in an organic solvent. Only dissolved solids, and no residue, should be placed in the waste organic solvent containers. See Section F for further information on the disposal of organic solvents.

I. POTENTIALLY EXPLOSIVE AND OTHER REACTIVE CHEMICALS

1. Potentially Explosive Chemicals

Each container of potentially explosive chemicals must be packaged separately. Label clearly as to hazardous characteristics and special handling precautions. In addition, inform the Safety Office that you have potentially explosive materials before delivering them for disposal.

a. Potentially explosive chemicals include:

Ammonium Nitrate Hydrazine Compounds
Diazo and diazonium Compounds Nitrocellulose (dry)
Peroxide forming agents (See paragraph b.)
Picric Acid (dry and crystalline)

b. Peroxide Forming Agents

Peroxides are low power explosives and very sensitive to shock and heat.
A variety of organic compounds react with oxygen to form unstable peroxides. Well known peroxide forming agents include:

Diethyl Ether Tetrahydrofuran
Isopropyl Ether Other ethers (e.g. Dioxanes)

Other peroxide forming agents include:

Aldehydes
Vinyls
Compounds with benzylic hydrogens
Compounds with allyl groups

i. Formation and Use

Exposure of any of the peroxide forming agents to light or air increases the rate of peroxide formation. Therefore, store these agents in full, light-tight containers. Order small amounts frequently to decrease storage time. Date all new containers when opened. Refrigeration does not prevent peroxide formation, and, unless the refrigerator used is explosion safe, these materials should not be refrigerated.

Be particularly cautious with materials of unknown vintage. Do not attempt to remove caps from containers that may cause sparks or excess friction (e.g. old metal cans or fitted glass stoppers).

Call the Safety Office when such containers are found.

Never distill peroxide forming solvents unless they are known to be free of peroxides. Peroxides concentrated in the residue can pose a serious explosion hazard. Other precautions for handling reactive chemicals can be requested from the Safety Office.

ii. Testing and Disposal

Before beginning work with a peroxide forming agent, determine its peroxide content. Dispose of agents containing greater than 80 ppm peroxide. Easy to use quantitative "peroxide test strips" are available from Lab Safety Supply.

Materials found to contain peroxides (greater than 80 ppm) can usually be treated prior to disposal. Methods for removal of peroxides commonly involve addition of a reducing agent such as ferrous sulfate (for diethyl ether peroxides). Details of peroxide treatment methods are available upon request from the Safety Office.

The treated solvent should be placed in a waste organics container and the empty container rinsed with water and placed in the normal trash.

Peroxides are usually water soluble and the rinsate can be put in the sanitary sewer.

2. Strong Oxidizers and Reducers

These materials should be chemically treated in the laboratory for disposal.

For information on treatment techniques, please call the Safety Office.

a Strong Oxidizers

Chromic acid (fresh)	Metallic chlorates
Metallic nitrates	Metallic perchlorates
Metallic permanganates	Perchloric acid

b. Strong Reducers

n-Butyllithium (also water reactive)
Metallic sulfides
Calcium hydride   Sodium hydride
Stannous chloride

3. Other Reactives (including water reactives)

Package liquids separately from solids. Please note special hazards and/or handling precautions on each box. See Section N for additional packaging and labeling instructions.

Acetyl chloride	Phosphorous (yellow)
Benzoyl peroxide	Potassium metal
Bromine	Sodium metal
Calcium metal	Thionyl chloride
Lithium metal	

J. PRECIPITATES, SEMI-SOLIDS, RESIDUES, GELS, ETC.

Precipitates, semi-solids, residues or gels of any kind must not be placed in with the waste organic solvents since they cannot be pumped for incineration. Use Section B to determine if the material is hazardous or call the Safety Office for assistance. If separable, the liquid phase should first be removed by decantation, filtration, evaporation or absorption. Hazardous materials should be packaged in leak-proof containers according to Section N.

K. LAB WARE CONTAMINATED WITH TOXIC CHEMICALS

Disposal of lab ware (which would usually be put into the normal trash) becomes of concern when it is contaminated with chemicals which are highly toxic. The term "lab ware" pertains to disposable laboratory items, such as gloves, benchtop coverings, pipettes, test tubes, aprons, etc.

The decision as to whether contaminated lab ware should be placed in a secure landfill, treated in some way, or put into the normal trash depends upon the toxicity and concentration of the contaminant. This decision is made by the Toxic Hazards Office staff through consultation with its resources.

If you feel that the normal trash is not an appropriate route of disposal for your contaminated lab ware (because the contaminant possesses a high degree of toxicity), package according to Section N. The Safety Office staff will evaluate the lab ware for its appropriate route of disposal.

All lab ware contaminated with PCB's of 50 ppm or greater must be given to the Safety Office for disposal.

In general, lab ware contaminated with chemicals should be put into the normal trash if it is non-reactive, non-ignitable and the contaminant does not possess a high degree of toxicity. Call the Safety Office if you are unsure or have any questions. Procedures for decontaminating non-disposable items are also available.

L. UNKNOWN CHEMICALS

Faculty and staff must make every effort to provide an accurate description of all surplus chemicals. Unknown chemicals present serious problems for the University. Without a description, chemicals can neither be handled nor disposed of in a safe manner. Disposal companies will not accept chemical waste without an analysis, and analysis of one sample can easily cost up to $200.

1. Investigation of Unknown Chemicals

The Safety Office offers assistance in investigating the identity of unknown chemicals. Any information provided by individuals wishing to dispose of unknowns will greatly aid investigation and identifications. Whether a chemical is organic or inorganic is an example of information which is very useful to the Safety Office.

2. Procedure

Please call the Safety Office upon discovery of an unknown chemical. Do not move unknown chemicals from the source of generation if possible.

3. Reducing the Problem

The problem presented by unknown chemicals can be reduced if lab personnel are thorough in maintaining labels on chemical containers. Periodic review of chemical stock and careful recordkeeping will lessen the chance of discovering containers with missing labels.

M. GENERAL LABORATORY CLEANUP? CALL US

The Safety Office often receives unknown and unwanted chemicals when laboratories change hands. The ensuing cleanup and disposal of chemicals is time consuming and costly. To alleviate this problem, the Safety Office offers assistance to individuals planning to leave their laboratory. This assistance includes proper sorting of unwanted chemicals. Before a faculty member or research investigator leaves the University, either the departing individual or the department should contact the Safety Office. This will save both time and resources of the individual or department, since excess chemical disposal costs may be charged to the individual or to the department.

N. PACKAGING AND LABELING

1. General Rules and Information

Good packaging provides safety in transporting chemicals and the labeling of materials is essential for proper disposal. Please use the following guidelines when giving material to the Safety Office for disposal:

a. Minimize the quantity of chemicals given to the Safety Office. Items which can be disposed of in the trash or into the sewer should not be sent. If you have more than one container of the same chemical, assure that the containers are filled to capacity. If you are unsure about a chemical, please check Section B or call the Safety Office.

b. Liquid and solid chemicals should be in closed, labeled containers.

Each container must have a "Chemical Waste" tag filled out completely and attached securely to the container. These forms are available upon request from the Safety Office.

c. Phone the Safety Office to indicate that you wish to dispose of waste.

Call 448-5661.

O. DISPOSAL OF LEAKING OR UNIDENTIFIED GAS CYLINDERS

1. If the leak cannot be remedied by tightening a valve gland or packing nut, the cylinder must be taken to an isolated, well-ventilated area. Then the cylinder may be vented cautiously if the gas is flammable or the gas slowly directed into an appropriate chemical neutralizer if it is corrosive or toxic.

Cylinders with unknown contents pose particularly difficult problems and considerable hazard. If the supplier can be identified, a phone call with a description of the cylinder may serve to identify the gas. If that fails, it is usually necessary to call in a waste-disposal firm that has the capability for dealing with the problem.

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