Hazardous Chemical Waste Management Guide UMASS Amherst

Hazardous Chemical Waste Management

The management of hazardous chemical waste at the University of Massachusetts consists of the collection, storage, and on site comingling of waste generated in laboratories and other campus facilities. Section 1 briefly describes the function and responsibility of each group and its relation to hazardous chemical waste management. The success of the management system depends on cooperation between the research community and Environmental Health and Safety (EH&S). All laboratory personnel should use this manual to help classify chemical waste and determine the appropriate route of disposal for that waste.

EH&S provides daily pickup of laboratory waste for recycling, incineration, or landfilling in accordance with local, state, and federal regulations. When surplus or waste chemicals are submitted to EH&S, the waste is first checked to see if the chemical is a waste or if it can be reused. Chemicals submitted for reuse and exchange can be found at: http://www.ehs.umass.edu/. Chemicals listed in Reuse and Exchange can be requested by contacting EH&S at: 413.545.2682. When submitting a request for any of these compounds, please provide the name of the compound(s), the container size, and the barcode number. Include the building name and lab room number, along with the name of the Principal Investigator (PI) requesting the compound(s). EH&S will update the electronic inventory and will deliver the requested chemical(s) to the laboratory free of charge.

Section 1 - Responsibilities

1.1 The Institutional Chemical Safety Committee

The Chancellor of the University is ultimately responsible for all health and safety-related matters. The Chancellor oversees the administration of safety policies through the normal chain of authority within the institution, delegating to the Provost, Vice Chancellors, Deans, Department Heads, Research and Teaching Directors (Principal Investigators/Faculty/instructors/Supervisors) the responsibility for ensuring safe work practices for those under their supervision and adherence to established policies and guidelines. The Institutional Chemical Safety Committee approves policies and procedures submitted by Environmental Health and Safety that reinforce this process.

1.2 Environmental Health and Safety

Environmental Health and Safety is responsible for surveillance of all laboratory activities involving the use of chemical agents and all additional chemical problem areas within the confines of the University. Specific duties of the Department include:

1. Implementation of policies established by the University and approved by the Institutional Chemical Safety Committee.
2. Design and implementation 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 properly generate and dispose of hazardous chemical waste.
5. Assuring that University policies and guidelines regarding the proper disposal of hazardous chemical waste are followed.

1.3 Research and Teaching Directors (Principal Investigators/Faculty/Instructors/Supervisors)

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

1.4 The Laboratory Worker and Other Individuals

The success of the hazardous chemical waste management program at the University is dependent on the conscientious efforts of the individual laboratory worker and staff employee. Since the laboratory worker frequently handles hazardous chemicals, it is absolutely essential that he or she follow implicitly the advice, policies and procedures established by EH&S. The individual staff member is expected to:

1. Manage and dispose of all chemical wastes in accordance with established procedures set forth in this disposal manual.
2. Make a concerted effort to identify all unknown or surplus chemicals utilizing the technical knowledge of faculty members or EH&S.
3. Package and label surplus and waste chemicals in accordance with established procedures set forth in this disposal manual.
4. It is important that small quantities of hazardous chemicals are not mixed with nonhazardous waste, as this may cause the entire waste to be listed as hazardous.
5. When necessary, seek advice from EH&S concerning the proper handling and disposal of hazardous chemicals.

Section 2 – Hazardous Waste Identification and Disposal

What is Hazardous Chemical Waste?

The information in this section will aid the laboratory worker in determining the regulatory hazards associated with chemicals that are encountered either during instructional classes or research at the University. The Massachusetts State Department of Environmental Protection (MADEP), the agency responsible for the regulation of hazardous chemical waste generated in this state, uses a very broad definition of hazardous waste. However, it bases its definition on the federal Environmental Protection Agency (EPA) criteria which considers chemical waste hazardous, if it exhibits certain hazardous characteristics or is included in one of the list below. If, after

reading these sections, you are in doubt about the proper method of disposal or hazard associated with a specific substance, contact EH&S at: 413.545.2682, for assistance.

2.1 Hazardous Characteristics

Chemicals which have the following ***four characteristics*** are considered to be hazardous by the federal EPA and MADEP:

2.1.1 Characteristic for Ignitability-Flammability, EPA Code D001

This table includes a small representative example of compounds that might meet the characteristic for ignitability.

Ignitability-Flammability		
A liquid which has a flash point of less than 60 C (140 F) is considered ignitable. This category includes almost all organic solvents. Some examples are:		
acetone	heptane	petroleum ethers
benzene	heptane	Toluene
dioxane	hexane	Xylenes
ethanol	methanol	
ethyl acetate	pentane	
Ignitability-Oxidizer		
bromates	iodates	Perchlorates
chlorates	nitrates	Permanganates
dichromates	nitrites	Peroxides

Organic Solvent Waste

Waste organic solvents that are free of solids and corrosives or reactive substances may be collected in a common bottle or container which must be properly labeled, stored, and managed.

Separation of Halogenated and Non-halogenated Wastes

Halogenated compounds contain any of the five electronegative elements namely, fluorine, chlorine, iodine, bromine and astatine. The objective of the solvent separation is to keep the halogen content of the organic solvents for incineration below 1.0% by volume. Do not intentionally mix halogenated solvents and/or solutes with non-halogenated solvents. The non-halogenated solvent waste stream is our most cost effective disposal waste stream. If organic solvent waste meets the restrictions below, these high BTU solvents are blended for use as fuels.

When large volumes of an individual solvent are involved, consideration should be given to recycling methods such as distillation rather than costly disposal methods. The amount of money saved in solvent purchase costs usually far exceeds the capital expense for such equipment and the success of such programs is well documented, as is the purity of recovered solvent. Information on permitted solvent recovery is available from EH&S.

GUIDELINES FOR THE COLLECTION OF ORGANIC SOLVENTS

Non-Halogenated Organic Solvents	
May NOT Contain Any	**May Contain**
Halogenated Compounds > 5%	Aqueous Solutions less than 3%
Strong Corrosives < 2 and > 12	Solids less than 1%
Alkali Metals	Acetonitrile less than 30%
Heavy Metals	Sulfoxides less than 10% (e.g. dimethyl sulfoxide)
Concentrated amines, sulfur, or phosphor substituted compounds (odors are a problem at disposal facilities)	Benzene less than 10%
	Any amount of ether's, alcohols, alkanes, alkenes
Azides	Poly nitrated organics less than 1%

Halogenated Organic Solvents	
May NOT Contain Any	**May Contain Any Halogenated Solvent with**
Concentrated amines	Aqueous Solutions less than 3%
Strong Corrosives < 2 and > 12	Solids less than 1%
Alkali Metals	Acetonitrile less than 30%
Heavy Metals	Sulfoxides less than 10% (e.g. dimethyl sulfoxide)
sulfur, or phosphor substituted compounds	Benzene less than 10%
	Any amount of ether's, alcohols, alkanes, alkenes
Azides	Poly nitrated organics less than 1%

The following substances may be inappropriate for fuel blending and should not be added to a container with non-halogenated organic solvents.

Solutions of Acids or Bases
Aqueous Solutions of Toxic Organic Chemicals
Metals (e.g. Ag, As, Ba, Cd, Cr, Hg, Pb, Se)
Some vacuum pump oil, (vacuum pump oil can be contaminated)
Sulfides or Inorganic Cyanides
Strong Oxidizers or Reducers
Water Reactive Substances
Unknowns
Large Amounts of Water

Waste Solvent Storage Precautions

Halogenated solvents, under certain conditions, may be corrosive and can corrode metal containers, as can any dissolved corrosive in a discarded mixture. It is necessary to assure that proper storage containers are used for waste solvents. Metal containers should not be used for the collection of corrosive compounds.

To avoid unnecessary exposure to toxic vapors, 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 performance of the hood. For advice, call EH&S at: 413.545.2682.

2.1.2 Characteristic for Corrosivity, EPA Code D002

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.

2.1.3 Characteristic for Reactivity, EPA Code D003

Chemicals that react 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 initiating source such as solid, dry (< 1% H20) picric acid, benzoyl peroxide or sodium borohydride.

Solutions of Cyanide or Sulfide Compounds

Solutions containing cyanide or sulfide compounds that may release toxic gases under acidic conditions are also classified as reactive. These solutions must be packaged separately from acids when stored. If possible, these compounds should be stabilized by raising the pH of solution to 10 before submitting a waste request to EH&S for removal.

Examples of Potentially Explosive and Otherwise Reactive Compounds

Peroxide-forming agents

Peroxides are explosives when concentrated and can be sensitive to shock and heat. A variety of organic compounds react with oxygen to form hydroperoxides or unstable peroxides. Exposure of any of the peroxide-forming agents to light or air increases the rate of potential hydroperoxide or peroxide formation. Be particularly cautious with materials of unknown age or origin. If caps are hard to remove do not attempt to force removal as this may create excess friction (e.g., old metal cans or ground glass stoppers). Call EH&S, 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. For a sample list of commonly found peroxide forming compounds see Appendix J

Other reactives (including water reactives)

When preparing reactives for disposal, please note special hazards and/or handling precautions when submitting a waste request to EH&S. Some examples may include but are not limited to:

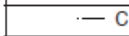
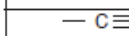
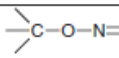
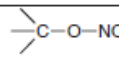
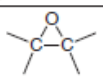
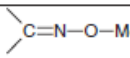
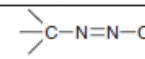
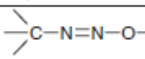
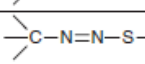
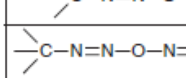
Acetyl chloride ---------- Phosphorus (yellow or red)
Benzoyl peroxide ---------- Potassium metal
Calcium metal ---------- Sodium metal
Lithium metal ---------- Thionyl chloride
Cyanides ----------Sulfides
Organic silanes ----------Organo-metals

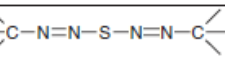
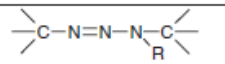
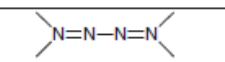
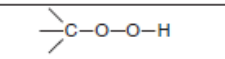
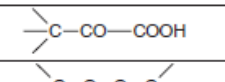
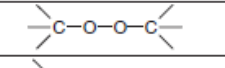
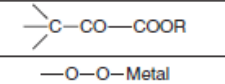
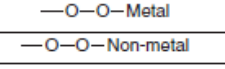
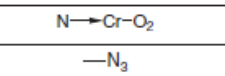
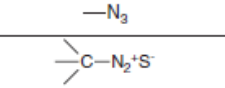
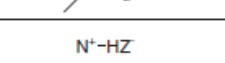
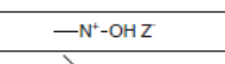
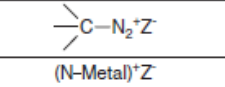
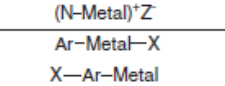
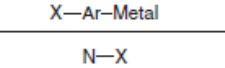
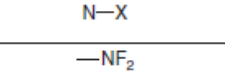
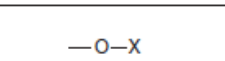
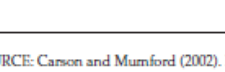
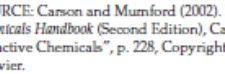
Potentially Explosive Chemicals

Each container of potentially explosive chemicals must be packaged and stored separately. Label clearly as to hazardous characteristics and special handling precautions. In addition, inform Environmental Health and Safety that you have potentially explosive materials when calling for a pickup. Potentially explosive chemicals include many functional groups Care should be taken when working with any of the functional groups listed in the table below. Some unstable explosive compounds are forbidden from transportation by USDOT. Disposal of these compounds requires some stabilization prior to shipment. Contact EH&S, if you produce or discover any of these explosive compounds or if some older chemicals such as picric acid stored in your lab becomes dry or shows other unstable characteristics.

Table below, is taken from “Prudent Practices in the Laboratory,” *Handling and Management of Chemical Hazards*. Jan, 2011, updated edition. National Academy Press, Washington D.C.

TABLE 4.7 Functional Groups in Some Explosive Compounds

Structural Feature	Compound
	Acetylenic compounds
	Metal acetylides
	Haloacetylene derivatives
	Diazirines
	Diazo compounds
	Nitroso compounds
	Nitroalkanes, C-nitro and polynitroaryl compounds
	Polynitroalkyl compounds
	Acyl or alkyl nitrites
	Acyl or alkyl nitrates
	1,2-Epoxides
	Metal fulminates or aci-nitro salts
	Fluorodinitromethyl compounds
	N-Metal derivatives
	N-Nitroso compounds
	N-Nitro compounds
	Azo compounds
	Arenediazoates
	Arenediazo aryl sulfides
	Bis-arenediazo oxides

Structural Feature	Compound
	Bis-arenediazo sulfides
	Trizazenes (R = H, —CN, –OH, —NO)
	High-nitrogen compounds, tetrazoles
	Alkylhydroperoxides
	Peroxyacids
	Peroxides (cyclic, diacyl, dialkyl)
	Peroxyesters
	Metal peroxides, peroxoacid salts
	Peroxoacids
	Aminechromium peroxocomplexes
	Azides (acyl, halogen, nonmetal, organic)
	Diazoniumsulfides and derivatives, "xanthates"
	Hydrazinium salts, oxosalts of nitrogenous bases
	Hydroxylammonium salts
	Diazonium carboxylates or salts
	Aminemetal oxosalts
	Halo-arylmetals
	Halogen azides, N-halogen compounds, N-haloimides
	Difluoroamino compounds
	Alkyl perchlorates, chlorite salts, halogen oxides, hypohalites, perchloric acid, perchloryl compounds

SOURCE: Carson and Mumford (2002). Reprinted from *Hazardous Chemicals Handbook* (Second Edition), Carson, P. and Mumford, C. "Reactive Chemicals", p. 228, Copyright 2002, with permission from Elsevier.

2.1.4 Toxicity Characteristic Leachate Procedure (TCLP)

Effective September 25, 1990, TCLP replaced the EP Toxicity procedure for characterizing wastes as being either hazardous or non-hazardous. The impetus behind the change to this rule is to address the leaching of organic compounds as well as inorganic elements. The list of Toxic Characteristic Wastes follows with their individual regulatory levels:

310 CMR: 30.125: Table 1.
MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

MAXIMUM CONCENTRATION OF CONTAMINANTS FOR TOXICITY CHARACTERISTIC

EPA HW No.	Contaminant	CAS No.	Regulatory Level (milligrams/liter)
D004	Arsenic.....	7440-38-2	5.0
D005	Barium	7440-39-3	100.0
D018	Benzene	71-43-2	0.5
D006	Cadmium	7440-43-9	1.0
D019	Carbon tetrachloride	56-23-5	0.5
D020	Chlordane	57-74-9	0.03
D021	Chlorobenzene.....	106-90-7	100.0
D022	Chloroform.....	67-66-3	6.0
D007	Chromium	7440-47-3	5.0
D023	o-Cresol.....	95-48-7	200.0 (1)
D024	m-Cresol.....	108-39-4	200.0 (1)
D025	p-Cresol.....	106-44-5	200.0 (1)
D026	Cresol.....	---------	200.0 (1)
D016	2, 4-D.....	94-75-7	10.0
D027	1, 4 Dichlorobenzene...	106-46-7	7.5
D028	1, 2 Dichloroethane....	107-06-2	0.5
D029	1, 1 Dichloroethylene.	75-35-4	0.7
D030	2,4 Dinitrotoluene....	121-14-2	0.1
D012	Endrin.....	72-20-8	0.02

D031	Heptachlor (and its epoxide).....	76-44-8	0.008
D032	Hexachlorobenzene.....	118-74-1	0.1
D033	Hexachlorobutadiene....	87-68-3	0.5
D034	Hexachloroethane.....	67-72-1	3.0
D008	Lead.....	7439-92-1	5.0
D013	Lindane.....	58-89-9	0.4
D009	Mercury.....	7439-97-6	0.2
D014	Methoxychlor.....	72-43-5	10.0
D035	Methyl ethyl ketone...	78-93-3	200.0
D036	Nitrobenzene.....	98-95-3	2.0
D037	Pentachlorophenol.....	87-86-5	100.0
D038	Pyridine	110-86-1	5.0
D010	Selenium.....	7782-49-2	1.0
D011	Silver.....	7440-22-4	5.0
D039	Tetrachloroethylene....	127-18-4	0.7
D015	Toxaphene	8001-35-2	0.5
D040	Trichloroethylene.....	79-01-6	0.5
D041	2, 4, 5-Trichlorophenol	95-95-4	400.0
D042	2, 4, 6-Trichlorophenol	88-06-2	2.0
D017	2, 4, 5-TP (Silvex).....	93-72-1	1.0
D043	Vinyl chloride.....	75-01-4	0.2

(1) If o-, m-, p-Cresol concentration cannot be differentiated, the total cresol (D026) concentration is used. The regulatory level of total cresol is 200 mg/l.

2.1.5 Lists of Hazardous Constituents

This section presents several lists 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 either as Acutely Hazardous Waste or Toxic Waste by the Environmental Protection Agency.

EPA designated **P-listed wastes** are substances found to be fatal to humans in low doses or, in the absence of data on human toxicity, have been shown in studies to have an oral LD50 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 are designated as Acute Hazardous Waste. P-listed wastes are restricted to a maximum quantity of one quart per satellite accumulation area. In addition, empty containers of P-listed wastes must be managed as hazardous waste unless the container is triple rinsed then properly labeled to indicate that this process has been completed.

EPA-designated listed materials containing any of the toxic constituents listed in the appropriate sections below are to be considered hazardous waste, unless, after considering the following factors, it can reasonably be concluded by EH&S that the waste is not capable of posing a substantial present or potential hazard to public health or the environment when improperly treated, stored, transported or disposed of, or otherwise managed.

F-Listed Waste is a list of waste from non-specific sources. Such wastes may be generated as a part of a number of different industrial operations. Any residue or contaminated soil, water, or other debris resulting from the clean-up of a spill, into or on any land or water.

K Listed Waste is a list of waste from specific industrial sources. Some of these may apply to some research activities

U Listed Waste hazardous wastes which are discarded commercial chemical products or off-specification batches of commercial chemical products or spill residues of either.
The following materials or items are hazardous wastes if and when they are, or are intended to be, discarded:
(a) Any commercial chemical product or manufacturing chemical intermediate having the generic name listed.
(b) Any off-specification commercial chemical product or manufacturing chemical intermediate which, if it met specifications, would have the generic name listed.
(c) Any residue remaining in a container or in an inner liner removed from a container that has held any commercial chemical product or manufacturing chemical intermediate having the generic name listed unless the container is empty.
(d) Residues or hazardous waste constituents contained in media. Any residue or contaminated soil, water, or other debris resulting from the clean-up of a spill, into or on any land or water, of any commercial chemical product or manufacturing chemical intermediate having the generic name listed, or any residue or contaminated soil, water or other debris resulting from the cleanup of a spill, into or on any land or water, of any off-specification chemical product or manufacturing chemical intermediate which, if it met specifications, would have the generic name listed.

STATE REGULATED WASTE
Authorized states are allowed to be more restrictive then the federal guidelines. MADEP has added some additional waste materials to this regulatory list. They are considered state only waste codes and are included below.

MA01, Waste oil means used or unused waste oil (or any mixture thereof) that is not otherwise hazardous waste. The largest state regulated waste by volume would typically be the organic combustibles such as waste oil, vacuum pump oil, and parts cleaners that could be listed under this waste code

MA02, Wastes which contain polychlorinated biphenyls (PCBs) in concentrations equal to or greater than 50 parts per million.

MA04, Waste generated in the manufacture of paint (e.g., oils, shellac, varnish, stains, lacquer, latex, enamel, alkyds, urethanes, acrylics, casein) which is not otherwise regulated as hazardous waste if:
(1) The paint is formulated with one or more ingredients which are listed as hazardous constituents; or
(2) The paint is formulated with any ingredient which contains 1% or more by weight of hazardous constituents.

MA95, Universal waste shipped on a hazardous waste manifest by a licensed hazardous waste transporter., (see section 5)

MA97, Class A regulated recyclable material (including, but not limited to, specification used oil fuel) that is shipped using a hazardous waste manifest. This could include permitted silver recovery system from photography developing systems or still bottoms from a solvent distillation process.

MA98, Off-specification used oil fuel that is shipped using a hazardous waste manifest.

MA99, Not hazardous waste. This designation is to be used only for material that is not hazardous waste and that is shipped using a hazardous waste manifest. Commonly used for those materials that we choose to manage as hazardous but does not meet any of the listed waste codes or definitions. Gels and gel staining solutions would be one example.

2.1.6 Hazardous Waste Determination

When making a hazardous waste determination, use the information provided above and consider:

1. The nature of the toxicity presented by the constituent;
2. The concentration of the constituent in the waste;
3. The potential of the constituent or any toxic degradation product of the constituent to migrate from the waste into the environment;
4. The persistence of the constituent or any toxic degradation product of the constituent;
5. The potential for the constituent or any toxic degradation product of the constituent to degrade into non-harmful constituents and the rate of degradation;
6. The degree to which the constituent or any degradation product of the constituent accumulates in an ecosystem;
7. The plausible types of improper management to which the waste could be subjected;
8. Other factors that may be appropriate:

a. Laboratories wishing to dispose of materials containing dilute concentrations of these constituents should contact EH&S for advice regarding the proper management and disposal of these materials.
b. These lists will be periodically updated to reflect current scientific information on the hazards associated with these chemicals. This list is not meant to be complete and may not include substances which have hazardous characteristics as defined above. Omission of a chemical from this list does not mean it is without toxic properties or any other hazard. Call EH&S, for additional hazard information.

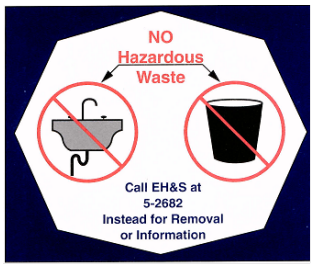
2.2 Chemicals for the Normal Trash

Many chemicals can be safely disposed of in the normal trash in solid form. Examples are given on the list below. These chemicals were selected because they are generally used in laboratories and have oral-rat LD50 values higher than 500 mg/kg and no positive determination for carcinogenicity, according to the National Institute for Occupational Safety and Health (NIOSH) Registry. *CAUTION:* Sometimes the perception of improper disposal can be burdensome and onerous. If in doubt contact EH&S for suggestions or submit a waste request and let EH&S decide on proper disposal.

Aluminum (Sheet)	Extract, malt	Paraffin
Base, blood agar	Extract, yeast	Pepsin
Beef extract	Galactose	Peptone
Broth, nutrient	Gelatin	Petroleum jelly
Buffer powders	Graphite	Pumice
Calcium chloride	Gum, Arabic	Sucrose
Calcium carbonate	Kaolin	Talcum powder
Calcium lactate	Lactose	Tin (foil, sheet)
Charcoal (granular)	Litmus paper	Urea
Dextrose	Maltose	Wax, bee's

2.3 Waste Chemicals for the Sanitary Sewer System

Persons generating chemical waste as a result of experimentation must consider the by-product waste as 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 can be a part of the experimental process, providing that you are dealing with bench scale quantities only. Acids and bases with no other underlying characteristics can be sewer disposed once the pH has been adjusted to >4 and <9.



Disposal of laboratory chemical waste to solid waste trash or the sanitary sewer system is <u>not generally permitted</u>.
Contact EH&S at: 413.545.2682, with questions.

Those chemicals with a disagreeable odor such as pyridine, dimethylamine, 1,4-butanediamine, butyric acids, mercaptoethanol, and valeric acids should never be disposed of in the sanitary sewer, regardless of the amount.
As always, if you have any question regarding the proper disposition of your materials, call EH&S at: 413.545.2682, for advice.

2.4 Inorganic Chemical Waste

Below is a list of water-soluble solutions of low-toxicity cations and low-toxicity anions. Compounds of any of these ions that are strongly acidic or basic should not be disposed of in the sanitary sewer. ONLY LIMITED AMOUNTS OF THESE SUBSTANCES SHOULD BE PERMITTED TO ENTER THE SYSTEM AT ANY ONE TIME. CONTACT EH&S, IF LARGER VOLUMES ARE PRESENT.

Cations	*Anions*
Al3+	$BO3^{3-}$
Ca2+	Br-
$Fe^{2+,3+}$	
$CO^{3\ 2-}$	
H+	Cl-
K+	HSO_3^{2-}
Mg^{2+}	OH-
NH^{4+}	I-
Zr^{2+}	PO_4^{3-}
	SO_4^{2-}

2.5 Aqueous Waste

Aqueous Solutions of Toxic Organic Chemicals

The decision as to whether an aqueous solution should be incinerated, treated in some way, or disposed into the sanitary sewer depends upon the toxicity and concentration of the solute. This decision can be made through consultation with EH&S.

Aqueous Solutions of Toxic Metals

Many toxic metals are regulated in the sanitary sewer system and should not be discharged into the sewer system under any circumstances. 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.

Concentrated Forms or Solutions of Pesticides, Herbicides, Insecticides, Fungicides

For disposal of solutions of these compounds, submit a waste request at: http://www.ehs.umass.edu/ Empty product containers should be triple rinsed and labels removed or defaced prior to disposal, if disposing in municipal trash. Containers that cannot be triple rinsed such as bags should be collected for disposal as hazardous waste.

2.6 Free-Flowing Metallic Mercury

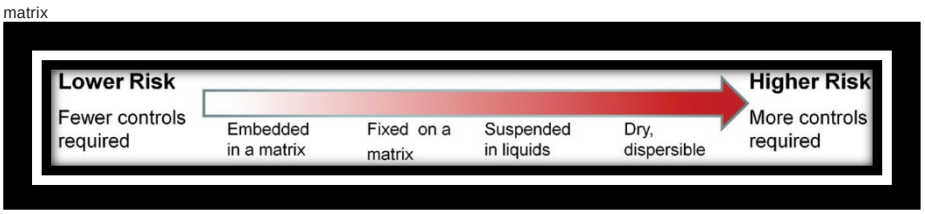
Environmental Health and Safety will accept and recycle metallic mercury in the free flowing form. A concerted effort has been made to reduce or eliminate the unnecessary use of metallic mercury. Massachusetts DEP has banned the sale of mercury-containing products or mercury added products. If you need metallic mercury for your research contact EH&S we maintain triple distilled mercury in the Chemical Reuse and Exchange list.
Cleanup of mercury spills is difficult and time consuming. Researchers should evaluate and consider using other alternatives to mercury-containing devices. Please remove all mercury containing devices by submitting a waste pickup request to EH&S. All mercury spills should be reported to EH&S immediately.

2.7 Vacuum Pump Oil

Generally, vacuum pump oil will be contaminated with whatever solvent product to which the pump apparatus is connected. Because of this cross contamination, vacuum pump oil should be collected separately or it can be mixed with any halogenated waste solvent stream.

2.8 Nanomaterial

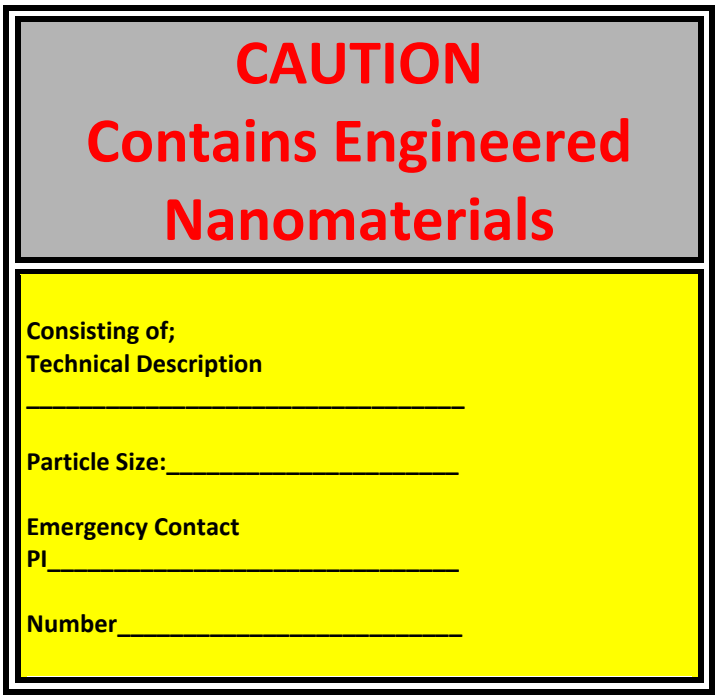
Nanoscale materials are of considerable scientific interest because some chemical and physical properties can change at this scale. Limited research has been completed on how the unique physical and chemical properties exhibited by the diverse array of nanomaterials may affect the human body and the environment.
Physiochemical properties that influence how particles interact with biological systems include particle size, shape, surface area, charge, chemical properties, solubility, and degree of agglomeration.



Nanomaterial in Liquid Form

As the graph indicates nanomaterials embedded in a matrix or in liquid suspension is typically considered to be a safe form for the storage and disposal of these waste. Do

not sewer dispose of these liquid wastes. Package in appropriate labeled containers and submit a waste request to EH&S for disposal.
Below is a suggested label with the proper information for containers that store engineered nanomaterials



Nanomaterial in Solid Form

Nanomaterials should not be stored or collected in a dry friable state. Waste nanomaterials should be fixed in a solid matrix so as to prevent aerosolized exposure. Solid matrix waste as well as contaminated laboratory debris such as gloves, adsorbents, and filters should be collected and managed in closed containers for offsite disposal. Proper description of contents including the matrix will guide us in determining proper disposal options.

2.12 Precipitates, Semi-Solids, Residues, Gels, Etc.

Precipitates, semi-solids, residues or gels of any kind must not be collected with waste organic solvents since they cannot be pumped for incineration. Use Section 2.1 to determine if the material is hazardous or call Environmental Health and Safety for assistance. If separable, the liquid phase should first be removed by decantation, filtration, evaporation, or absorption. Hazardous materials should be packaged in leakproof containers, according to Section 2.14.

2.13 Labware Contaminated With Chemicals

Disposal of some labware can be considered laboratory debris and disposed of in the normal trash. The term "labware" pertains to disposable laboratory items such as gloves, benchtop coverings, pipets, test tubes, filter paper, aprons, etc. The decision as to

whether contaminated labware 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. Environmental Health and Safety staff can assist in this decision through consultation with its resources, including members of faculty and staff.

If you feel that solid waste trash, (municipal landfill, municipal incinerator) is not an appropriate route of disposal for your contaminated labware (because the contaminant possesses a high degree of toxicity), package according to Section 2.14. Department of Environmental Health and Safety staff will evaluate the labware for appropriate disposal options.

All labware contaminated with PCB concentrations of 50 ppm or greater is hazardous by state regulation. A waste request must be submitted to Environmental Health and Safety for disposal as hazardous waste. EPA has a derived from rule that applies to all PCB contamination down to 1ppm that resulted from a source of material with a concentration greater then 500 ppm. Try to eliminate use of pure, or greater than 500 ppm source material when working with PCB's.

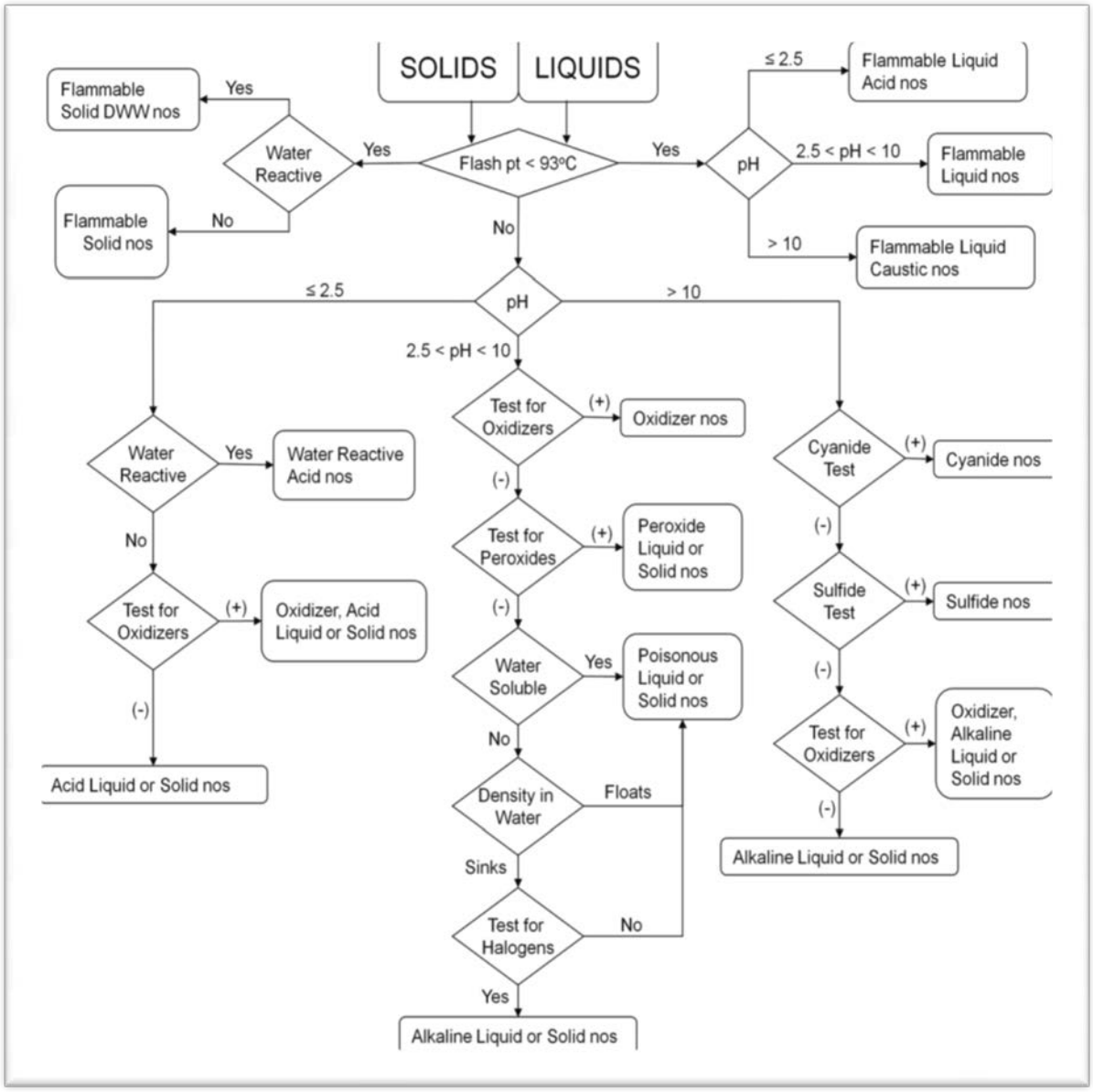
2.14 Unknown Chemicals

Faculty and staff must make every effort to provide an accurate description of all unknown chemicals. Unidentified chemicals present serious problems for the University. Unknown chemicals cannot be handled, shipped, nor disposed of in a safe manner. Disposal companies will not accept chemical waste without some generator certification or laboratory analysis.

Environmental Health and Safety offers assistance in investigating the identity of unknown chemicals. However, any information provided by individuals wishing to dispose of unknowns will greatly aid investigation and identification. Whether a chemical is organic or aqueous, halogenated or non halogenated is an example of information that is very useful to Environmental Health and Safety.

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

Upon discovery of an unknown chemical, call Environmental Health and Safety for assistance. The basic flow chart that we use to fingerprint unknowns is included below. Any information you can provide will assist us in this process.



2.15 Labs Which Cease Operations or Change Hands

Environmental Health and Safety often receives unknown and unwanted chemicals when laboratories change hands. All waste chemicals and reagent samples should be identified, labeled, and stored properly. For more information refer to the Laboratory Safety Manual for the Laboratory Closeout policy in detail.

3.00 Hazardous Waste Management at the Point of Generation

All hazardous waste must be stored and managed at the point of generation, (the laboratory generating the waste), until the containers are full. Generator management requirements that apply to hazardous waste storage are called Satellite Accumulation

Area standards, (SAA). Violations of these SAA requirements account for over 90% of all hazardous waste violations according to EPA inspection records.

These storage requirements are found in the 310 CMR 30.3340 (6). The requirements state that a large quantity Generator may accumulate and store hazardous waste without a license provided the waste is:

- Accumulated at or near the point of generation.
- The waste is generated as a result of a process occurring at the point of generation.
- The area is under the control of a key staff person.
- Only one container of a specific waste stream per designated storage area at a time.
- Containers may be up to fifty-five gallons for non-acutely hazardous waste and one quart for acutely hazardous waste.

3.10 General rules and Information

Proper packaging of hazardous waste provides for increased safety in storage and when transporting the materials. Proper labeling of such materials is essential for proper disposal. Please use the following guidelines when submitting a waste request to Environmental Health and Safety for disposal:

- Minimize the quantity of chemicals given to Environmental Health and Safety. Items which can be disposed of in the trash or into the sewer should not be included in the Hazardous Waste Pickup Request. If you are unsure about a chemical and its proper disposal options, please review Section 2.1, or call Environmental Health and Safety.

- Liquid and solid chemicals should be in closed, labeled containers. Each container must have a "Hazardous Waste Label" filled out completely and attached securely to the container. These labels are available upon request from Environmental Health and Safety or from the Fisher Chemical Stockroom.

3.12 Containers of hazardous chemical waste in the SAA

- Must be labeled “Hazardous Waste” with the respective hazard warning, ignitable, corrosive, reactive, toxic, or other indicated.
- Must be labeled with the contents described using complete chemical names itemized by approximate % composition.
- Must be stored in containers compatible with the contents.
- Must have tight fitting caps and must be closed at all times except when adding waste to the container.
- Must be stored in secondary containment designated for this storage with a label that says HAZARDOUS WASTE in 1-inch letters.
- Incompatible waste must be stored in separate secondary containment.
- Once a container is full, it must be removed within 3 days. Submit waste request for removal at: https://cems.unh.edu/umass/CEMS/RequestRemoval.

- Generator is responsible for inspecting compliance of these storage areas weekly.

Hazardous waste labels, secondary containment trays can be obtained by contacting EH&S at: 413.545.2682.


Hazardous Waste

☐ Recycle/Exchange (explain in "Comments")

Waste Identity (Be Specific): 4 liter methanol, 30%; acetone, 40%; hydrochloric acid, 2%; water, balance

Hazard (Check all that apply):

☒ Ignitable (FP<60°C) ☒ Corrosive (2 <pH>12.5)

☐ Reactive ☒ Toxic

☐ Other

Generator's name: J. Reynolds

Phone: 5-5555

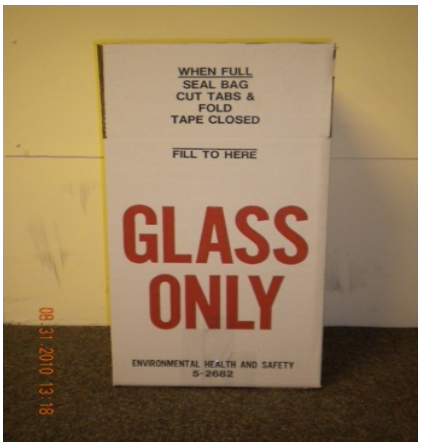
Location of waste: GRC-999

Comments

Call EH&S at 5-2682 for Pickup

Some nonhazardous waste may be disposed of in the sanitary sewer or with normal trash, *if so advised by Environmental Health and Safety*. Small empty glass containers and pipettes that are suitable for sanitary landfill disposal should be collected in glass only boxes.

Glass only boxes can be obtained from EH&S, Physical Plant Custodial, or the Fisher Chemical Stockroom in LGRT.



Insert the plastic bag liner, do not fill above the "fill to here" line marked on the box. When full, seal the plastic liner, close and tape the box shut and leave for custodial removal.

DO NOT PLACE ANY LIQUIDS IN THESE GLASS ONLY BOXES OR IN ANY WASTE BOUND FOR THE SANITARY LANDFILL. Liquids are prohibited from any solid waste landfill.

EH&S manages many technically nonhazardous wastes, as "hazardous". This decision is based on the assumption that some hazards may be present that may not be adequately treated if disposed as either solid waste or in the sanitary sewer. Typical examples of these types of waste include the many gel type solids that contain trace contamination such as EtBr gels, silica gel contaminated with trace solvents, pharmaceuticals, and solidified nanoparticles. Waste solvents and other hazardous

wastes are disposed of through a commercial, licensed hazardous waste disposal company. These wastes will either be incinerated, or solidified for burial in an EPA-permitted hazardous waste landfill.

Throughout this disposal process, the University is required to keep complete records that account for the disposal of hazardous wastes. This “from the cradle to the grave,” concept holds the Generator of the waste liable for that waste essentially forever.

3.13 Examples of Proper Collection Containers

Methods of Collecting Specific Waste Streams

Below are examples of waste streams typically found at UMass/Amherst. Any questions should be directed to Environmental Health &Safety at: 413-545-2682.

ORGANIC WASTE

The above **APPROPRIATE CONTAINERS** are located in the LGRT Fisher Stockroom and are free of charge from EH&S, as available. Large Volume Generators can use either the Safety can or a 20 liter empty metal solvent can that is in good condition with tight closing caps. Glass bottles in good condition with tight closing caps can also be used for organic waste. If you save empty glass 4 liter bottles complete with cap these can be used for waste collection. If you have too many empty bottles call EH&S at 5-2682 and we will pick them up and bring them to the Fisher stockroom for community use.

If waste is compatible and co-mingled, the University can realize significant savings in disposal cost.

AQUEOUS CORROSIVES

Polyethylene & Glass Containers

- Any aqueous waste either acidic or basic can be collected in either glass or polyethylene containers
- Metal cans must not be used to store or collect any corrosive waste

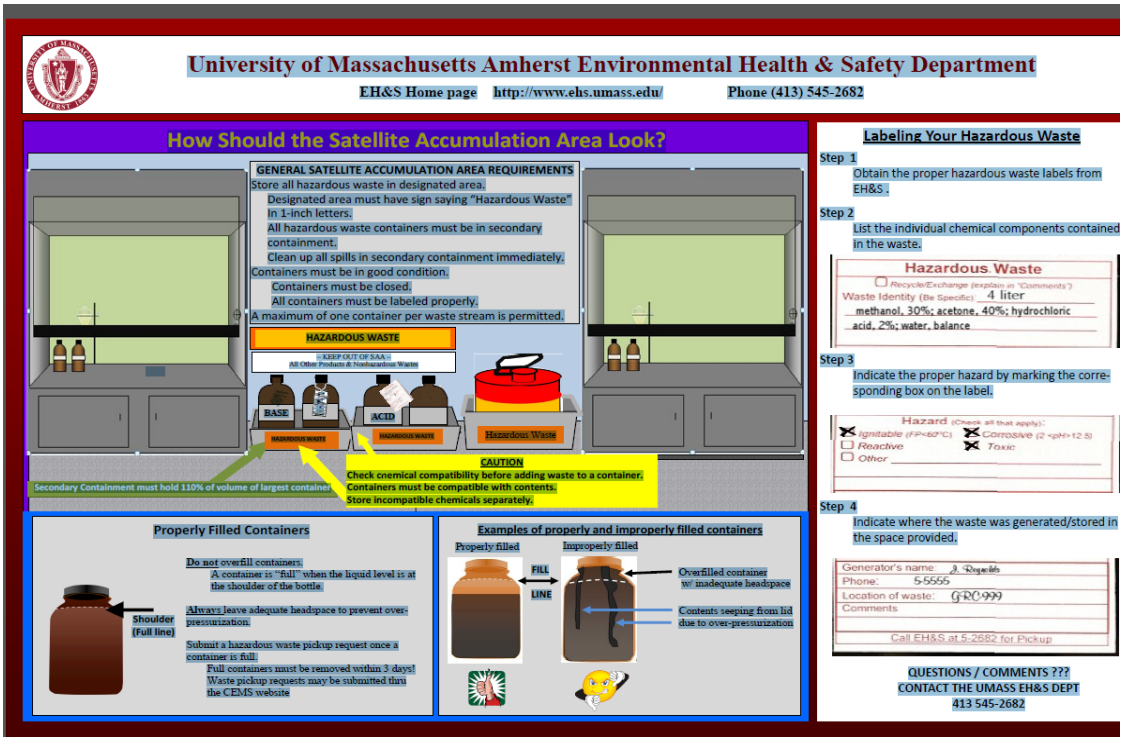
HAZARDOUS AND NON HAZARDOUS SOLID WASTE/ENVIRONMENTAL TOXINS

Some laboratory solid waste may not fit the definition of “Hazardous Waste” but these wastes can pose some hazards to people and the environment when disposed. These can include but are not limited to;

- Ethidium bromide
- Dimethyl formamide
- Acridine orange or any other green cell staining replacements
- Silica gels
- Gels with trace pharmaceuticals and gels with trace Antibiotics

We attempt to maintain an assortment of containers in the Fisher chemical stockroom for These solid waste streams. Heavy mil plastic bags are available and should be inserted in the bucket. A label should be applied as shown. Collect your waste in the plastic liner and remove the liner, tape it closed when full. Label with hazardous waste label and submit a waste request with EH&S at http://www.ehs.umass.edu/ Insert new plastic liner in bucket for continued collection.

3.14 How Your SAA should look:



3.15 SAA Weekly Inspection:

Weekly Satellite Accumulation Area Inspection for _____ Room #_____ USE ERASABLE MARKER				
KEEP A ROLLING 4-WEEK RECORD. --- ERASE ENTRIES FROM OLDEST WEEK COLUMN TO RECORD CURRENT INSPECTION.				
Weekly inspections are required by MA state regulation	**Week 1**	**Week 2**	**Week 3**	**Week 4**
A satellite accumulation area must be located in the same room/floor where waste is generated. Waste should be stored in proper storage cabinets or in a designated area within the lab. Labs may use tape, placards or signs to demarcate a designated satellite accumulation area.	Date ___/___/_____	Date ___/___/_____	Date ___/___/_____	Date ___/___/_____
1.) Are all containers marked "hazardous waste"?	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO
2.) Have you indicated the corresponding hazard(s) for each container?(Ignitable? Corrosive?,Reactive? Toxic?)	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO
3.) Are all hazardous waste containers labeled with chemical names for the corresponding contents? Chemical names must be spelled out. Chemical formulas ARE NOT acceptable	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO
4.) If reusing original containers, have the original labels been removed or defaced?	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO
5.) Is the waste compatible with the container?				
6.) Are all hazardous waste containers in good condition? (e.g no dents, cracks, or loose/broken caps)	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO
7.) Are containers closed except when adding or removing waste?	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO
8.) Is there adequate head space in all containers?	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO
9.) Has a hazardous waste pick up request been submitted for full containers? SUBMITTING A HAZARDOUS WASTE PICKUP REQUEST Go to www.ehs.umass.edu or the CEMS website to fill out a waste request	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO
10.) Do all containers have adequate secondary containment for spill prevention?	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO
11.) Spilled material in the secondary containment vessel has been cleaned?	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO
Date Corrective Action Completed				
Briefly describe any corrective actions				

4 Hazardous Waste Minimization/Reduction

The Act of Congress that authorized the management of hazardous wastes is entitled: "The Resource Conservation and Recovery Act," or RCRA. A focus of this act was to encourage generators to “Reduce, Reuse, and Recycle. Environmental Health and Safety embraces this philosophy and has designed its management system around waste reduction and recycling methods. The handling, transport, treatment and disposal of chemical waste is expensive. You can help reduce the volume of chemical waste by following these three R’s.

Persons generating chemical waste as the result of experimentation must consider that waste is an integral part of the experiment. If a procedure exists whereby the initial chemical by-product can be readily converted to a less hazardous form or can be neutralized, this procedure should also be incorporated into the experimental method. In Massachusetts “treatment” of hazardous waste is prohibited by statute. However, converting energetic or hazardous compounds to less hazardous waste is allowed if completed as part of the research process and completed prior to removal from the reaction process. Some treatment procedures and examples are published in the Third Ed. Of the Hazardous Laboratory Chemicals Disposal Guide, Armour, Margaret-Ann, Lewis Publishers, 2003, or the updated Prudent Practices in the Laboratory, titled, Procedures for the Laboratory Scale Treatment of Surplus and Waste Chemicals

Waste Reduction Methods

The significant amount of chemical wastes generated at the University each month presents a serious and complex problem for the entire University community. The key to solving this problem lies in recognizing the responsibility to reduce this volume when possible.

ORDER ONLY WHAT IS NEEDED. The economy of purchasing larger sizes is offset by the University's disposal cost for your excess. These costs are generally more than the original price of the chemical. 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.

SUBSTITUTE non-hazardous or less hazardous materials for hazardous ones whenever possible. There are commercially available non-hazardous substitutes for chromic acid cleaning solution. Alcohol based thermometers are less toxic than mercury ones and can be substituted satisfactorily in most cases. Investigate other possible substitutions through the literature or call EH&S for assistance.

Before submitting a waste request for pickup of an unwanted but useable chemical, please check to see if other laboratories in your department or building can use it. Contact EH&S when transferring chemicals to another laboratory so that the electronic inventory can be updated. Waste solvents should not be evaporated in your laboratories. Segregate and collect solvents for pickup by EH&S.

When planning experiments, consider the following questions in your planning:

- Can any material be recovered for reuse? Can the product of one reaction be used as the starting material for the next experiment?
- Will the experiment generate any chemical that can be safely broken down by a laboratory procedure (e.g., elementary neutralization)?
- Can any unusual disposal problems be anticipated? If so, inform EH&S (e.g.,mixed waste, Chemical/Radioactive, or Chemical/Biological).
- Are chemicals being acquired only in needed quantities?
- Is there a possibility of replacing a hazardous reagent or solvent with one that is less hazardous and easier to dispose of?

4.1.6 Reduction of the Scale of Experiments

The use of microscale 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. Technical advances that have made this possible include:

- Fast microprocessor-based, top-loading balances that are sensitive to 0.1 mg.
- Chromatographic techniques such as high performance liquid, gas, size exclusion, and ion exchange that can cleanly separate and purify milligram quantities of substances.
- Sensitive spectrometers that can analyze milligram, and sometimes microgram, quantities of substances.
- Microscale glassware including pipettes, burettes, syringes, reactors, and stills for handling reagents and reagent products.
- Flow and transfer systems based on small internal diameter metal and plastic tubing that make it possible to study flow type reactions, catalysts, and multi-step reactions on a very small scale, even under pressure. In addition to reduction of waste volumes, today's economies dictate investigation of these microtechniques for use in laboratory operations.

4.1.7 Control Reagents That Can Deteriorate

INDEFINITE AND UNCONTROLLED ACCUMULATION OF EXCESS REAGENTS CREATES STORAGE PROBLEMS AND SAFETY HAZARDS. THESE PROBLEMS CAN BE ALLEVIATED, AND PURCHASE COSTS SAVED, BY REVIEWING YOUR INVENTORY PRIOR TO PURCHASING NEW PRODUCT. THIS CAN REDUCE DUPLICITY OF HAZARDOUS CHEMICAL CONTAINERS AND ALLOW YOU TO USE THE OLDEST FIRST.

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 review of these chemicals which deteriorate over time should be instituted to prevent accumulation of outdated chemicals which pose an increased risk to the laboratory and personnel.

4.1.8 Prevent 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 and faculty member responsible, and a notebook reference. Research samples should also include this information. When storing research samples for a period of time, a number of like samples can be stored together in a box with this label information permanently affixed to the outside of the box. This procedure can provide the information necessary to guide the disposal of the mixture, if the responsible laboratory worker is not available.

DEPARTMENTS SHOULD INITIATE A CHECKOUT PROCEDURE THAT REQUIRES DEPARTING LABORATORY WORKERS TO IDENTIFY ANY REACTION MIXTURES THAT THEY HAVE NOT DISPOSED OF AND TO PROVIDE THE INFORMATION NECESSARY FOR THEIR SAFE DISPOSAL. (See; Laboratory Decommissioning Procedure in the Laboratory Safety Manual).

Individual principle investigator's or departments may be held responsible for the costs associated with the identification and removal of orphan reaction mixtures and unknown chemicals left behind by departing investigators or graduate students, and any extraordinary cleanup costs for removal of waste chemicals.

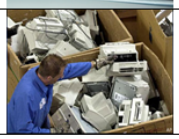
5.0 Universal Waste Management

State and federal agencies have provided reduced collection storage and disposal requirements for a set of common consumer waste streams if they are recycled. These waste streams might be classified as hazardous by definition but pose insignificant personal exposure issues and are commonly found in the consumer environment. The concern is that improperly managed these items could pose a significant exposure issue to the environment. The waste streams listed below are managed at the Waste Recycling and Transfer Facility. If you generate any of these waste streams you can deliver these to the WRTF or contact the recycling facility at 5.0618 or submit a waste request electronically at http://www.ehs.umass.edu/

Reduction of the use of mercury in newer green labeled fluorescent light bulbs has allowed us to manage these as nonhazardous solid waste. We will still collect and manage these new bulbs at the WRTF and will look at methods to recycle these wastes. Do not throw any fluorescent light bulbs in the trash.

UNIVERSAL WASTE			
Waste Stream	**Description**	**Examples of Use**	**Disposal Procedures**
Aerosol cans	 **Hazardous** – Contains hazardous materials, and/or is under pressure.	Spray paints, disinfectants, lubricants, etc.	**Must be drained of the hazardous contents, and the empty can recycled.** Submit waste request with EH&S
Fluorescent lamps and CFL's	  **Hazardous** – Contains mercury vapor.	Indoor lighting. Exterior street lamps (High pressure sodium, sodium vapor lamps also contain mercury.)	**Must be recycled.** Place in cardboard box supplied by Waste Management. Tape box shut and label with Universal Waste Label, bring full box to WRTF
Nickel Metal Hydride (Ni-MH) and Nickel Cadmium (Ni-CAD) Batteries, (Rechargeable)	 **Hazardous** – labeled Ni-Cd.	Portable tools and appliances, cell phones, cordless phones, video cameras, 2-way radios. Used as alternatives to alkaline batteries.	**Must be recycled.** Sort batteries by type accumulate in plastic containers. Use tape to cover electrodes submit waste pickup with EH&S
Alkaline and Zinc Carbon Batteries (Non-rechargeable and rechargeable)	 Non-hazardous. Labeled "General Purpose," or " Heavy Duty."	Flashlights, toys, radios, calculators, remote controls, electronic games, garage door openers, lanterns, and fire and smoke detectors and other products.	May be discarded into regular trash.
Lithium Batteries (Non-rechargeable)	 **Hazardous** – Some may be reactive.	Cameras, computer memory back up, watches, remote controls, hand-held games.	**Must be recycled.** Sort batteries by type accumulate in plastic containers. Use tape to cover electrodes submit waste pickup with EH&S
Note: Please place a piece of tape on battery terminals before disposing, to prevent accidental discharge or reaction.			

Universal Waste Management Guide

Waste Stream	**Description**	**Examples of Use**	**Disposal Procedures**	**Waste Stream**
Lithium Ion Batteries (Rechargeable)	 **Hazardous** – labeled Li-ion.	Laptop computers, cellular phones, camcorders and portable electronic equipment.	**Must be recycled.** Sort batteries by type accumulate in plastic containers. Use tape to cover electrodes submit waste pickup with EH&S	
Button Batteries – Silver Oxide and Mercuric Oxide (Non-rechargeable)	 **Hazardous** – usually button shaped, with no markings. Mercuric Oxide button cells are no longer sold in the U.S.. Larger batteries are still available.	Hearing aids, medical devices, watches, calculators, cameras, toys, musical greeting cards.	**Must be recycled.** Sort batteries by type accumulate in plastic containers. Use tape to cover electrodes submit waste pickup with EH&S	
Button Batteries – Zinc Air (Non-rechargeable)	  Non-hazardous. Usually button-shaped with a pin hole on one side. May resemble regular 9 volt batteries.	Hearing aids, medical devices.	May be discarded into the regular trash.	
Used Electronics	 **Hazardous** – Contains lead, mercury, cadmium, silver and many other toxic materials.	Computers, monitors, keyboards, televisions, printers, etc. (Anything that has a monitor or circuit board.)	**Must be Recycled.** Call WRTF at 545-0618	
Note: Please place a piece of tape on battery terminals before disposing, to prevent accidental discharge or reaction.				

Call the Office of Environmental Health & Safety at: 545-2682, or the Office of Waste Management at 545-0618 for assistance in disposing of these, or any other Universal waste.