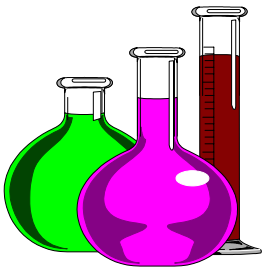
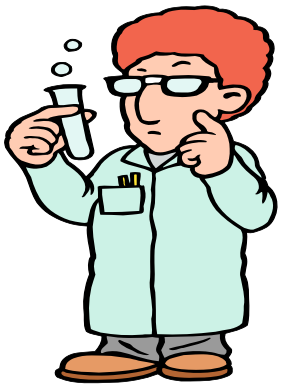
Guideline for Safety Management of Laboratories Hazardous Wastes "Chemical and Biological"





Prepared By

Committee for Safty and Occupational Health

Group of Hazardous Waste

Prof. Dr. Sohair Abou-Elela

Dr. Hanan Sayed Abd El-Rahman

National Research Center

Environmental Research Division

Water Pollution Research Department

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Hazardous Labeling

Danger symbols (e.g., found on chemical substance labels):

Explosive

Oxidising

Acid

Easily flammable

Highly flammable

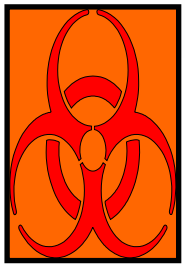
Poisonous

Very poisonous

Noxious

Irritating

Environmental hazard



Biohazard

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APPENDICES

LIST OF ABBREVIATION

Resource Conservation and Recovery Act	**RCRA**
National Research Center	**NRC**
Environmental Protection Agency	**EPA**
Characteristic Chemical Wastes code	**D code**
Material Safety Data Sheets	**MSDSs**
Committee for Safety and Occupational Health	**CSOH**
Toxicity Characteristic Leaching Procedure	**TCLP**
TriNitroToluene	**TNT**
Chemical Abstract ServiceNumber	**CAS**
Lethal Dose 50 is the amount of a solid or liquid material that it takes to kill 50% of test animals (mice or rats) in one dose	**LD50**
chromium trioxide in solution which, when mixed with a 4.1kg 2.50 liters container of sulfuric acid, makes a highly efficient cleaner	**Chromerge**
For storage of biological specimens	**Formalternate**
pounds per square inch	psi
Waste Characterization Form	WCS
Conditionally-Exempt Small Quantity Generators	**CE-SQG**
Small Quantity Generators	**SQG**
Large Quantity Generators	**LQG**
Department of Transportation	**DOT**

GUIDELINE OF SAFETY MANAGEMENT FOR LABORATORIES HAZARDOUS WASTES "CHEMICAL AND BIOLOGICAL"

CHAPTER 1

IDENTIFICATION OF REGULATED WASTES

1.1. INTRODUCTION

Hazardous waste is defined as any substance, material and its mixture or solution that capable of poising an unreasonable risk to health, safety and property and is no longer reusable, recyclable and must be disposed off properly.

The term 'Hazardous Substance is very broad and includes chemicals, biological agents, carcinogens, dusts, flammable materials (solvents and fuels) and gases that may create a risk to human health or harm to the environment.

In practice, they may be in a solid, liquid, sludge, or gaseous state. A waste is regarded as hazardous if it is lethal, nondegradable and persistent in the environment, can be biologically magnified (as in food chains), or otherwise causes detrimental cumulative effects.

Resource Conservation and Recovery Act (RCRA) 1976, defined hazardous waste as any waste or combination of wastes, "solid, liquid, semi-solid or contained gaseous material that is discarded, abandoned, recycled, or is an

inherently waste-like material...” which because of its quantity, quality, concentration, physical, chemical, or infectious characteristics may:

i. Cause, or significantly contribute to an increase in mortality or increase in serious incapacitating reversible illness;
ii. Pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed off, or otherwise managed.

Research and educational activities commonly produce a wide variety of hazardous wastes in relatively small volumes, including new materials of unknown toxicity and hazard. These could represent a significant risk to human health and the environment unless it is identified, contained, and disposed off in accordance with applicable laws, regulations, and best management practices.

Reduction of pollutant emissions associated with research and educational activities is an important objective consistent with the National environmental policy. Therefore, The purpose of this book is to provide information, requirements, guidelines and procedures for the handling and disposal of hazardous and non-hazardous chemicals and biological wastes generated from any laboratory in National Research Center (NRC) dealing with these materials. This will improve environmental performance by assisting in the development and implementation of environmental management programs that meet important National regulatory requirements and minimizing pollution.

1.2. OBJECTIVES

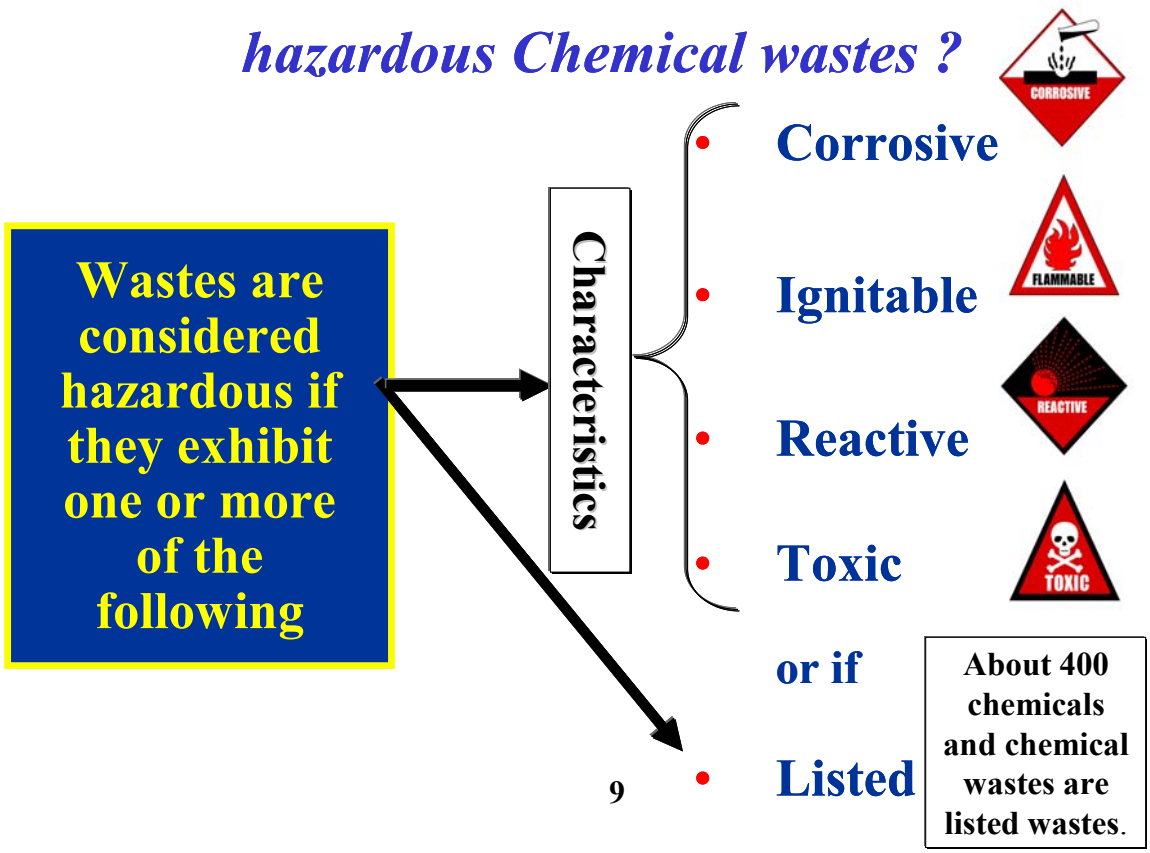
- To provide safety guidelines on waste disposal procedures;
- To provide primary information on classification of hazardous waste;
- To train all lab executives to handle hazardous waste safely.

1.3. CHEMICAL WASTES

1.3.1. Definition of Chemical Wastes and Characterization

What Is Hazardous Chemical Wastes?

For practical purposes, consider all waste hazardous unless it is listed in ***Appendix I.*** The Environmental Protection Agency (EPA) through the Resource Conservation and Recovery Act (RCRA) regulations defines a hazardous waste as a solid waste that is either ***Characteristic Waste, or Listed Waste.***



Characteristic Chemical "D" Wastes

The EPA has identified four characteristics for hazardous waste:

Ignitability, Corrosivity, Reactivity and Toxicity.

Material Safety Data Sheets (MSDSs) are a good source of information for determining whether a particular material meets any of these criteria. Hazardous wastes may include by-products and wastes from chemical reactions or unwanted commercial products and chemicals.

Any solid waste exhibiting any one or more of these characteristics is hazardous and subject to regulations for safe disposal.

A. Ignitability D001

A waste is characteristic for ignitability if it has any one of the following properties:

I- Liquids with a flash point less than 60°C (140°F); is considered ignitable. This category includes almost all organic solvents. Some examples are:

Examples include, but are not limited to, most organic solvents such as:

Acetone	Ethyl ether	Pentane
Benzene	Heptane	Petroleum Ether
Ethanol	Hexane	Toluene
Ethyl acetate	Methanol	Xylene

II- Materials other than liquids that are capable, under standard temperature and pressure, of causing fire by friction, adsorption of moisture, or

spontaneous chemical changes and, when ignited, burn so vigorously and persistently that they create a hazard.

III- Flammable compressed gases, including those that form flammable mixtures with air.

IV- Oxidizers that stimulate combustion of organic materials such as

Bromates	Chlorates	Dichromates
Iodates	Nitrates	Nitrites
Perchlorates	Permanganates	Peroxides

B. Corrosivity D002

Corrosive wastes include highly acidic or highly alkaline chemicals and those that are capable of corroding metals. A waste has the characteristic of corrosivity if it has one of the following properties:

1- An aqueous waste with pH 2 or less, OR pH 12.5 or greater; or,

2- A liquid that corrodes steel at a rate greater than 6.35 mm (0.25 inches) per year at 55 °C.

If a waste exhibits ONLY the characteristic of corrosivity and is NOT a listed waste, it may be neutralized before disposal to the sanitary sewer. When in doubt, or if neutralization is not feasible "Authorized Office for Safety and Occupational Health (**CSOH)** for hazardous waste should manage the waste."

C. Reactivity D003

Any wastes exhibiting one or more of the following characteristics are classified as reactive wastes and require specially storage and handling during transportation to the treatment facility:

- Unstable materials capable of undergoing violent chemical change (without detonating).
- Materials which react violently with water.
- Materials which form potentially explosive mixtures with water.
- Materials which, when mixed with water, generate toxic gases, vapours, or fumes in a quantity sufficient to present a danger to human health or the environment.
- Cyanide or sulfide bearing wastes which, when exposed to pH conditions between 2 and 12.5, will generate toxic gases, vapors, or fumes in a quantity sufficient to present a danger to human health or the environment.
- Materials capable of detonation or explosive reaction when subjected to a strong initiating source or if heated in confinement.
- Materials which are capable of detonation or explosive decomposition at standard temperature and pressure.

Alkali metals, peroxides, cyanide and sulfide compounds are examples of compounds that become reactive wastes.

D. Toxicity D004-D043

A solid waste whose leachate (extract) contains any of the toxic heavy metals, pesticides, or organics in concentrations equal to or greater than the regulatory levels given in the Table 1.

Toxicity is determined by the "Toxicity Characteristic Leaching Procedure" (TCLP), a laboratory test that measures the concentration of the toxic material that could leach into ground water if improperly managed.

The TCLP must be conducted on any waste that contains any of the specified TCLP contaminants. These contaminants include toxic metals such as lead and mercury, organics such as benzene and chloroform, and pesticides such as endrin.

The TCLP, or Toxicity Characteristic Leaching (not Leachate) Procedure is designed to determine the mobility of both organic and inorganic analytes present in liquid, solid, and multiphase wastes. This is usually used to determine if a waste may meet the maximum concentration of contaminants for toxicity characteristic (see Table 1). As it is the generator's responsibility to make this determination, but generators often contract outside labs to perform the TCLP test.

1.3.2. Listed Chemical Wastes

The EPA has also designated hazardous waste to be any solid waste that is listed in one of the four following lists (***See Appendix II)***.:

I. “F” List

“F” listed hazardous wastes are generic wastes from non-specific sources. Wastes on this list include spent halogenated and non-halogenated solvents. The F001 waste code is used ONLY for degreasing wastes.

II. “K” List

“K” listed hazardous waste are specific wastes from specifically identified industries (sources) (e.g., pink/red water from TNT operations and is generally not applicable to wastes generated in research laboratories..

III. “P” List

“P” Listed are discarded commercial chemicals, off- specification chemicals, and container or spill residues from such compounds, including unused laboratory chemicals(e.g., laboratory chemicals having an LD_{50} of less than 50 mg/kg (oral; rat). “P” listed wastes are acute hazardous waste, and no more than 1 kg of such waste may be generated in any one month. It is applicable to many surplus chemicals that are disposed of by research laboratories.

Some examples are nickel tetracarbonyl, phosphine, and osmium tetraoxide.

IV. “U” List

“U” Listed addresses unused hazardous materials (e.g., toxic laboratory chemicals) like the P list. This is applicable to many surplus chemicals that are disposed of by research laboratories. Some examples are aniline, benzene, and acetone.

Note: If the waste is spent (not in its original form), these lists do not apply.

Table 1. Maximum Concentration of Contaminants For Toxicity Characteristic Leaching Procedure (TCLP) Hazardous Wastes (D code)

Name of Constituent	C.A.S. Number	Regulatory Level	E.P.A. Waste No.
Arsenic	7440-38-2	5.0 mg/L	D004
Barium	7440-39-3	100.0 mg/L	D005
Benzene	71-43-2	0.5 mg/L	D018
Cadmium	7440-43-9	1.0 mg/L	D006
Carbon Tetrachloride	56-23-5	0.5 mg/L	D019
Chlordane	57-74-9	0.03 mg/L	D020
Chlorobenzene	108-90-7	100.0 mg/L	D021
Chloroform	67-66-3	6.0 mg/L	D022
Chromium	7440-47-3	5.0 mg/L	D007
m-Cresol	108-39-4	200.0 mg/L**	D024
o-Cresol	95-48-7	200.0 mg/L**	D023
p-Cresol	106-44-5	200.0 mg/L**	D025
Cresols (total)	-----	200.0 mg/L**	D026
2,4-D	94-75-7	10.0 mg/L	D016
1,4-Dichlorobenzene	106-46-7	7.5 mg/L	D027
1,2-Dichloroethane	107-06-2	0.5 mg/L	D028
1,1-Dichloroethylene	75-35-4	0.7 mg/L	D029
2,4-Dinitrotoluene	121-14-2	0.13 mg/L*	D030
Endrin	72-20-8	0.02 mg/L	D012
Heptachlor (and its epoxide)	76-44-8	0.008 mg/L	D031
Hexachlorobenzene	118-74-1	0.13 mg/L*	D032
Hexachlorobutadiene	87-68-3	0.5 mg/L	D033
Hexachloroethane	67-62-1	3.0 mg/L	D034
Lead	7439-92-1	5.0 mg/L	D008
Lindane	58-89-9	0.4 mg/L	D013
Mercury	7439-97-6	0.2 mg/L	D009
Methoxychlor	72-43-5	10.0 mg/L	D014
Methyl ethyl ketone	78-93-3	200.0 mg/L	D035
Nitrobenzene	98-95-3	2.0 mg/L	D036
Pentachlorophenol	87-86-5	100.0 mg/L	D037
Pyridine	110-86-1	5.0 mg/L*	D038
Selenium	7782-49-2	1.0 mg/L	D010
Silver	7440-22-4	5.0 mg/L	D011
Tetrachloroethylene	127-18-4	0.7 mg/L	D039
Toxaphene	8001-35-2	0.5 mg/L	D015
Trichloroethylene	79-01-6	0.5 mg/L	D040
2,4,5-Trichlorophenol	95-95-4	400.0 mg/L	D041
2,4,6-Trichlorophenol	88-06-2	2.0 mg/L	D042
2,4,5-TP (Silvex)	93-72-1	1.0 mg/L	D017
Vinyl Chloride	75-01-4	0.2 mg/L	D043

*Quantitation limit is greater than calculated regulatory level. The quantitation limit therefore becomes the regulatory limit.

** If o-, m- and p-cresol concentrations cannot be differentiated, the total cresol (D026) concentration is used. The regulatory level of total cresol is 200mg/L.

1.3.3. Special Wastes

Many laboratory chemicals are known to be toxic or otherwise hazardous but are not characteristic or listed wastes, Examples include ethidium bromide. Therefore, a special waste can be defined as any solid waste that is not regulated as hazardous but because of its quantity, concentration, physical and/or chemical characteristics, or biological properties requires special handling and disposal to protect human health and the environment, or any chemicals with sufficient mutagenic, tetrogenic, carcinogenic, or reproductive hazards may warrant special handling. Material Safety Data Sheets (MSDSs) are a good source of information for determining whether a particular material meets any of these criteria. The following are considered special wastes:

- Waste whose toxic constituent concentration falls below the regulatory
  limits for the toxicity characteristic.
- Petroleum products, including oil and oil filters.
- Empty hazardous chemical containers.
- Light ballasts and small capacitors containing PCBs.
- Asbestos.
- Lead acid and Nickel/Cadmium batteries.

In general, waste streams greater than 1 ppm of these waste should either be deactivated in the laboratory or processed through on site laboratory of chemical waste.

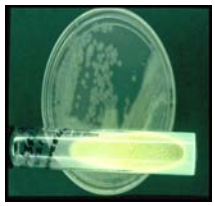
1.4. BIOLOGICAL (INFECTIOUS) WASTES

Biological waste has been identified as waste which requires special handling to protect human health or the environment. It is further defined as a solid waste which if improperly treated or handled may serve to transmit an infectious disease(s). The following types of waste are identified and defined as infectious or physically dangerous medical or biological waste: (***See Appendix III***)

1.4.1. Microbiological Wastes

Microbiological waste includes:

1. Discarded cultures, specimens and stocks of infectious agents and associated biological substance;
2. Discarded vaccines and;
3. Discarded used disposable utensils.



Note: In vitro tissue cultures that have not been intentionally exposed to pathogens are exempt from these regulations.

1.4.2. Animal Wastes

Animal waste includes:

1. Carcasses of animals;
2. Body parts of animals;
3. Whole blood, serum, plasma, and/or other blood components and excreta from animals; and;
4. Bedding of animals intentionally exposed to pathogens.

1.4.3. Human Wastes

1. Human blood, serum, plasma, other blood components, and body fluids;
2. Disposable items contaminated with human blood or body fluids;
3. Human materials removed during surgery and delivery or abortions, autopsy, biopsy and;
4. Samples of stool and urine

Contaminated is defined as the presence or the reasonably anticipated presence of blood, body fluids, or other infectious materials.

1.4.4. Sharps

Sharps include but are not limited to the following, **regardless of contamination**:

1. hypodermic needles and syringes;
2. scalpel blades and razors; and
3. glass wares including:
    - glass pipettes;
    - broken glassware;
    - specimen tubes;
    - blood culture bottles; and
    - microscope slides.

1.5. HOW CAN I KNOW THAT I HAVE HAZARDOUS WASTE???

1.5.1. Identification of the hazardous chemicals in your Lab

1.5.1.1. Priority chemical substances list of the most hazardous or the most used chemicals in National Research Centre (NRC).

Please sign on the most hazardous waste found in your lab in the provided check lists (Table 2).

Table 2. Priority chemical substances list –1

Chemical Substance	Procurement ITEM_CODE	Chemical Substance	Procurement ITEM_CODE
1,2-Dibromoethane(ethylene Dibromide)	428	Benzene A.R.	109
1,2-Ethane Dithiol	532	Benzene sulfonyl chloride	247
1,2-Ethane Dithiol	567	Benzidine	204
1,5-Diphenyl Carbazide	461	Benzoic acid GPR	177
1-Decanothiol 96 %	407	Benzoic Acid Sodium Salt 99+%	181
2-Chloro Aniline	1112	Benzoyl chloride	152
3-Chloro aniline	341	Benzoyl Cyanide	202
4-Chloro aniline	1268	Benzyl Chloride	151
4-Fluoro aniline	580	Beryllium chloride anhydrous	186
Acetic acid 96%	1	Beryllium oxide99.99%	185
Acetic acid glacial	2	Boron Trifloride Methanol	2702
Acetic anhydride	53	Brilliant blue G	174
Aceton HPLC	34	Bromine	170
Acetone D6 99.5%	38	Bromo benzene	123
Acetone D6 deuter	37	Bromo benzene	90091
Acetone G.P.R.	31	Bromo Succinimide-N	243
Acetonitrile	32	Butyllithium Solution	220
Acetonitrile H. P L C	33	Cadmium carbonate	216
Acetyl chloride	50	Cadmium chloride	217
Acrylo nitrile	9	Cadmium chloride hydrate	219
Aflatoxin B2 @	2146	Cadmium metal	222
Aflatoxin Total	2291	Cadmium oxide	223
Alcian blue 8GX	23	Cadmium sulphate	218
Alizarin Red S	1	Cadmium sulphate hydrate	327
Aluminium chloride anhydrous	2	Cadmium sulphide	224
Aluminium fluoride	3	Cadmuim Nitrate - 4 - hydrat	200
Ammania Solution AR	29	Caesium chloride	250
Ammonium di chromate EP	26	Calcium fluoride GPR	228
Ammonium fluoride	64	Calcium hydroxide	234
Antimony (III) chloride	71	Carbon di sulphide	260
Antimony penta chloride	76	Carbon tetra cloride	258
Antimony Pot. oxide tartrate	75	Chloro benzene technical	240
Antimony St.	2642	chloro form	326
Arsenic acid sodium salt	17	Chloro form D6	245
Azide Dextrose Broth	5	Chloro form HPLC	242
Azure B	2609	chloro sulfonic acid	210
Barium acetate	152	Chloro tri methyl silane	232
Barium bormide	9025	Chloroform	243
Barium carbonate	158	Chloroform A. R.	244
Barium chloride di hydrate extra pure	162	Chromic (IV) oxide	9032
Barium chloride fixanate water solution	154	Chromium (III) chloride 6 hydrate	268
Barium chloride hydrate	159	Chromium (III) chloride anhydrous	267
Barium chromate	157	Chromium (III) nitrate 9 hydrate	270
Barium hydroxide hydrate	161	Chromium (III) oxide	265
Barium stantard slulion	156	Chromium (VI) oxide	273
Barium sulphate	167	Cloro form D1	291
Barium sulpide	9026	Congo Red	306
Barium titanate (IV) 99%	165	Coomassie(R)Brilliant blue R250	304
Benzaldahyd cbr	106	Crystal violet high purity	358
Benzalde hyde extra pure	62	Cyanogen Bromide	251
Benzene	108	Cyanogen Bromide	2414
Benzene 99% thio phene free A.R	156	Cyclo hexane	254

Table 2. Priority chemical substances list –2

Chemical Substance	Procurement ITEM_CODE	Chemical Substance	Procurement ITEM_CODE
Di Chloro Methane for HPLC	346	Mercuric oxide yellow purified	728
di ethyl ether	343	Mercury (II) chloride	722
Di ethyl ether H PLC	344	Mercury (II) oxide	712
Di ethyl sulfate	559	Mercury (II) sulphate	715
Di iso propyl ether	350	Mercury (I) nitrate	717
Di Methyle Formamide AR	352	Mercury (II) chloride G P	732
Di phosphorus penta oxide	416	Mercury iodide	710
Eosin Methylene Blue PK	2052	Mercury metal	1522
Erythrosine	2001	Mercury oxide red	718
Ethidium bromide	425	Mercury triple di stilled	714
Ethidium bromide AR	424	Mercury(11)Nitrate-iH?o.	732
Ethyl Methane Sulfovnate	2612	Methanol A.R.	702
ethylene di amine (1.2 di amine ethane	438	Methanol D4 99.5%	722
Formaldhyde solution	487	Methanol for Adrorption HpLC	447
Formic acid 85%	500	Methanol GPR	700
Hydrazin Hydrate	732	Methanol GPR	704
Hydro chloric Acid A.R 37%	551	MethanoL H P L c	624
Hydrofluoric acid	552	Methyl Hydrazine	994
Hydrogen peroxide	554	Methylene blue	921
Inorganic Phosphoruse	2264	Methylene chloride	342
Iodine resublimed	545	Mitomycin	2718
Iodo benzene	608	Morpholine	711
Iodo benzene	813	n Heptane	565
Iodo Methane99%	610	n-Hexane	557
Lead (II) acetate tri hydrate	616	Nickel powder extra pur	802
Lead (II) carbonate	624	Nickel wire	813
Lead (II) chloride	621	Nitric acid 55%	807
Lead (II) chromate	620	Nitric acid 65 %	809
Lead (II) citrate tri hydrate	614	Nitric acid fuoming 100%	810
Lead (II) oxide	625	nitro benzene	808
Lead (II)sulphate 98&	612	Orcein Synthetic	1105
Lead (II.IV) oxide	609	Ortho phosphoric acid	868
Lead (IV) oxide	626	Oxalic acid	1113
Lead acetate basic	615	Oxalic Acid	2109
Lead granuler 99.999%	666	Oxalic Acid Dihydrate	1120
Lead Nitrate Perfied	611	Oxalinic Acid	2247
Lead oxide (per oxide)	628	O-xylene(88)	1204
Lead oxide yellow	610	Perchloric acide 70%	936
Lead phthalocyanine	622	Phenanthrene	1226
Lead powder	611	Phenanthrene Dio	2043
Lead tetra acetate	617	Phenol Altra Pure Crystal	2818
Lead tetra acetate	645	Phenyl Hydrazine 95%	1259
Lithium aluminum hydrate	632	Phosphorus (V) oxide	941
Lithium aluminum hydrate	663	Phosphorus penta chloride	941
Lithium fluoride (PRS)	640	Phosphorus red	905
Lithium hydride powder	633	Phosphorus tri chloride	902
Litium aluminium hydride 95%	635	Phosphoruse Kit	2142
Loeffer's Methylene Blue Solution	881	Phosphoryl chloride	898
Magnesium perchlorate dried	688	Phosphrous penta chloride extra pure	920
Mercuric (1) chloride powder	731	Picric Acid (2,4,6,Tri nitro Phenole)98%	966
Mercuric acetate 99%	708	Poly Chlorinated Bi Phenyl Standard	2269
Mercuric iodide	709	Poly phosphoric acid	897

Table 2. Priority chemical substances list –3

Chemical Substance	Procurement ITEM_CODE	Chemical Substance	Procurement ITEM_CODE
Pot. Permangente	1190	**Tri chloro ethylene**	1169
Potassium chromate	893	**Tri fluorro acetic aced 99%**	1112
Potassium cyanide	928	**Triphenyl Arsine**	1497
Potassium di chromate fine	901	**Triphenyl phosphine sulfide 98%**	1486
Potassium fluoride anhydrous	924	**Triphenyl phosphline sulfide**	1469
Potassium hydroxide	933	**Trypan Blue**	2798
Potassium hydroxide	958	**TSC-Agar (Tryptose sulfite cycloserine**	1518
Potassium Nitrate	938	**Uranyl Acetate 2 hydrate**	1532
Potassium permanganate	898	**Uranyl acetate 2-hydrate**	1527
Potassium peroxide sulphate	908	**Urethane**	2073
Pyridine	955	**Xylene extra pure**	1202
Rose Bengal	2000	**Zinc fluoride**	1364
Safranine-O	1332		
Selenium (IV) oxide	1021		
Selenium di oxide GPR	1030		
Selenium St.	2643		
Silicon tetra chloride	1107		
Silver perchlorate hydrate 99%	1048		
Sodium Azide	1086		
Sodium boro hydride powder	1146		
Sodium chromate anhydrous	1072		
Sodium cyanide	1105		
Sodium ethylate	1098		
Sodium floride	1083		
Sodium hydride suspension	1130		
Sodium hydroxide	1086		
Sodium hydroxide pellets	1088		
Sodium hypochloride	1183		
Sodium hypochlorite	1184		
Sodium Nitrit	1074		
Sodium nitro ferri Cyanide	1104		
Sodium per iodate	1097		
Sodium peroxde granuler	1140		
Sodium sulpide	1113		
Sodium sulpite	1189		
Soduim cyanide	1075		
Strantium fixanal water solution	1131		
Streptozotacin	2288		
Sulfamic acid	1334		
Sulfamic acid	1367		
Sulfuric acid	1083		
Tannic acid	1472		
Thionyl chloride	1110		
Thiourea extra pure	1421		
Tin (]V) chloride extra pure	1253		
Tin (IV) chloride 5 hydrate	1254		
Tin (IV) chloride 99%	1271		
Tin (IV) chloride anhydrous	1256		
Tin (IV) chloride penta hydrate	1261		
Titanium tetra chloride	1208		
toluene A R	1172		
Tri chloro ethane	1177		

1.5.1.2. MATERIAL SAFETY DATA SHEET (MSDS)

Material Safety Data Sheet (MSDS) can provide you and help to gather necessary information to safely manage the hazardous substance.

When new substances are to be introduced into the workplace, the researcher should make arrangements to get a copy of the MSDS before the substance is brought into the workplace. Also, know the hazards of laboratory wastes BEFORE handling. Often, MSDSs for laboratory chemicals can be helpful in gaining an understanding of the hazards of the waste. Be sure that wastes are accumulated and stored in appropriate containers. Take precautions to ensure that incompatible wastes are not placed in the same container. Wear appropriate personal protective equipment (e.g., gloves, aprons, splash goggles, and possibly respiratory protection) when transferring wastes.

HOW YOU CAN FIND ACCESS TO AN MSDS ??

- Per copy collections of MSDSs;
- From CD-Rom, book or catalogue of chemical supplier

  e.g. CD-ROM from Merck
- Microfiche copy collections of MSDSs with microfiche readers open to use by all workers;
- Computerised MSDS databases; and
- Internet databases sites.

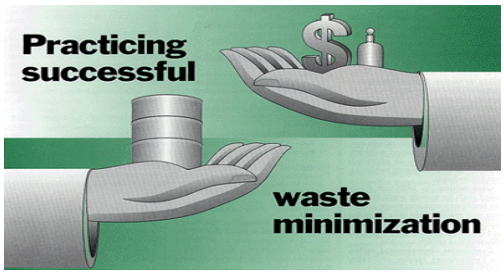
  e.g. http://www.ilpi.com/msds/index.chtml
  http://http://hazard.com/msds/
  http://hp9.wr.disa.mil:8001/

Once you know what do you have, Do the following steps:

1- **Waste avoidance and minimization**
2- **Segregation of waste**
3- **Collection, labelling, storage and send to centre accumulation area**

CHAPTER 2

WASTE AVOIDANCE AND MINIMIZATION



Waste minimization is any action that reduces the amount and/or toxicity of chemical wastes that must be ***shipped off-site*** for disposal as hazardous waste. It is incumbent upon every member of our research center to be aware of the environmental and financial impacts of hazardous chemical waste and to actively seek to minimize the volume of hazardous waste that is generated. The management of this waste should be an integral part of the laboratory setup and operating procedures and laboratory managers should conduct an annual review of their waste management procedures.

The Resource Conservation and Recovery Act (RCRA) outlines proper hazardous waste management, placing special emphasis on waste reduction and recycling. Through waste minimization, you can help reduce unnecessary expenditure of our Research Institute funds (and ultimately your department's funds) on waste disposal and material procurement by following the guidelines below:.

Waste avoidance and minimization can be done doing the following steps:

2.1. SOURCE REDUCTION

2.1.1. Laboratory Chemical Inventories and Housekeeping

1- Maintain a running inventory of chemicals present in your lab.

An inventory will prevent you from ordering more of what you

already have. It also helps you to store chemicals properly and can be an invaluable tool in emergency situations.

2- Date all chemical containers when received so that the older chemicals will be used first.

3- Keep on file, updated MSDS's for all chemicals in laboratory inventory.

4- Inventory chemicals and identify their location at least once a year.

5- Keep the number of chemicals on-hand in the laboratory limited to those actually in use or planned for use.

6- Periodic reviews of chemical inventories are encouraged to eliminate unwanted chemicals.

7- Ensure all containers are in good condition and clearly labeled. Over time, labels can fade or fall off, leaving an unidentified chemical.

8- Ensure students and researchers properly dispose of any wastes or residuals from their work prior to leaving the Research Institutes.

2.1.2. Planning and Purchases

1- **The planning of every experiment must include the consideration of the disposal of leftover starting materials and of the products and by products that will be generated. Questions to be considered include the following:**

- Can any material be recovered for reuse?

- Will the experiment generate any chemical that can be destroyed by a laboratory procedure?
- Will the experiment produce an acutely hazardous waste?
- Can any unusual disposal problem be anticipated? If so, the Committee for Safety and Occupational Health (**CSOH)** must be informed beforehand.
- Are chemicals being acquired in only the quantities needed? Are any of the chemicals already on site? (in the stockroom or another lab).
- Consider the use of microscale experiments.
- Consider the use of demonstrations or video presentations as a substitute for some student experiments.
- Is there the possibility of replacing a hazardous reagent or solvent with one with less hazardous or more easily disposed of**?**

- ***Almost 75% of our present laboratory waste consists of partially used or unopened bottles of chemicals that have been accumulating for decades***.

2- **Order only what you need:**

- Don't buy a kilogram of material when you plan to use only a few grams.
- The economy of larger sizes may be offset by the cost of disposing of your excess.

- Before ordering chemicals, check your current stock; and it may be possible to borrow small amounts of chemicals from other labs. Please take the time to check.

3- **Use recycled chemicals whenever possible:**

- please check to see whether other labs in your building can use the material.

4- Unused or excess chemicals

The American Chemical Society estimates that 40% of the chemical waste generated by labs consists of unused chemicals.

As a result, Committee for Safety and Occupational Health (**CSOH) encourages:**

- please check to see whether other labs in your building can use the material.
- Departments/laboratories to purchase chemicals only in amounts that will be used within the next six to nine months.
- Bulk purchases may be cheaper (price per unit) for laboratories, however if these chemicals are unused, disposal costs will far outweigh any savings.
- If your laboratory has excess or unused chemicals and does not have any use for these chemicals, Committee for Safety and Occupational Health (**CSOH)** recommends that you contact members within your department to see if another laboratory can use them.

- **If you are unable to share these chemicals within your department, contact Committee for Safety and Occupational Health (CSOH) and we will attempt to find a home for them.**

5- Substitute non-hazardous or less hazardous materials

- Avoid the use of reagents containing arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver.
- Substitute red liquid (spirit-filled), digital, or thermocouple thermometers for mercury thermometers.
- Consider using detergent and hot water for cleaning parts instead of solvents.
- Chromic acid e.g. used for cleaning can be substituted by non-hazardous material (see Table 3)
- Use latex-based paints which are typically non-hazardous. Recycle excess or waste latex paints.
- Dispose of excess, non-latex paints as a hazardous waste.
- Alcohol or mineral spirit thermometers will be substituted for mercury thermometers whenever possible. In most cases, these can meet accuracy and range requirements. If mercury thermometers must be purchased, use only ***Teflon Coated***. Stainless steel thermometers can be used in heating and cooling units.

- Many substitutes are available for mercury reagents as well. Some alternatives to mercuric chloride as a biocide are solutions such as 5-10% methylene chloride, 1% formalin, 1N hydrochloric acid, sodium azide, and sodium hypochlorite.
- If mercury compounds are used as catalysts, an alternative is to simply eliminate the catalyst and let the reaction run longer. Mercury free catalysts such as $CuSO_4$, TiO_2 , or K_2SO_4 can be used in Kjedahl digests.
- **Mercury spills** can be collected in a flask equipped with a pipette and rubber hose connected to a vacuum source. Small droplets of mercury can be amalgamated with zinc dust and the resulting solids swept up. Droplets in crevices can be converted to mercuric sulfide by dusting with sulfur powder.

Table 3. Suggested alternatives to chromic acid cleaning solutions

Product	Manufacturer
No Chromix	Godax Laboratories
RBS 35 Concentrate	Pierce Chemical Co.
RBS Solid	Pierce Chemical Co.
S/P Laboratory Detergent Concentrate	American Scientific Products
S/P Contrad 70	American Scientific Products
Alconox	American Scientific Products Fisher Scientific Co.
Fisherbrand Sparkleen	Fisher Scientific Co.
FL-70 Concentrate	Fisher Scientific Co.
Liquinox Liquid Detergent	Fisher Scientific Co.
Isoclean	Lab Safety Supply
Count-Off	New England Nuclear Co.
Life Away Concentrated Decontaminant	Research Products International Corp.

6- **Do not mix hazardous and non-hazardous waste:** Non-hazardous waste, when mixed with hazardous waste, will become hazardous itself as shown in Table 4. Do not mix small quantities of hazardous waste with non-hazardous waste because it will increase the volume of hazardous waste produced. Likewise, high concentration waste should not be mixed with low concentration waste .

Table 4. Examples of Incompatible Chemicals

Substances in the left hand column should be stored and handled so that they cannot accidentally come into contact with corresponding substances in the right hand column under uncontrolled conditions.

Chemical	Is Incompatible With
acetic acid	chromic acid, nitric acid, perchloric acid, peroxides, permanganates
acetic anhydride	Hydroxyl-containing compounds such as ethylene glycol and perchloric acid
acetylene	chlorine, bromine, copper, fluorine, silver, mercury
acetone	concentrated nitric and sulfuric acid mixtures
alkali and alkaline earth metals	water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, halogens
ammonia (anhydrous)	mercury, chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid (anhydrous)
ammonium nitrate	acids, powdered metals, flammable liquids, chlorates, nitrates, sulfur, finely divided organic or combustible materials
aniline	nitric acid, hydrogen peroxide
arsenical materials	any reducing agent
azides	acids
bromine	see chlorine
calcium oxide	water
carbon (activated)	calcium hypochlorite, all oxidizing agents
carbon tetrachloride	sodium
chlorates	ammonium salts, acids, powdered metals, sulfur, finely divided organic or combustible materials
chromic acid and chromium trioxide	acetic acid, naphthalene, camphor, glycerol, alcohol, flammable liquids in general
chlorine	ammonia, acetylene, butadiene, butane, methane, propane or other petroleum gases, hydrogen, sodium carbide, benzene, finely divided metals, turpentine
chlorine dioxide	ammonia, methane, phosphine, hydrogen sulfide
copper	acetylene, hydrogen peroxide
cumene hydroperoxide	acids (organic and inorganic)
cyanides	acids

Table 4. Cont.

Chemical	Is Incompatible With
flammable liquids	ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
fluorine	everything
hydrazine	hydrogen peroxide, nitric acid, any other oxidant
hydrocarbons (e.g., propane, butane, benzene)	fluorine, chlorine, bromine, chromic acid, sodium peroxide
hydrocyanic acid	nitric acid, alkali
hydrofluoric acid (aqueous or anhydrous)	ammonia (aqueous or anhydrous)
hydrogen peroxide	copper, chromium, iron, most metals or their salts, alcohols, acetone, organic materials, aniline, nitromethane, combustible materials
hydrogen sulfide	fuming nitric acid, oxidizing gases
hypochlorites	acids, activated carbon
iodine	acetylene, ammonia (aqueous or anhydrous), hydrogen
mercury	acetylene, fulminic acid, ammonia
nitrates	sulfuric acid
nitric acid (concentrated)	acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases, copper, brass, any heavy metals
nitrites	acids
nitroparaffins	inorganic bases, amines
oxalic acid	silver, mercury
oxygen	oils, grease, hydrogen, flammable liquids, solids, or gases
perchloric acid	acetic anhydride, bismuth and its alloys, alcohol, paper, wood, grease, oils
peroxides, organic	acids (organic or mineral), avoid friction, store cold
phosphorus (white)	air, oxygen, alkalis, reducing agents
phosphorus pentoxide	alcohols, strong bases, water
potassium	carbon tetrachloride, carbon dioxide, water
potassium chlorate	sulfuric and other acids
potassium perchlorate (also see chlorates)	sulfuric and other acids
potassium permanganate	glycerol, ethylene glycol, benzaldehyde, sulfuric acid
selenides	reducing agents
silver and silver salts	acetylene, oxalic acid, tartaric acid, ammonium compounds, fulminic acid

Table 4. Cont.

Chemical	Is Incompatible With
sodium	carbon tetrachloride, carbon dioxide, water
sodium nitrite	ammonium nitrate and other ammonium salts
sodium peroxide	ethanol and methanol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural
sulfides	acids
sulfuric acid	potassium chlorate, potassium perchlorate, potassium permanganate (and similar compounds of light metals such as sodium, lithium)
tellurides	reducing agents

This list is not all inclusive ?.

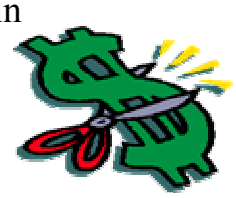
You should always consult a Material Safety Data Sheet (MSDS) or other chemical information sources such as Bretherick's Handbook or the Merck Index for compatibility information.

2.2. RECOVERY AND RECYCLING

The second option for waste minimization is recycling. When a waste material is used for another purpose, treated and reused in the same process, or reclaimed for another process, this is called recycling. Some examples of a viable recovery and recycling option.

- Solvents distillation is an example of a viable recovery option

- Photographic fixer solutions cannot be discharged to the sink and will be collected for silver recovery.
- Other candidates for recycling include precious metals, scrap metals, waste oil, and formaldehyde. Every effort must be made to determine if other materials can be reused, recovered, or recycled.
- When solvents are used for cleaning purposes, use contaminated solvents for the initial cleaning and use new solvents for the final rinse.
- Purchase compressed gas cylinders (including lecture bottles) from manufacturers who will accept the return of the empty or partially used cylinders.
- Return excess pesticides to the distributor.
- Do not contaminate used oil with solvents or heavy metals.
- Re-circulate unused, excess chemicals within your department.
- Use non-hazardous solvents or cleaning solutions in industrial parts washers.



2.3. COST CONTROL METHODS FOR DISPOSAL OF HAZARDOUS WASTES

An equally important aspect of an effective waste minimization program is the reduction of disposal costs through the proper segregation of various waste streams once they have been generated.

How to minimize the cost of disposal of hazardous chemicals ?

** The following sections on specific liquid wastes are meant to give laboratories/shops some information on how to minimize the cost of disposal of these waste streams by ***proper segregation of the wastes and volume reduction***. In some situations, these suggestions will be difficult or impractical to implement in which case, consult with Committee for Safety and Occupational Health (**CSOH)** for hazardous waste to determine the best method for collection and disposal.

a. Flammable Liquids

Examples: *acetone, methanol, ethanol, toluene, xylene, and acetonitrile*

Flammable liquid wastes are typically burned as fuel in waste disposal incinerators and as a result, disposal is relatively easy and inexpensive. For this reason, the lower the water content in the waste – the less expensive the costs of disposal. Solvents contaminated with materials not permitted for incineration will require alternative, costly treatment methods.

Some suggestions for reducing disposal costs

1. Minimize water content of waste by minimizing any unnecessary dilution.
2. Keep separate, if possible, from wastes that contain heavy metals, pesticides, cyanide, acute hazardous wastes (P-listed), etc. These wastes tend to drive up the costs of disposal, because of the need for more complex waste treatment.

3. Recycle or redistill solvents.
4. Investigate the use of nonflammable, biodegradable alternative solvents.
5. Replace solvent-based inks in printing operation with soy-based inks.

6. Make multiple uses of cleaning solutions before disposing to them.

b. Flammable Acidic & Alkaline Mixtures

Examples: *phenol & chloroform, acetic acid & methanol, potassium hydroxide & methanol*

Flammable acidic and alkaline mixtures are difficult to dispose of due to their corrosive nature. These wastes can cost at least four times (4X) more to dispose of than other flammable liquids.

Some suggestions for reducing disposal costs

1. Minimize unnecessary dilution of wastes.
2. Do not mix unnecessarily with other solvents.
3. Keep acidic and alkaline wastes separate to minimize the risk of reactions.
4. Minimize the volume of these wastes by keeping separate from other waste streams.
5. Keep separate, if possible, from wastes that contain heavy metals, pesticides, cyanide, acute hazardous wastes (P-listed), etc. These wastes tend to drive up the costs of disposal, because of the need for more complex waste treatment.

C. Halogenated Solvents

Examples: *methylene chloride, chloroform, carbon tetrachloride, trichloroethane, trichloroethylene.*

Not only are many halogenated solvents (solvents containing Cl^-, F^-, and Br^-) carcinogenic, but they are difficult to dispose of and can cost three times (3X) more to dispose of as compared to non-halogenated solvents. An effort to keep halogenated and non-halogenated wastes in separate containers would significantly reduce disposal costs.

Some suggestions for reducing disposal costs

1. Minimize unnecessary dilution of wastes.
2. Keep separate from acidic or alkaline waste streams.
3. Keep halogenated wastes separate from non-halogenated wastes.
4. Substitute non-halogenated solvents in place of halogenated solvents in parts washers or other solvent processes.
5. Keep separate, if possible, from other waste streams that contain heavy metals, pesticides, cyanide, acute hazardous wastes (P-listed), etc. These wastes tend to drive up the costs of disposal, because of the need for more complex waste treatment.
6. Recycle or redistill solvents.
7. Investigate the use of alternative non-halogenated solvents.

d. Chromerge & Chromium-bearing Wastes

The chromerge was used for the cleaning of laboratory glassware. There are alternative glassware cleaning solutions available in most chemical supplier catalogs (as shown in Table 3). Chromium is of concern due to its toxic characteristics. Researchers who use chromium as a part of a procedure in their laboratory, should investigate the viability of alternative procedures or chemicals.

If it is necessary to use chromium or chromerge in your laboratory procedures, consider the following suggestions for reducing disposal costs:

1. Minimize the volume of waste generated by eliminating any unnecessary dilution.
2. Keep separate, if possible, from other waste streams that contain other heavy metals, pesticides, cyanide, acute hazardous wastes P-listed, etc. These wastes tend to drive up the costs of disposal, because of the need for more complex treatment of these wastes.

e. Formalin & Formaldehyde Solutions

Some suggestions for reducing disposal costs

1. Minimize the volume of waste generated by eliminating any unnecessary dilution.
2. Do not mix with any other waste streams.
3. Use "Formalternate" (Flinn Scientific) or ethanol as an alternative to formaldehyde for the storage of biological specimens.

f. Liquids with Heavy Metals

Treatment and disposal of metal solutions (*aqueous solutions containing arsenic, barium, cadmium, chromium, copper, lead, mercury, osmium, selenium, silver, etc*.) varies depending on the type and concentration of the metal present in the waste. Committee for Safety and Occupational Health (**CSOH)** recommends the substitution of less hazardous metals for those procedures that involve heavy metals.

Some suggestions for reducing disposal costs

1. Keep heavy metal solutions separate from other wastes.
2. Minimize the volume of waste generated by eliminating any unnecessary dilution.
3. Contact Committee for Safety and Occupational Health (**CSOH)** if you have any questions about appropriate disposal or segregation methods.
4. Consider options for reducing the amount of metals used in laboratory experiments (example: microscale experiments).
5. Substitute less hazardous metals.
6. Eliminate metal catalysts in chemical procedures and allow more time for completion of reactions.
7. Use silver recover units in dark rooms for fixer waste.
8. Precipitate out precious and semiprecious metals.

h. Non-Latex Paints & Solvents

Non-latex paints and solvents are hazardous waste due to their flammable nature and/or toxic components.

Some suggestions for reducing disposal costs:

1. Minimize the volume of waste generated by reducing any unnecessary dilution.
2. Use latex paints whenever possible.
3. Contact Committee for Safety and Occupational Health (**CSOH)** if you have any questions about appropriate disposal or segregation methods.
4. Clean out stockpiles of old paints and send them to Committee for Safety and Occupational Health (**CSOH)** for disposal or contact other departments that may be able to make use of them.
5. Minimize your inventory of paints and solvents. Only order enough to satisfy immediate needs.

j. Used Oil

Used oil alone is not considered a hazardous waste.

Some suggestions for reducing disposal costs:

1. Minimize the volume of waste generated by reducing any unnecessary dilution or addition of water.
2. Avoid contamination with hazardous materials. If the oil has been contaminated or exposed to heavy metals, solvents and/or chemicals, it is potentially hazardous. Identify contamination source on the label so that

Committee for Safety and Occupational Health (**CSOH)** can dispose off the oil properly.

3. Contact Committee for Safety and Occupational Health (**CSOH)** if you have any questions about appropriate disposal or segregation methods.

K. Mercury & Mercury Compounds:

- Mercury-bearing wastes requires special treatment, as a result, they are expensive for the Research Institute to dispose off. Committee for Safety and Occupational Health (**CSOH)** recommends that:

- All mercury and mercury-bearing wastes are kept separate from all other wastes.
- Mercury thermometers and manometers be replaced with non-mercury containing instruments.
- If you must use a mercury thermometer, purchase those with a teflon coating.
- Separate out metallic mercury so that it can be recycled.
- Use alternative procedures that do not make use of mercury compounds.
- Use mercury-free catalysts or simply let the reactions run longer.
- Evaluate laboratory procedures to eliminate or minimize the use of mercury and mercury compounds.

L. Compressed Gas Cylinders

Compressed gas cylinders pose two issues of concern: safety and disposal costs.

- **Safety concerns**
  - physical hazards associated with pressurized and aging cylinders.
  - inhalation (corrosive/toxic gases) and asphyxiation hazards associated with the gases in the cylinder.
- **Disposal concerns**
  - Most of the large standardized gas cylinders are recycled by the distributors and disposal is easy and relatively inexpensive. However, the specialized gas cylinders (lecture bottles, bubbler, etc) are typically not accepted back by the distributor. Due to the nature of the cylinder and its contents, disposal of these cylinders becomes quite expensive.
- **Before purchasing cylinders**
  - Check within the department for existing cylinders that are available for use.
  - Attempt to establish accounts with suppliers who will allow for the return of unused product and/or empty cylinders.
  - Call Committee for Safety and Occupational Health (**CSOH)** if you have any questions about cylinder handling and disposal.

The enclosed waste minimization fact sheet (***See Appendix IV)*** summarizes a number of waste minimization opportunities that may be applicable to your lab. The opportunities provided are listed for different lab waste categories. Consider these opportunities when completing your waste audit (***See Appendix V***) and developing your waste minimization plan.

CHAPTER 3

ON-SITE LABORATORY TREATMENT OF CHEMICAL WASTE

On site waste management can be divided into management activities:

1- In the laboratories where the wastes are produced and,

2- Those activities conducted at a central storage area.

Laboratories generating hazardous waste have a few options for treating hazardous waste on site without permit:

- ***Elementary Neutralization***
- ***Recycling***
- ***Treatment in Accumulation Tanks or Containers***
- ***Treatment as Part of a Process***

Chemical waste treatment in laboratories is an essential activity, although it is a minor component of most chemical waste management programs. Planning for a laboratory procedure should include decisions about how to manage waste.

Recycling, for example, might require careful segregation of wastes during the procedure, not after it is complete. Therefore, an effective waste management process must be established before the waste is generated.

Before treating hazardous waste on site, laboratory personnel must be absolutely sure that the treatment is allowed without a permit. They must also ensure that they have proper procedures, equipment, and skilled researchers to conduct treatment safely and effectively on site.

On site treatment at the laboratories where the wastes are produced??

In-lab treatment of small quantities of hazardous waste is an effective way of minimizing off site treatment and disposal costs. Elementary neutralization of corrosive wastes and treatment in accumulation containers is exempt from permitting requirements for hazardous waste treatment. Ideally, these treatment steps should be written into every laboratory procedure. Potential treatment methods include phase separation of organics/aqueous solutions and liquids/solids; acid/base neutralization; precipitation of toxic metals and inorganic salts; oxidation of inorganic cyanides and sulfides. Many procedures for the neutralization or destruction of laboratory wastes are available in the following reference books available in Committee for Safety and Occupational Health (CSOH) at National Research Centre:

- **George Lunn and Eric B. Sansone (1994). "Destruction of Hazardous Chemicals in the Laboratory" 2nd Ed., John Wiley & Sons INC..**

- **Margaret-Ann Armour (2003). "Hazardous Laboratory Chemicals Disposal Guide" 3rd Ed., John Wiley & Sons New York**

Some Examples of Available Chemical Waste Treatment Methods

The chemical wastes generated by the research institute community may be treated prior to disposal. The various classes of chemical wastes require different handling procedures and some of the treatment methods for particular wastes may include:

(l) ***Non-Chlorinated Solvents***

Nonchlorinated solvents are processed so as to reclaim the solvents in as high a purity as is technically possible. The initial process involves passing the solvent over and through various filters to eliminate solid particles from the waste solvent. Next the solution is placed in a distillation process where the waste system is distilled and the distillate collected. This reclaimed solvent is now usually 80-100% pure and is sold to cement kilns.

(2) ***Chlorinated Solvents***

Chlorinated solvents are handled in the same manner as outlined above, but are handled by equipment which is kept separate from that used to reclaim the non-chlorinated solvent.

(3) ***Organic Acids***

Organic acids are handled on an individual basis, whereby the acids are collected in a reaction vessel and an alkaline solution is slowly introduced into the tank. The alkaline solution used is either waste alkaline liquids which have been given prior approval for use in the neutralization process or virgin alkaline liquids.

Once enough alkaline solution has been added to the vessel to bring about approved neutralization, at a pH of 7.0, the solution is tested to insure that discharge proceeds within all EPA regulations.

(4) ***Inorganic acids***

Inorganic acids are neutralized in the same manner as outlined above for organic acids, except that inorganic acids, can be handled in bulk rather than on an individual basis.

(5) ***Oxidizers*** -Oxidizers are treated in individual reaction vessels with sodium bisulfate or similar compounds to neutralize the waste oxidizer compounds.

(6) ***Inorganic Salts***

Inorganic salts and certain salts of organic, salts of Cd, Pb, Cu, Ni are also effectively neutralized in separate reaction vessels with the effluent being tested, as in all cases, before being discharged.

(7) ***Cyanides***

Solid cyanide compounds are tested for leaching using a 24-hour extraction process and a representative sample of the waste solid cyanide compound. Once the material passes the extraction tests and proves no leaching will occur, the solids are then collected and ready for disposal in a landfill certified by the particular state and the federal EPA. All liquid cyanide compounds are introduced into individual reaction vessels where they are effectively neutralized

by approved and tested appropriate methods and the effluent is collected and tested.

(8) ***Flammable Solids***

Flammable solids, except for water- and air-reactive solids, are combined with stabilizing compounds which produce a concrete-like solid. Once tested and approved, this material is then shipped to a landfill, certified by the individual state and the federal EPA. All water reactives and air reactives are handled on an individual basis. Once tested to determine reactivity and special handling procedures, these compounds are transported to federally approved treatment sites where the compounds are essentially ***"detonated"***.

(9) In many countries almost 90 % of all hazardous waste is hazardous wastewater. Regardless of the degree of acidity, the main method of treatment of ***acid wastes*** is ***neutralisation***. This may be carried out by filtration of acid waste through the limestone bed or by adding lime.

(10) ***Oil refineries*** use sulphuric acid for desulphurisation, improvement of colour, refinement of lubricating oils etc. Oil refineries commonly use two processes for sulphuric-acid wastes disposal: ***spray-burning and indirect combustion***.

Spray burning involves spraying waste acid into a hot combustion chamber (900-1100 °C) with small amounts of excess air added to oxidise hydrocarbons to CO_2 and H_2O. The hot gases are cooled and dried, and the SO_2 is absorbed to make new sulphuric acid.

The principal reaction of the second method, ***indirect combustion***, is the reduction of the sulphuric acid in the sludge by the hydrocarbons that are present. The granular by-product coke is recirculated through a mixer, acid sludge is added to this circulating stream, and heat is applied in the decomposing chamber.

(11) ***Many procedures for the neutralization or destruction of laboratory wastes are available in the reference books mentioned before.***

CHAPTER 4

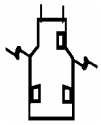
PRE-TREATMENT AND SEGREGATION OF CHEMICAL WASTE

Chemical waste segregation has several advantages: the prevention of unwanted or potentially dangerous reactions, the protection of personnel from potentially unsafe working environments, the ease in handling and disposing off wastes, the reduction of disposal costs, and the minimization of chemical waste. Segregation should start with storage of your chemical supplies. Suggested categories are presented in Table 5.

The following guidelines should help in generating more easily managed and separated waste streams:

- The same types of chemicals must be mixed together to make a common segregation group (see below).
- Collect halogenated and non-halogenated organic solvents in separate containers.
- Separate recyclable waste/excess chemicals from non-recyclables.
- •Separate organic wastes from metal-containing and/or inorganic wastes.
- Keep aqueous-based waste separate from organic solvent-based waste

- Do not mix solids and liquids, unless the waste is a result of a process combining them. Liquids should be strained of all solids (e.g. towels, filters, centrifuge tubes, gloves, pipet tips). These filterable items should be handled as contaminated debris.
- Separate mercury solutions and mercury compounds from other wastes as much as possible. Do not combine mercury wastes of different concentrations.
- Vacuum pump oil and other machine oil must be separated from organic solvents and other chemicals. Used oil cannot be recycled if solvents are present. When segregating oils, “flushing oil” is considered to be free of solvents.
- Lab ware and equipment obviously contaminated with acutely hazardous or toxic chemicals should be handled as contaminated debris. Such items include disposables such as gloves, bench top coverings and aprons.



- Separate radioactive waste from chemical waste.
- Separate nonhazardous chemical wastes from hazardous chemical waste.
- Keep highly toxic wastes (such as cyanides) separate from all other wastes.
- Avoid mixing heavy metals with solvents.

- Large volumes of liquid waste should be accumulated in a 5 gallon carboy.
- Do not fill liquid containers to the top. Leave space in the container to allow for expansion of the liquid.

The following tables summarizes the groups of chemical hazardous waste segregated according to the rule.

- Laboratory manager shall take necessary measures to segregate the chemical waste according to the rule, or to implement on-site treatment as described at later section.
- Segregated waste shall be kept in the container with clear label stating type, composition, name of laboratory, department, and date filled up. Model label format on hazardous waste collection containers is attached in ***Appendix VI***.
- Laboratory manager shall keep all record of pre-treatment and segregation practice on dairy basis. Model log book disposal form is attached in ***Appendix VII***

- Only compatible chemicals may be mixed together within segregation groups. ***Be sure commingled chemicals are compatible! Caution: mixing chemicals that are incompatible may result in splattering, heat generation, container pressurization, fire or explosion.***
- Various chemical wastes depending on the involved chemical type can be segregated with required pre-treatment according to the following general rule as shown in Table 5**.**
- Waste can be commingled within the following general groups

- Halogenated, e.g., chloroform, methylene chloride.
- Hydrocarbon, e.g., xylene, ether, hexane, acetone.
- Nitrogenous, e.g., triethylamine, diisopropylamine.
- Sulfurous, e.g., dimethylsulfoxide, dimethylsulfate.
- Corrosive, e.g., sulfuric acid.
- Aqueous solutions, e.g., diaminobenzidine, ethidium bromide, heavy metals.
- Oils, e.g., motor oil.

Table 5. Group definition and final disposal option

Container	Content	Final Disposal
A	Halogen-free organic solvents and organic substances in solution.	Cement Kiln
B	Halogen-containing organic solvents and Halogen-containing organic substances in solution.	Cement Kiln
C	Solid residues of organic laboratory chemicals with exception of F.	Cement Kiln
D	Salts in solution; the contents should be adjusted to pH 6 - 8 with exception of E.	Sewage system
E	Toxic inorganic residues and salts of heavy metals and solutions	HW Landfill site (Alexandria)
F	Toxic flammable compounds.	Cement Kiln
G	Mercury and inorganic mercury salt residues	Permanent storage at NRC
H	Inorganic solids with exception of E,and G	HW Landfill site (Alexandria)
I	Separate collection of glass, metal, and plastic waste materials.	HW Landfill site (Alexandria)
J	Inorganic selenium compounds	Permanent storage at NRC
K	Beryllium and its salts	Permanent storage at NRC
L	Radioactive compounds	Permanent storage at NRC

Table 6. Segregation of various waste type

Waste and original chemical type	Container	Pre-treatment required
Strongly contaminated halogen-free organic solvents	A	Solvent should be first considered for recycling.
Relatively unreactive organic reagents	A	
Bases and amines in solution	A	Recommended careful neutralization with dilute hydrochloric acid or sulfuric acid beforehand
Organic halogenated solvents and solutions of organic halogen-containing substances	B	Solvent should be first considered for recycling. *Do not use aluminium containers; in addition, in the case of water-containing chlorinated waste materials do not use stainless-steel containers*
Solid residues of relatively unreactive organic reagents	C	
Aqueous solutions of organic acids	D	Should be carefully neutralized with sodium hydrogen carbonate or with sodium hydroxide
Aromatic carboxylic acids (residue)	C	Then should be precipitated with dilute hydrochloric acid and vacuum-filtered off.
Aromatic carboxylic acids (filtrate)	D	
Nitriles and mercaptans (Organic phase)	A	Should be oxidized by stirring for several hours with sodium hypochlorite solution. Any excess oxidant should be neutralized with sodium thiosulfate
Nitriles and mercaptans (Aqueous phase)	D	Should be oxidized by stirring for several hours with sodium hypochlorite solution. Any excess oxidant should be neutralized with sodium thiosulfate
Water-soluble aldehydes	A Or B	Should be converted into bisulfite adducts with a concentrated aqueous solution of sodium hydrogen sulfite. Or treated with hydroxyl amine to form solid oxime.
Hydrolysis-sensitive organometallic compounds (Organic phase)	A	Should be carefully stirred dropwise into n-butanol in a hood with the front screen closed. Any flammable gases formed should be fed via a tube directly into the extractor duct. When gas development has ceased, continue stirring for one hour and add an excess of water.

Table 6. Cont.

Waste and original chemical type	Container	Pre-treatment required
Hydrolysis-sensitive organometallic compounds (Aqueous phase)	D	Should be carefully stirred dropwise into n-butanol in a hood with the front screen closed. Any flammable gases formed should be fed via a tube directly into the extractor duct. When gas development has ceased, continue stirring for one hour and add an excess of water.
Carcinogenic compounds and flammable compounds	F	Labelled "Highly toxic" or "Toxic" (except solvents)
Alkyl sulfates	D	Take particular care to avoid inhalation and skin contact. To neutralize alkyl sulfates, add dropwise (from a dropping funnel) to concentrated ice-cool ammonia solution with vigorous stirring. Before placing in container, check the pH with pH universal indicator strips.
Organic peroxides (organic residue)	A or B	Pure peroxides should be dissolved in a suitable solvent and likewise neutralized
Organic peroxides (aqueous solutions)	D	Pure peroxides should be dissolved in a suitable solvent and likewise neutralized
Acid halides	B	Should be esterified by adding dropwise to an excess of methanol to convert them into the corresponding methyl esters. A few drops of hydrochloric acid can be added to accelerate the reaction. Neutralize with sodium hydroxide solution. Before placing in container, check the pH with pH universal indicator strips
Acid gases (hydrogen bromide, hydrogen chloride, hydrogen iodide, chlorine, phosgene, sulfur dioxide)	D	Should be bubbled into dilute sodium hydroxide solution and treated as described under "Inorganic acids"
Bases and alcoholates	D	Should be diluted if necessary by carefully stirring them into water and then neutralized (protective gloves, fume cupboard!) with hydrochloric acid. Before placing in container, check the pH with pH universal indicator strips

Table 6. Cont.

Waste and original chemical type	Container	Pre-treatment required
Inorganic acids and anhydrides	D	Should first be diluted or hydrolyzed by stirring carefully into ice water and then neutralized (protective gloves, fume cupboard!) with sodium hydroxide solution. Before placing in container, check the pH with pH universal indicator strips. Fuming sulfuric acid should be carefully stirred a drop at a time into 40 % sulfuric acid. Have plenty of ice on hand for cooling. When sufficiently cool, treat the highly concentrated sulfuric acid as described above. Analogous to this procedure, other anhydrides can be converted into their corresponding acids.
Inorganic salts	I	
Neutral solutions of inorganic salts	D	Before placing in container, check the pH with pH universal indicator strips.
Heavy metal-containing solutions and solids	E	
Inorganic selenium compounds	J	Toxic and must, therefore, be handled with caution
Beryllium and its salts	K	Must be handled with special caution. Take special care to avoid inhalation and skin contact.
Radioactive compounds	L	
Inorganic mercury residues	G	
Cyanides	D	Should first be oxidized to cyanates with hydrogen peroxide at pH 10-11. Further addition of the oxidant such as sodium hypochlorite at pH 8-9 oxidizes the cyanates to CO2.
Azides	D	Should be decomposed to nitrogen by causing them to react with iodine in the presence of sodium thiosulfate
Inorganic peroxides and oxidants as well as bromine and iodine	D	Should be rendered harmless by reduction with acidic sodium thiosulfate solution

Table 6. Cont.

Waste and original chemical type	Container	Pre-treatment required
Hydrogen fluoride and solutions of inorganic fluorides (filtrate)	D	Must be handled with extreme caution. Do not permit contact of any kind under any circumstances and be sure to work under an efficient fume cupboard with the front screen closed. Precipitate residues with calcium carbonate to yield calcium fluoride.
Hydrogen fluoride and solutions of inorganic fluorides (precipitate)	H	Must be handled with extreme caution. Do not permit contact of any kind under any circumstances and be sure to work under an efficient fume cupboard with the front screen closed. Precipitate residues with calcium carbonate to yield calcium fluoride
Residues of liquid inorganic halides and hydrolysis-sensitive reagents	E	Should be carefully stirred a drop at a time into ice-cool 10 % sodium hydroxide solution
Phosphorus compounds (filtrate)	D	Should be oxidized under an inert gas in an efficient hood with the front screen closed. From each gram of phosphorus compound measure out a 100 ml aliquot of 5 % sodium hypochlorite solution containing 5 ml of 50 % sodium hydroxide solution, and carefully add the substance solution to be neutralized a drop at a time, cooling with ice. Add calcium hydroxide and filter off the precipitated phosphates
Phosphorus compounds (precipitate)	H	Should be oxidized under an inert gas in an efficient hood with the front screen closed. From each gram of phosphorus compound measure out a 100 ml aliquot of 5 % sodium hypochlorite solution containing 5 ml of 50 % sodium hydroxide solution, and carefully add the substance solution to be neutralized a drop at a time, cooling with ice. Add calcium hydroxide and filter off the precipitated phosphates
Red phosphorus	H	Must not come into contact with oxidizing substances

Table 6. Cont.

Waste and original chemical type	Container	Pre-treatment required
Alkali metals	D	Should be taken up in an inert solvent and treated by adding 2—propanol a drop at a time with stirring. Should the reaction be more violent than expected, conversion should be carried out with tert-butanol or octanol. Caution: This reaction produces hydrogen, which can form explosive mixtures; take necessary precautions. When the reaction has ceased, add water a drop at a time;
Alkali borohydrides	D	Add methanol with stirring; in the case of alkali amides and alkali hydrides add 2-propanol a drop at a time. When the respective reaction has ceased, hydrolize with water
Lithium aluminium hydride	A	Slurry in an ether. Under an inert gas and with thorough stirring add one drop at a time a 1:4 mixture of ethyl acetate and the ether used to prepare the slurry. Ensure that none of the reagent comes into contact with the walls of the flask, as this may result in the formation of small pockets of residue that do not completely react
Aqueous solutions	D	
Aluminium alkyls	F	Extremely hydrolysis-sensitive. should be diluted with an inert solvent (e.g. petroleum benzine) under protective gas, followed by the dropwise addition of 1-octanol and — once the reaction has ceased — subsequently of water.
Natural substances: carbohydrates, amino acids, and other aqueous residues accumulating in the biochemical laboratory	D	
Natural substances: carbohydrates, amino acids, and other aqueous residues accumulating in the biochemical laboratory. When mixed with organic solvents or reagents	A or B	

Mixing of Hazardous Waste???

Important Note: **Above rule is general rule and does not contain all possible cases. Laboratory manager SHALL refer to MSDS of the chemical before mixing the waste with other chemical for safety reason.**

Incompatible materials, whether wastes or unused chemicals, should never be mixed. Incompatible materials when mixed together may cause explosions, fires or may generate flammable or toxic gases resulting in serious health hazards. If in doubt do not mix!

Caution must be exercised in any area where chemicals or wastes are stored to insure incompatible materials are segregated appropriately. Segregate by hazard class, not by alphabet. If possible do not store waste with "good" chemicals (products).

Flammable waste should be kept away from heating sources and should be stored in accordance with the safety manual on proper storage of flammable and combustible materials. The pairs below are examples of incompatible materials as shown in Table (4).

Halogenated waste materials (those containing halogen compounds such as chlorine or fluorine) should be separated from non-halogenated compounds, unless unavoidable. This is for both economic and safety reasons. The halogenated wastes, while much less flammable, are generally more toxic than non-halogenated waste materials. The disposal cost of non-halogenated solvents is approximately one third that of halogenated solvents.

Where possible, **mercury compounds** should be eliminated from the laboratory. It is very important not to mix mercury with other materials due to the difficulty (and cost) of disposing of mercury and mercury compounds.

Committee for Safety and Occupational Health (CSOH) will not pick up containers with dangerous or incompatible materials. These situations will be handled on a case by case basis by the director of **Safety and Occupational Health** and the principle investigator.

CHAPTER 5

COLLECTION, LABELLING, STORGAGE AND DISPOSAL OF HAZARDOUS WASTE

5.1. CHEMICAL WASTE

5.1.1. Proper Containers and labeling

Selection of Waste Containers and Packaging

1. It is the responsibility of each laboratory to provide suitable containers for the collection of its waste. Hazardous waste must be collected in a container that is clean, in good condition, appropriate and compatible for the stored waste.

2. If outdated reagents are to be discarded it is appropriate to leave them in their original containers. This is especially true for solid chemicals and small quantities of toxic materials.
3. Ensure the waste material is compatible with the collection container and will not react with it, for example, do not put corrosives in metal containers. In general, plastic containers are preferred to glass, as they are less likely to break if knocked over. If a particular waste is generated on a fairly large scale, as with some solvents, you may want to obtain a 2 gallon plastic container.
4. Unbreakable containers should be used whenever feasible.

5. Only similar wastes should be collected in the same container. Mixing incompatible or different types of wastes may cause a chemical reaction or greatly increase disposal costs. Therefore, you may have several different waste containers accumulating at the same time, for example, one for non-chlorinated flammable solvents, another for acids, etc.

6. Large quantities of flammable liquids should be collected in 2.5 or 5 gallon safety cans. Polyethylene cans are best because of their high resistance to many types of chemicals. It is best not to fill these containers more than 2/3 full. This allows for easier transfer. These containers can be returned.

7. The five gallon plastic jugs and metal cans in which some solvents are purchased are suitable for one time collection of waste. Use these containers only for the same solvents which they originally held. Continued reuse of these containers is discouraged because they tend to develop leaks with time.

8. Except for safety cans purchased for the collection of solvent waste suitable for bulk disposal, waste containers cannot be returned to the laboratories.

9. Do not mix chemicals unless they are mixed in the experiment.

10. Collection containers must not be overfilled (Leave at least 2 inches head-space) and must be capped with a tight fitting cap. Cap fitting corks, para-film, and stoppers are not acceptable.

11. All containers must be tightly closed with an appropriate cap. Container and cap/cap liner must be compatible with waste and in good condition. If the container is leaking or damaged, transfer the waste to another compatible container.
12. All containers must be kept closed at all times except when adding waste to the container. You must not leave a funnel sitting in the container. The only exception to this rule is for processes, such as HPLC, which run and add waste to the container continuously. However, when the process is not running the top must be on the container.
13. All containers must be clean on the outside with no evidence of spills or leaks. Dirty or leaking containers will not be picked up.
14. Waste containers must be periodically inspected.
15. Container must be properly labelled.
16. Store all chemical waste containers in a suitable and compatible secondary containment.
17. If chemically contaminated lab waste requires hazardous waste disposal the material should be double-bagged and tightly sealed preferably with a knot.
18. Do not put broken glass or other sharp items into plastic bags. These must be placed in a puncture resistant container for disposal.
19. Unacceptable containers or containers without tight-fitting lids will not be picked up by personnel of **Safety and Occupational Health** and it will

be the responsibility of the generator to transfer the material to another container or to provide a proper lid for the container.

Information on acceptable container for specific waste types:

1- For flammable liquids use high-density plastic containers or approved metal container.

2- For concentrated acids and bases use 2.5-liter "acid" bottle.

   NOTE: One gallon glass bottles are not acceptable for acids and bases. Hydrofluoric acid must be stored in closed polyethylene containers Metal containers or metal caps or cap liners made of cardboard are not acceptable for corrosive materials.

3- For trace contaminated solid wastes (contaminated paper, gloves, etc.) use double bag using clear polyethylene bags. Bags should be sealed and placed in sturdy cardboard cartons that are sealed with tape.

4- For aqueous solutions use high density plastic containers.

5- For broken thermometers with mercury use a glass or plastic container with a tight cap. Because the density of mercury and the safety of staff please request for waste pick up before the container becomes too heavy to lift.

6- Items with sharp edges (syringes, razor blades, etc...) must be placed into a puncture proof container. Placing these items into a cardboard box or plastic bag is not acceptable. Broken glass must be disposed of in a broken glass box.

7- All used oils must also be marked with the words, "used oil."

Waste Labeling

Why Label Waste?

- Ensure safety and prevent accidental violent chemical reactions.
- Prevent waste from becoming an unknown.
- Comply with the EPA regulations.
- Contribute to the efficiency of material handling.
- The personnel of **Safety and Occupational Health** will not pick up waste without proper labeling.
- The label must be complete, legible and permanent.

To dispose of any hazardous waste you must completely fill out a hazardous waste Labeling (*See Appendix VI*) for each container. Labeling must be filled out by the person who generates the waste, not a staff assistant or student employee who does not have knowledge of chemicals or has not been through the hazardous waste class. **Labeling** should be filled out as completely as possible.

1. 'All' hazardous waste shall be identified at the source. A material does not become a waste until it can no longer be used for its intended purpose. **Hazardous waste containers must be labeled with the words "Hazardous Waste" in addition to their specific chemical contents.**

2. The Committee for Safety and Occupational Health (CSOH) will provide appropriate labels for the identification of hazardous wastes, or you can use laboratory tape, etc. as long as it states HAZARDOUS WASTE and has the specific names of the waste constituents as soon as the waste is generated to prevent accidental mixing of incompatible wastes and to comply with the EPA regulations.
3. All hazardous waste shall be clearly labeled with chemical names for waste constituents and its corresponding percentages. Be sure to also list on the label the specific contents; for example, flammable solvents – acetone, hexane, xylene instead of non-halogenated. Chemical names must be completely spelled out, abbreviations or chemical structures are not allowed. Toxic chemicals, other than mercury and PCBs, that constitute less than 1% may be listed as "trace." **Please write legibly**.
4. Affix label to containers with a rubber band.
5. If you use an empty commercial chemical container to collect waste, you must obliterate the old chemical label to avoid possible confusion as to the contents.
6. The START DATE shall be placed on the label on the date that waste is first added. ***Do not*** put a date in the STORAGE DATE location. The storage date will be completed when the container is moved from the generation point to the storage location.

7. Complete the other information requested on the label including department and /or research group, name of individual/ researcher/ supervisor providing the information, and a phone number.
8. Each department is to continue handling disposal of hazardous waste and contact the Committee for Safety and Occupational Health (CSOH) when a container has been filled or a particular project generating waste has been completed for new directives as warranted.
9. All liquids should have a pH test performed and recorded on the waste ticket, pH must range from 3 to 12.
10. The laboratory supervisor will maintain all records of hazardous waste manifests (i.e. certificates of disposal, and invoices). Copies of all manifest records are to be forwarded to the Committee for Safety and Occupational Health (CSOH). These records will be maintained for a minimum of 3 years.

One label should be filled out for each container. If you have a box of vials or small containers that are all of the same chemicals, then only one label is needed for the box. For different chemicals, one label will be needed for each container. For animal carcasses, one label is needed for each bag or box with the total weight listed for the container.

Do's and Don'ts:

1. *Do* use an appropriate size container for the waste generated. Under filled containers cost the same to dispose as a filled one.
2. *Do not* overfill containers. Leave approximately a one to two inch air space at the top of the container. Over filled containers of volatile

organics pressurize and leak in storage. Leaking containers are a violation of hazardous waste regulations and also eradicate the ink on labels.

3. *Do* write legibly on the label with permanent ink. Write out chemical name(s) of the components. Avoid using chemical formulas. Please do not use water based felt tip markers.
4. *Do not* mix metallic mercury (Hg) with any other chemicals.
5. Keep all organic and inorganic mercury compounds separate from other materials.
6. *Do not* mix radioactive materials with any hazardous waste.
7. *Do not* mix biohazardous materials with any hazardous waste.
8. Do not mix incompatible materials together. If unsure of any particular combinations, use a separate container.
9. *Do* call the Committee for Safety and Occupational Health (CSOH) if you have any questions or are not sure how to manage a particular substance.

5.1.2. Storing Hazardous Waste

There are two types of storage areas:

- The Satellite Accumulation Area and
- The Main Hazardous Waste Storage area.

5.1.2.1. The Satellite Accumulation Area

it is an area at or near the point of hazardous waste generation and under the control of the operator of the process generating the waste where the wastes are allowed to be temporarily stored for **3 days** before being moved to the main hazardous waste storage area. The key here is ***at or near*** the point of

generation and ***under the control*** of the process operator. Thus the satellite accumulation area can not be three floors down from the laboratory that generated the waste.

The following requirements apply to satellite accumulation areas container management:

Proper Hazardous Waste Storage. Hazardous waste is labeled, segregated by compatibility, stored in secondary containment, and in an isolated area.

- Hazardous waste should be stored near the point of generation, in the lab in which it is generated. Waste should be consolidated in one place in the lab – not spread out in several different cabinets and counter tops. You may utilize a single hazardous waste accumulation area for a suite of labs, as long as the labs are under the control of the same director and all lab occupants are familiar with the activities/experiments of the others. Hazardous waste should not be moved down hallways or to other floors. Or designate an area in your lab as a chemical waste accumulation area. Reserving a portion of a hood for this purpose is OK, so long as there is still enough work space and it doesn't effect the fume hood air flow.
- Can accumulate up to 55 gallons of non-acute hazardous waste or one quart of acute hazardous waste.
- Required to date the containers when the above quantity limits are reached so that the generator can remove the hazardous waste to the main hazardous waste storage area or ship the wastes off-site within 3 days of reaching the above limits

- Containers must be in good condition and compatible with the waste placed in them. Need to keep the containers closed except when adding or removing wastes; and
- Must mark the containers with either the words “Hazardous Waste” or with other words that identify the contents of the container.
- Hazardous waste storage area must be inspected weekly and the inspection documented
- Incompatible materials need to be kept separated or have a physical barrier between them.
- Containers may not be handled or stored in a manner which may cause the container to rupture or leak. (Protect them from high traffic areas and direct sun or freezing).
- Secondary containment is not required by the hazardous waste regulations but is required by the State Fire Marshal’s Office.
- Adequate aisle space between pallets of drums is required to be able to conduct inspections and respond in emergencies (two and a half feet is a rule of thumb minimum).
- Waste containers, as any chemical container, should not be stored in a location where a spill could potentially cause a release to the environment. Containers should not be stored next to sinks and ideally not in hoods with sinks. Containers should not be stored on the floor where they can be kicked over, particularly in rooms with floor drains.
- Separate and protect ignitable waste from ignition sources
- Do not use biohazard bags for the storage of chemical wastes.

Packaging

Good packaging is essential for the safe transportation of chemicals to the main hazardous waste storage area and chemical waste handling facility. Use the following procedures when packaging chemicals to be collected by Committee for Safety and Occupational Health (CSOH) which responsepal on management of hazardous waste:

- Package liquid chemicals only in containers with screw caps and not in wide-mouth containers such as buckets, basins, beakers, etc.
- No liquid container may exceed 5 gallons in capacity unless pre-approval is obtained from EH&S.
- The maximum weight acceptable for any single package is 25 pounds. If special circumstances exist where this weight limitation poses difficulty to an operation, contact EHS.
- Containers must be compatible with the chemicals placed in them.
- Boxes used in packaging other chemical containers must be sturdy enough or reinforced to provide safety in transportation. EHS furnishes the boxes for chemical transportation.
- Contact EH&S with questions on packaging chemicals for disposal.

Additional Waste Packaging Instructions for Solvents Waste (See Appendix VIII for Container/ Solvent Compatibility Chart)

- Waste solvents should be cleared from labs on a weekly basis. In no circumstance should solvents be allowed to accumulate for over two weeks.
- Safety cans are mandatory for ignitable solvents and advised for halogenated solvents. Glass bottles are discouraged, but will be accepted from very small generators.
- A safety can does not have to be full to bring it to the main storage area
- Solvents should be free of all other wastes, including aqueous wastes and water.

5.1.2.2. The Main Hazardous Waste Storage Area

Hazardous waste accumulated in labs will be collected and consolidated "central" accumulation or main storage area. The following procedures will be followed for disposal and collection of hazardous waste:

- Fill out and sign a generator's Waste Characterization Form (WCS) **(*See Appendix IX*)**. All of the constituents of the waste material must be listed, especially the constituents that make it a hazardous waste. List all significant components and their concentrations or percentage of the whole. If the material is in solution, name the solvent(s)..
- Bring the waste and Waste Characterization Form (WCS) to "central" accumulation or storage area during window hours, or go to request hazardous waste pickup.

The waste will not be accepted if:

- It is not accompanied by a properly filled out WCS.
- It is not in the proper container with a proper label.

UNKNOWN WASTES WILL BE NOT ACCEPTED unless accompanied by an account (budget) code. The cost of analysis of the unknown waste will be charged to the generator.

The following guidelines for accumulating and storing hazardous waste should always be followed:

The main hazardous waste storage area can be anywhere at the facility and is where the facility stores their waste before being sent off-site for treatment, disposal, or recycling. There can also be more than one main storage area. The requirements for each storage area are listed below.

Main Hazardous Waste Storage Areas

1- Required to comply with the hazardous waste time and quantity limits appropriate to your generator status;

Quantity Limits and Time Limits for Hazardous Waste

Conditionally-Exempt Small Quantity Generators (CE-SQG) who generate less than 100 kg of non-acute hazardous waste a month, less than 1 kg of acute hazardous waste a month (e.g. p-listed wastes such as epinephrine) and less than 100 kg of residues or contaminated soil, waste, and other debris from the spill cleanup of acute hazardous waste.

For non-acute hazardous waste, this limit is 1000 kg and 1 kg limit for an acute hazardous waste or 100 kg for spill residue from an acute hazardous waste. There are no time limits placed on a CE-SQG for the storage of hazardous waste

Small Quantity Generators (SQG) who generate between 100 kg and 1000 kg of non-acute hazardous waste a month, less than 1 kg of acute hazardous waste a month, and less than 100 kg of spill residue from acute hazardous waste; For non-acute hazardous waste, this limit is 6000 kg and 1 kg limit for an acute hazardous waste or 100 kg for spill residue from an acute hazardous waste. can only keep their waste for 180 days or 270 days if their treatment, storage, and disposal facility is more than 270 miles away.

Large Quantity Generators (LQG) who generate 1000 kg or more of non-acute hazardous waste a month, 1 kg or more of acute hazardous waste a month, and 100 kg or more of spill residue from acute hazardous waste. There is no quantity limitation but can only store their waste for 90 days.

2- Must keep the containers sealed, in good condition, and secured from failure (i.e., the container's material needs to be compatible with the waste)

3- Must conduct weekly inspections with log book entries; and

4- Need to label each container with the words “Hazardous Waste”, the specific description of its contents, and the date on which the container first entered the main storage area. In regards to this latter point, if you have several main hazardous waste storage areas at your facility, you cannot start the clock over again by moving your wastes from one main hazardous waste storage area to another. The date is the time the container first left the satellite accumulation area and was transferred to a main storage area.

5- LQGs must comply with air emission standards for waste with greater than 500 parts per million by weight (ppm/w) volatile organic compounds. Containers of less than 26 gallon capacity are exempt.

6- LQGs cannot accumulate ignitable or reactive wastes within 50 feet of the property line.

7- Containers which meet **Department of Transportation (DOT)** packaging specifications have a capacity of less than 119 gallons, and which are kept closed, comply with this requirement.

8- Waste must not be stored over drains, in sinks, or in an area where a spill would contaminate any soils or outside areas

5.1.3. Disposal Facilities for Hazardous Waste

A. **Sanitary Sewer: -** Only trace amounts of hazardous waste should be put down the sanitary sewer. Acceptable amounts are those commonly associated with washing glassware.

Some chemicals that are not regulated as hazardous waste can be safely disposed of in the sanitary sewer or normal trash. The decision to use one of these methods of disposal must be made after careful consideration of the consequences.

Most lab drains are connected to a sanitary sewer system and the effluent eventually flows to a sewage treatment plant. Concerns about chemicals that can create hazards such as fire, explosion, air pollution and water pollution, or can corrode the system piping or upset the operation of the sewage treatment plant have meant that disposal of some materials is no longer acceptable. Wastewater disposal practices must comply with applicable regulations, such as the local sewer bylaw, and will depend on characteristics and capabilities of the local wastewater treatment plant.

Materials that cannot be disposed of via the sanitary sewer are materials that interfere with the treatment systems or chemicals that may cause a danger to the system or human health. These chemicals include but are not limited to:

- Any substance that alone or by interaction with other substances can cause fire or explosion. Prohibited materials include but are not limited to: solvents and alcohols, peroxides, oxidizers, sulfides, hydrides, carbides, chlorates, perchlorates, bromates, carbides, ethers, gasoline, kerosene. Generally this includes wastes that would be characterized as ignitable.
- Solid or viscous substances that may cause obstruction to the flow such as garbage, animal guts or tissues, hair, bones, feathers, sand, metal, glass, straw, plastics, wood, rags, oil, grease, or paper.
- Waste having a pH less than 5.0 or greater than 9.5. Wastewater with corrosive properties capable of causing damage or hazard to structures, equipment, or personnel at the treatment plant.

- Waste containing toxic substances in sufficient quantity to interfere with the wastewater treatment process, constitute a hazard to humans or animals, or create a toxic effect in the receiving waters.
- Any noxious or malodorous liquids, gases, or solids.
- Heavy metals.
- Waste of objectionable color such as dyes or stains.
- Waste with temperature that inhibits biological activity (exceeding 104^{o} F).
- Any wastewater containing radioactive isotopes. Certain amounts are acceptable. Contact the RSO prior to disposal.
- Any cyanide in excess of 2 mg/l by weight as CN.

Some suggestions for the disposal of wastewater are:

- Drain disposal should only be to the sanitary sewer and not to the storm sewer. Wastes disposed of down manholes or catchbasins enter the storm sewer system and are discharged directly to rivers and lakes. These wastes receive no treatment.
- Familiarize yourself with the municipal sewer bylaws. This is your best resource for determining if a chemical is suitable for drain disposal. For chemicals that are not explicitly listed, contact your contact Committee for Safety and Occupational Health (CSOH) or, if in doubt, assume a material is hazardous and do not dispose of it down the drain.
- The quantity of chemicals disposed of down the drain should be relatively small and highly diluted with water. For example, dilute solutions of inorganic salts may be acceptable for disposal down the drain.

- In addition to being compatible with the sewer system and treatment plant (as stated in the municipal regulations), there is a need for compatibility with other chemicals entering the drain system. Incompatible chemicals can mix in your lab's plumbing or in the sewer pipes and become corrosive or toxic.
- As described earlier, consider pretreatment of liquid wastes before disposing of them down the drain. For example, acids and bases should be neutralized before they are disposed of.

Sink Disposal Procedures

- The materials must be water soluble.
- Drain disposal will be only into a drain that is connected to the sanitary sewer, never into a storm sewer drain that flows directly to surface water.
- The quantities of chemicals disposed of in the drain must be limited generally to not more than a few hundred grams or milliliters. Flush with at least 100 fold excess of water at the sink. Lab supervisors must monitor disposal for adherence to guidelines on type, quantity, rate, and flushing procedures.

B. Ordinary Trash

Trash Disposal

Non-hazardous solids can be disposed of in the trash (no liquid wastes are allowed to go to the landfill). As mentioned before, the decision to use the trash must be made after careful consideration of the consequences. Non-hazardous materials will create a hazard if solid particles are inhaled or reach the eyes. A

custodian may come in contact with it when he or she empties the trash. Our grounds grew could be exposed to the material when they handle the trash and compact it in the truck.

a. Most empty containers of chemicals can be disposed of in the ordinary trash. A container is considered empty if all material has been removed using common practice and no more than 2.5 cm of residue remains on the bottom of the container.
b. Empty containers of chemicals on the EPA's P list of acutely hazardous chemicals must be triple rinsed with an appropriate solvent prior to disposal. The waste solvent must be disposed of as hazardous waste. An alternative is to dispose of the container as hazardous waste. Please contact Institutional Safety for help in handling this waste.
c. When work is to be done with highly toxic materials which pose a significant threat to human health or the environment contact Committee for Safety and Occupational Health (CSOH) which responsible on management of hazardous waste prior to beginning the work so that appropriate disposal plan can be arranged.

C. Hazardous Waste Disposal

Hazardous lab wastes which meets any of the definitions of "hazardous" should be disposed of in a safe and responsible manner. Hazardous waste must be disposed of at an approved facility.

Examples of approved facilities may include hazardous waste incinerators or landfills approved to accept hazardous waste. Before you dispose of your hazardous waste, check to ensure that the disposal facility is approved to accept your waste.

Hazardous waste disposal facilities may accept wastes in a variety of forms, including lab packs, containers such as pails or drums, or in bulk. Lab packs are one of the most common packaging methods for hazardous wastes from labs.

Small containers are packed together in a drum according to hazard class with an absorbent material added to cushion and absorb any leaks or spills. The advantage of lab packs is that they are relatively simple and safe to use. The main disadvantage is that they are generally a more expensive disposal method as there is excess void space in the drum.

An alternative to lab packing is bulking wastes, which requires the removal of materials from their original containers. Bulking is more time consuming and more attention must be paid to compatibility. However, the advantage of bulking wastes is that it can reduce the total cost of disposal through a more efficient use of drum space.

Landfill Disposal and Shipping of Hazardous Waste Off-Site

Conventional landfill disposal is only appropriate for non-hazardous waste. The disposal by landfilling of suitable solid hazardous waste requires, strict compliance with specific landfill design requirements. Hazardous waste shipments require the preparation and distribution of detailed shipping papers (manifest) and land disposal notification forms. Hazardous waste vendors must hold appropriate permits and are subject to periodic audits.

5.2. BIOLOGICAL WASTE

5.2.1. Collection and Storage

i. Biological wastes must be collected and stored in a special container which is leakproof, rodentproof, insect-tight, to ensure that no

discharge or release of such waste occurs and that no odour or other nuisance is created.

ii. All onsite storage containers must be held in an area away from public, preferably in a room identified for this purpose. The manner of storage must be restricted only to authorized persons.

iii. Sharps must be segregated from other wastes and aggregated in leak- proof, rigid, puncture-resistant, shatterproof containers immediately after use.

iv. Wastes other than free draining blood and blood products, sharps arid biotechnology by-product effluents must be placed in a non-permeable 3mm thickness or greater polyethylene bag (or equivalent)

v. Compactors or grinders shall not be used to process waste until it has been rendered non-infectious and safe for disposal. The following methods of treatment shall be used as appropriate:

(a) Steam sterilization

(b) Gas sterilization

(c) Chemical disinfection

(d) Incineration at an approved incineration facility

5.2.2. Disposal

5.2.2.1. Microbiological Wastes

Microbiological wastes can either be treated on-site in the lab or can be given to the Authorized person from the Committee for Safety and Occupational Health (**CSOH)** for disposal. The following requirements must be met when treating biological waste in the lab.

A. Record Keeping

All lab personnel who treat and dispose microbiological waste on site in accordance with the guidelines described below, must keep the following records:

1. date of treatment;
2. amount of waste treated;
3. method/conditions of treatment;
4. name (printed) and initials of person(s) performing treatment; and
5. written procedure for the operation and testing of any equipment used and a written procedure for the preparation of any chemicals used in treatment.

B. Performance Monitoring

A minimum 4 $\log_{10}$ reduction must be demonstrated on routine performance testing using appropriate *Bacillus species* biological indicators. This testing needs to be performed on autoclaves that are used to treat special waste. Committee for Safety and Occupational Health (CSOH) responsible of management for hazardous waste has a program in place for the testing of autoclaves.

C. Treatment Methods

Acceptable methods of treatment of microbiological waste include:

Steam Disinfections

a. To allow sufficient steam access or penetration.

1. packaged according to the recommendations provided by the manufacturer, and

2. loaded into the chamber so as to not exceed the capacity limits as set by the manufacturer.

b. When subjecting waste to steam under pressure, the temperature in the chamber of the autoclave must reach at least 121ºC and there must be at least 15 pounds per square inch (psi) gauge pressure for at least 30 minutes.

c. The autoclave must be operated according to the manufacturer's instructions.

Chemical Disinfection

a. Use a chemical agent that is registered with the Environmental Protection Agency (EPA) as a disinfectant and in accordance with the manufacturer's instructions.

or

b. Immerse the waste for not less than three minutes in:

1. A freshly prepared solution of household chlorine bleach diluted 1:10 (volume/volume) with water.

or

2. A solution of 70% by volume 2-propanol (isopropyl alcohol).

c. Waste that has been immersed in a liquid chemical agent must be thoroughly drained before disposal.

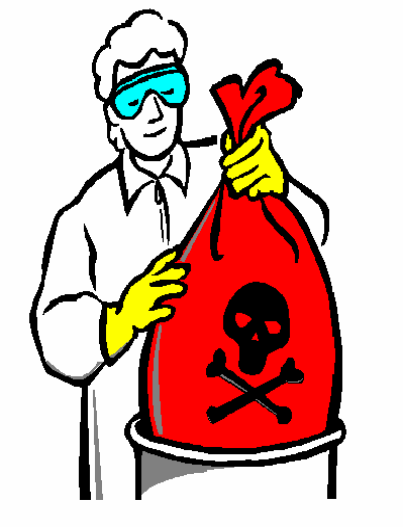
Microbiological waste which has been treated in accordance with the methods described above can be disposed of through the regular trash as long as the following procedures are followed:

a. Place a label on the original bag or container stating, *and*

b. Place the bag or other container into another bag or container that is a different colour and is opaque, e.g., a black trash bag.

Note: If treated waste is in a liquid form it can be disposed of through the sanitary sewer.

5.2.2.2. Animal Waste



Carcasses and Body Parts of Animals

Carcasses and body parts of animals that have not been preserved must be double bagged to prevent leakage and kept frozen until pickup by Committee for Safety and Occupational Health (CSOH) responsible of management for hazardous waste or transferred to the Animal Resources Centre. Carcasses and body parts of animals that have been preserved must be separated from the preservative and double bagged to prevent leakage. Submit a Biological Wastes and Sharps Request for Disposal form to Committee for Safety and Occupational Health (CSOH) when the waste is ready for pick-up.

Whole Blood, Serum, Plasma, and/or other Blood Components from Animals

All should be disposed of through Committee for Safety and Occupational Health (CSOH). Place into a non-breakable, closeable container. Submit a Biological Wastes and Sharps Request for Disposal form to Committee for Safety and Occupational Health (CSOH) when the waste is ready for pick-up.

Bedding of Animals Intentionally Exposed to Pathogens

This waste can be treated on-site in the lab as long as all the requirements listed under Microbiological Waste are followed. Another option is to submit the waste to Committee for Safety and Occupational Health (CSOH) for disposal. Place the waste into a Biohazard bag (these bags are available at Committee for Safety and

Occupational Health (CSOH). Submit a Biological Wastes and Sharps Request for Disposal form to Committee for Safety and Occupational Health (CSOH) when the waste is ready for pick-up.

5.2.2.3. Human Blood and Blood Products

- If the waste generator is connected to a municipal sewerage system or septic system, free draining blood and blood products except blood saturated materials may be disposed of directly into these systems unless such disposal is otherwise restricted by the authorized approving agency.
- If the waste generator is prohibited by the authorized approving agency from disposing of blood and blood products into the municipal sewerage system or septic system, blood and blood products, except blood saturated materials, shall be sent to an approved incineration facility for incineration or shall be rendered non-infectious by gas, chemical or steam sterilization prior to disposal and disposed of in a sanitary landfill approved by the Department of Environmental Protection or in case of out-of-state disposal, approved by the appropriate regulatory agency responsible for landfill approval.
- **Disposable Items Contaminated with Human Blood or Body Fluids Non-Sharp Items:** This waste can be treated on-site in the lab as long as all the requirements listed under Microbioloigcal Waste are followed. Another option is to submit the waste to Committee for Safety and Occupational Health (CSOH) for disposal. Place the waste into a Biohazard bag (these

bags are available at Committee for Safety and Occupational Health (CSOH). Submit a Biological Wastes and Sharps Request for Disposal form to Committee for Safety and Occupational Health (CSOH) when the waste is ready for pick-up.

5.2.2.4. Pathological Waste

Pathological waste **must** either be preserved or kept frozen until pick-up by Committee for Safety and Occupational Health (CSOH). Submit the waste to EHS for disposal. Place the waste into a Biohazard bag (these bags are available at EHS). Submit a Biological Wastes and Sharps Request for Disposal form to EHS when the waste is ready for pick-up.

5.2.2.5. Sharps

All sharps must be placed into sharps containers provided by Committee for Safety and Occupational Health (CSOH). When a sharps container is ready for pick-up, submit a Request for Disposal form for Biological Wastes and Sharps to Committee for Safety and Occupational Health (CSOH). If you need a replacement container, please note this on the form and pick one from Committee for Safety and Occupational Health (CSOH).

a. Do not fill containers more than 3/4 full.

b. Keep contents of sharps containers as free of chemicals as possible.

c. To avoid accidental sticks, place needles directly into containers and *do not* recap, bend, break, clip, or remove needles from disposable syringes.

d. Do not dispose of sharps containers with the regular trash.

Appendix III show the definition of all kind of biological waste and waste disposal flow chart.

5.2.3. Labelling

(A) Every container or bag of waste which has not been rendered non-infectious shall:

- be distinctively marked with the international biohazard symbol and colored red to indicate that it contains waste; and
- in the case of sharp wastes, be distinctively labeled to indicate that it contains sharp waste capable of inflicting punctures or cuts.

(B) Every container or bag of waste which has not been rendered non-infectious and which will be transported off the premises of the waste generator shall be placed in containers which are:

(a) Rigid

(b) Leak resistant

(c) Impervious to moisture

(d) Sufficient strength to prevent tearing or bursting under normal conditions of use and handling, and

(e) Sealed to prevent leakage during transport

- Bear a label which states the name, address and telephone number of the generator. The label shall be fixed in a manner which ensures that it cannot be easily removed.

(C) Prior to transport for off-site disposal, waste which has been rendered non-infectious by a method other than incineration shall be labelled or otherwise marked so as to clearly identify it as non-infectious medical or biological waste and to identify the waste generator responsible for the treatment. Such waste may be disposed of in the same manner as waste mentioned above except for sharps.

5.3. MANIFESTS

- Generators shall prepare manifests before shipping waste off-site. The manifest is a tracking document designed to record the movement of waste from the generator through its trip with a transporters to an approved disposal facility and final disposal. The generator shall appoint a designee to prepare, sign and maintain such manifests.
- The manifest must include the following information:

  (1) description of waste to be shipped;

  (2) total quantity of waste; and

  (3) type of container in which waste is transported.
- A generator shall designate on the manifest the address of the site to which the waste is to be delivered and sign it. The transporters of the waste or an agent of the transporters shall sign the manifest to indicate that the transporters has received the waste and will comply with the generators transportation instructions. Once the waste arrives at the approved off-site disposal facility, and has been disposed of the disposal facility owner or agent of the owner shall sign the manifest and return the original to the generator.

- If the generator does not receive the manifest from the disposal facility within 30 days after shipment of waste by the generator, the generator shall report this fact to the Department of Public Health.
- The generator-shall-maintain a-copy of the manifest, both as initially sent out and-as returned by the disposal facility for a period of three years.

SUMMARY/CONCLUSION

In order to address the unique challenges of managing hazardous waste in a research institutes, it is imperative to attempt to provide a management system that is clear, consistent with all applicable legal requirements, and both feasible and cost-effective in achieving environmental health and safety objectives. A successful program will, in all likelihood, be the result of a cooperative effort between environmental professionals, administrators or managers and environmental attorneys, and should continually identify steps that research laboratories might take to:

(i) Understanding the Material Safety Data Sheet (MSDS) is necessary for laboratory workers to receive hazardous chemical information

(ii) Improve waste handling methods,

(iii) Increase awareness regarding proper waste management,

(iv) Enhance communication among all relevant parties without compromising workplace safety and environmental protection

(v) Safe management and handling of chemicals in the laboratory is based on knowledge, knowledge of the chemicals you are dealing with. There is no other way to safely handle them but at the very basic level a knowledge of the chemical

class if any of the chemical is the most important starting point. Not all chemicals are dangerous or hazardous and they do not all have the same properties. Acquaint yourself with the properties and dangers of the chemicals you are dealing with and take the appropriate steps. Be proactive in your planning for safety because accidents are bound to occur.

(vi) Each laboratory manager and Principal Investigator should make waste minimization an active and ongoing component of their overall laboratory management strategy.

(vii) Establishment of a Waste Minimization Committee which is actively seeking ways to reduce the amount of waste generated is recommended. The Committee is continually seeking feedback from the research institutes community on how the Waste Minimization Program can be improved

The successes of such management strategy depend on willing and active participation of the whole institute. ***Appendix X*** show an overview and checklist of hazardous waste management

Appendixes

Appendix I.

A. Chemicals For The Normal Trash

You can safely dispose of many solid chemicals in the normal trash if the containers are tightly capped and of good integrity. Examples are given on the following list.

These chemicals were selected because they:

• have oral-rat LD50 toxicity values higher than 500 mg/kg, and

• have no positive determination for carcinogenicity according to the Toxic Effects of Chemical Substances.

-- A --

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 Hydroxide
Aluminum Metal
Aluminum Oxide
Amino acids (alpha and naturally occurring salts)
Ammonium Bicarbonate
Ammonium Carbonate
Ammonium Chloride
Ammonium Citrate
Ammonium Lactate
Ammonium Phosphate
Ammonium Sulfate
Ammonium Sulfamate

-- B --

Base, Blood Agar
Beef Extract
Beeswax
Brain Heart Infusion
Brom Phenol Blue
Broth Nutrient
Buffer Solution

-- C --

Calcium Borate
Calcium Carbonate
Calcium Chloride
Calcium Citrate
Calcium Floride
Calcium Lactate
Calcium Oxide
Calcium Phosphate
Calcium Sulfate
Cerelose (Glucose)
Charcoal, Animal
Chromatographic absorbent
Crystal Violet
Cobalt Oxide
Copper Oxide

-- D, E, F, G --

Dextrose
Drierite
Extract, Malt
Extract, Yeast
Ferric Chloride
Ferric Nitrate
Ferrous Ammonium Sulfate
Galactose
Gelatin
Glucose
Graphite
Gum Arabic
Gum Guaiac

-- H, I, K, L --

Hematoxylin
Iron Oxide
Kaolin
Lactose
Lithium Carbonate
Lithium Chloride
Lithium Sulfate
Litmus Mild

-- M --

Magnesium Borate
Magnesium Carbonate
Magnesium Chloride
Magnesium Citrate
Magnesium Lactate
Magnesium Oxide
Magnesium Phosphate
Magnesium Sulfate
Maltose
Manganese Acetate
Manganese Chloride
Manganese Dioxide
Manganese Sulfate
Methyl Red
Methyl Salicylate
Methylene Blue

-- P --

Paraffin
Pepsin
Peptone
Petroleum Jelly
Potassium Acetate
Potassium Bicarbonate
Potassium Bisulfate
Potassium Bitartrate
Potassium Bromate
Potassium Bromide
Potassium Carbonate
Potassium Chloride
Potassium Citrate
Potassium Lactate
Potassium Iodide
Potassium Phosphate
Potassium Sodium Tartrate
Potassium Sulfate
Potassium Sulfite
Potassium Sulfocyanate
Pumice

-- S --

SDS (Sodium Dodecyl Sulfate)
Sodium Acetate
Sodium Ammonium Phosphate
Sodium Benzoate
Sodium Bicarbonate
Sodium Bisulfate
Sodium Bisulfite
Sodium Borate
Sodium Bromide
Sodium Carbonate
Sodium Chloride
Sodium Citrate
Sodium Formate
Sodium Iodide
Sodium Lactate
Sodium Phosphate
Sodium Salicylate
Sodium Silicate
Sodium Succinate
Sodium Sulfate
Sodium Sulfite
Sodium Tartrate
Sodium Thioglycollate
Sodium Thiosulfate
Sodium Tungstate
Starch
Strontium Carbonate
Strontium Phosphate
Strontium Sulfate
Sucrose
Sulfur
Sugars
Sugar Alcohols

-- T, U, W, Z --

Talcum Powder
Thymol
Tin Metal
Tin Oxide
Trypticase
Urea
Zinc Oxide

APPENDIX II

P List of Acute Hazardous Wastes

ACUTE HAZARDOUS WASTES

EPA Hazardous Waste No.	Chemical Abstract No.	Substance
P023	107-20-0	Acetaldehyde, chloro-
P002	591-08-2	Acetamide,N-(aminothioxomethyl)-
P057	640-19-7	Acetamide,2-fluoro-
P058	62-74-8	Acetic acid, fluoro-, sodium salt
P002	591-08-2	1-Acetyl-2-thiourea
P003	107-02-8	Acrolein
P070	116-06-3	Aldicarb
P004	309-00-2	Aldrin
P005	107-18-6	Allyl Alcohol
P006	20859-73-8	Aluminum phosphide (R,T)
P007	2763-96-4	5-(Aminomethyl)-3-isoxazolol
P008	504-24-5	4-Aminopyridine
P009	131-74-8	Ammonium picrate (R)
P119	7803-55-6	Ammonium vanadate
P099	506-61-6	Argentate(1-),bis(cyano-C)-, potassium
P010	7778-39-4	Arsenic acid H_3AsO_4
P012	1327-53-3	Arsenic oxide As_2O_3
P011	1303-28-2	Arsenic oxide As_2O_5
P011	1303-28-2	Arsenic pentoxide
P012	1327-53-3	Arsenic trioxide
P038	692-42-2	Arsine, diethyl-
P036	696-28-6	Arsonous dichloride, phenyl-
P054	151-56-4	Aziridine
P067	75-55-8	Aziridine, 2-methyl-
P013	542-62-1	Barium cyanide
P024	106-47-8	Benzenamine, 4-chloro-
P077	100-01-6	Benzenamine, 4-nitro-
P028	100-44-7	Benzene, (chloromethyl)-
P042	51-43-4	1,2-Benzenediol, 4-[1-hydrozy-2-(methylamino)ethyl]-(R)-
P046	122-09-8	Benzeneethanamine,alpha,alpha-dimethyl-
P014	108-98-5	Benzenethiol
P001	81-81-2	2H-1-Benzopyran-2-one, 4-hydrozy-3-(3-oxo-1-phenylbutyl)-, & salts, when present at concentrations greater than 0.3%
P028	100-44-7	Benzyl chloride
P015	7440-41-7	Beryllium
P017	598-31-2	Bromoacetone
P018	357-57-3	Brucine
P045	39196-18-4	2-Butanone, 3,3-dimethyl-1-(methylthio)-, O-[methylamino)carbonyl] oxime
P021	592-01-8	Calcium cyanide
P021	592-01-8	Calcium cyanide $Ca(CN)_2$

ACUTE HAZARDOUS WASTES

EPA Hazardous Waste No.	Chemical Abstract No.	Substance
P022	75-15-0	Carbon disulfide
P095	75-44-5	Carbonic dichloride
P023	107-20-0	Chloroacetaldehyde
P024	106-47-8	p-Chloroaniline
P026	5344-82-1	1-(o-Chlorophenyl)thiourea
P027	542-76-7	3-Chloropropiontrile
P029	544-92-3	Copper cyanide
P029	544-92-3	Copper cyanide Cu(CN)
P030		Cyanides (soluble cyanide salts), not otherwise specified
P031	460-19-5	Cyanogen
P033	506-77-4	Cyanogen chloride
P033	506-77-4	Cyanogen chloride (CN)Cl
P034	131-89-5	2-Cyclohexyl-4,6-dinitrophenol
P016	542-88-1	Dichloromethyl ether
P036	696-28-6	Dichlorophenylarsine
P037	60-57-1	Dieldrin
P038	692-42-2	Diethylarsine
P041	311-45-5	Diethyl-p-nitrophenyl phosphate
P040	297-97-2	O,O-Diethyl O-pyrazinyl phosphorothioate
P043	55-91-4	Diisopropylfluorophosphate (DFP)
P004	309-00-2	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa- chloro-1,4,4a,5,8,8a -hexahydro-(1alpha,4alpha,4abeta,5alpha, 8alpha,8abeta)-
P060	465-73-6	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa-chloro-1,4,4a,5,8,8a-hexahydro-, 1alpha,4alpha,4abeta,5beta,8beta, 8abeta)
P037	60-57-1	2,7:3,6-Dimethanonaphth [2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta,2aalpha,3beta,6beta, 6aalpha,7beta,7aalpha)-
P051	72-20-8	2,7:3,6-Dimethanonaphth [2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta,2abeta,3alpha, 6alpha6abeta,7beta,7aalpha)- & metabolites
P044	60-51-5	Dimethoate
P046	122-09-8	alpha,alpha-Dimethylphenethylamine
P047	534-52-1	4,6-Dinitro-o-cresol,& salts
P048	51-28-5	2,4-Dinitrophenol
P020	88-85-7	Dinoseb
P085	152-16-9	Diphosphoramide, octamethyl-
P111	107-49-3	Diphosphoric acid, tetraethyl ester

ACUTE HAZARDOUS WASTES

EPA Hazardous Waste No.	Chemical Abstract No.	Substance
P039	298-04-4	Disulfoton
P049	541-53-7	Dithiobiuret
P050	115-29-7	Endosulfan
P088	145-73-3	Endothall
P051	72-20-8	Endrin
P051	72-20-8	Endrin, & metabolites
P042	51-43-4	Epinephrine
P031	460-19-5	Ethanedinitrile
P066	16752-77-5	Ethanimidothoic acid, N-[[(methylamino)carbonyl]oxy]-, methyl ester
P101	107-12-0	Ethyl cyanide
P054	151-56-4	Ethyleneimine
P097	52-85-7	Famphur
P056	7782-41-4	Fluorine
P057	640-19-7	Fluoroacetamide
P058	62-74-8	Fluoroacetic acid, sodium salt
P065	628-86-4	Fulminic acid, mercury(2+) salt(R,T)
P059	76-44-8	Heptachlor
P062	757-58-4	Hexaethyl tetraphosphate
P116	79-19-6	Hydrazinecarbothioamide
P068	60-34-4	Hydrazine, methyl-
P063	74-90-8	Hydrocyanic acid
P063	74-90-8	Hydrogen cyanide
P096	7803-51-2	Hydrogen phosphide
P060	465-73-6	Isodrin
P007	2763-96-4	3(2H)-Isoxazoione, 5-(aminomethyl)-
P092	62-38-4	Mercury, (acetato-O)phenyl-
P065	628-86-4	Mercury fulminate (R,T)
P082	62-75-9	Methanamine, N-methyl-N-nitroso-
P064	624-83-9	Methane, isocyanato-
P016	542-88-1	Methane, oxybis[chloro-
P112	509-14-8	Methane, tetranitro- (R)
P118	75-70-7	Methanethiol, trichloro-
P050	115-29-7	6,9-Methano-2,4,3-benzodioxathiepin,6,7, 8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-,3-oxide
P059	76-44-8	4,7-Methano-1H-indene, 1, 4, 5, 6, 7,8,8-heptachloro-3a,4,7,7a-tetrahydro-
P066	16752-77-5	Methomyl
P068	60-34-4	Methyl hydrazine
P064	624-83-9	Methyl isocyanate
P069	75-86-5	2-Methyllactonitrile
P071	298-00-0	Methyl parathion
P072	86-88-4	alpha-Naphthylthiourea
P073	13463-39-3	Nickel carbonyl
P073	13463-39-3	Nickel carbonyl Ni(CO)4,(T-4)-
P074	557-19-7	Nickel cyanide

ACUTE HAZARDOUS WASTES

EPA Hazardous Waste No.	Chemical Abstract No.	Substance
P074	557-19-7	Nickel cyanide $Ni(CN)_2$
P075	54-11-5	Nicotine, & salts
P076	10102-43-9	Nitric oxide
P077	100-01-6	p-Nitroaniline
P078	10102-44-0	Nitrogen dioxide
P076	10102-43-9	Nitrogen oxide NO
P078	10102-44-0	Nitrogen oxide NO_2
P081	55-63-0	Nitroglycerine (R)
P082	62-75-9	N-Nitrosodimethylamine
P084	4549-40-0	N-Nitrodomethylvinylamine
P085	152-16-9	Octamethylpyrophosphoramide
P087	20816-12-0	Osmium oxide OsO_4, (T-4)-
P087	20816-12-0	Osmium tetroxide
P088	145-73-3	7-oxabicyclo[2.2.1]heptane-2,3 dicarboxylic acid
P089	56-38-2	Parathion
P034	131-89-5	Phenol, 2-cyclohexyl-4,6-dinitro-
P048	51-28-5	Phenol, 2,4-dinitro-
P047	534-52-1	Phenol, 2-methyl-4,6-dinitro-,& salts
P020	88-85-7	Phenol, 2-(1-methylpropyl)-4,6-dinitro-
P009	131-74-8 salt (R)	Phenol, 2,4,6-trinitro-, ammonium
P092	62-38-4	Phenylmercury acetate
P093	103-85-5	Phenylthiourea
P094	298-02-2	Phorate
P095	75-44-5	Phosgene
P096	7803-51-2	Phosphine
P041	311-45-5	Phosphoric acid, diethyl 4-nitrophenyl ester
P039	298-04-4	Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthic)ethyl] ester
P094	298-02-2	Phosphorodithioic acid, O,O-diethyl S-[(ethylthio)methyl] ester
P044	60-51-5	Phosphorodithioic acid, O,O-dimethyl S-[2-(methylamino)-2-oxoethyl] ester
P043	55-91-4	Phosphorofluoridic acid, bis(1-methylethyl) ester
P089	56-38-2	Phosphorothioic acid, O,O-diethyl O-(4- nitrophenyl) ester
P040	297-97-2	Phosphorothioic acid, O,O-diethyl 0- pyrazinyl ester

ACUTE HAZARDOUS WASTES

EPA Hazardous Waste No.	Chemical Abstract No.	Substance
P097	52-85-7	Phosphorothioic acid, O-[4-[(dimethylamino)sulfonyl]phenyl] O,O-dimethyl ester
P071	298-00-0	Phosphorothioic acid, O,O,-dimethyl O- (4-nitrophenyl) ester
P110	78-00-2	Plumbane,tetraethyl-
P098	151-50-8	Potassium cyanide K(CN)
P099	506-61-6	Potassium silver cyanide
P070	116-06-3	Propanal, 2-methyl-2-(methylthio)-, O-[(methylamino)carbonyl]oxime
P101	107-12-0	Propanenitrile
P027	542-76-7	Propanenitrile, 3-chloro-
P069	75-86-5	Propanenitrile, 2-hydorxy-2-methyl-
P081	55-63-0	1,2,3-Propanetriol, trinitrate (R)
P017	598-31-2	2-Propanone, 1-bromo-
P102	107-19-7	Propargyl alcohol
P003	107-02-8	2-Propenal
P005	107-18-6	2-Propen- 1-ol
P067	75-55-8	1,2-Propylenimine
P102	107-19-7	2-Propyn-1-ol
P008	504-24-5	4-Pyridinamine
P075	54-11-5	Pyridine, 3-(1-methyl-2-pyrroliidinyl)-, (S)-, & salts
P114	12039-52-0	Selenious acid, dithallium(+ 1) salt
P103	630-10-4	Selenourea
P104	506-64-9	Silver cyanide Ag(CN)
P105	26628-22-8	Sodium azide
P106	143-33-9	Sodium cyanide
P106	143-33-9	Sodium cyanide Na(CN)
P107	1314-96-1	Strontium sulfide SrS
P108	47-24-9	Strychnidin- 10-one, & salts
P018	357-57-3	Strychnidin- 10-one, 2,3-dimethoxy-
P108	57-24-9	Strychnine, & salts
P115	7446-18-6	Sulfuric acid, dithallium(+ 1) salt
P109	3689-24-5	Tetraethyldithiopyrophosphate
P110	78-00-2	Tetraethyl lead
P111	107-49-3	Tetraethyl pyrophosphate
P112	509-14-8	Tetranitromethane (R)
P062	757-58-4	Tetraphosphoric acid, hexaethyl ester
P113	1314-32-5	Thallic oxide
P113	1314-32-5	Thallium oxide Tl_2O_3
P114	12039-52-0	Thallium(I) selenite
P115	7446-18-6	Thallium(I) sulfate
P109	3689-24-5	Thiodiphosphoric acid, tetraethyl ester
P045	39196-18-4	Thiofanox

ACUTE HAZARDOUS WASTES

EPA Hazardous Waste No.	Chemical Abstract No.	Substance
P049	541-53-7	Thioimidodicarbonic diamide $[(H_2N)C(S)]_2NH$
P014	108-98-5	Thiophenol
P116	79-19-6	Thiosemicarbazide
P026	5344-82-1	Thiourea, (2-chlorophenyl)-
P072	86-88-4	Thiourea, 1-naphthalenyl-
P093	103-85-5	Thiourea, phenyl-
P123	8001-35-2	Toxaphene
P118	75-70-7	Trichloromethanethiol
P119	7803-55-6	Vanadic acid, ammonium salt
P120	1314-62-1	Vanadium oxide V_2O_3
P120	1314-62-1	Vanadium pentoxide
P084	4549-40-0	Vinylamine, N-methyl-N-nitroso-
P001	81-81-2	Warfarin, & salts, when present at concentrations greater than 0.3%
P121	557-21-1	Zinc cyanide
P121	557-21-1	Zinc cyanide $Zn(CN)_2$
P122	1314-84-7	Zinc phosphide Zn_3P_2, when present at concentrations greater than 10% (R,T)

(I) = Ignitability
(C) = Corrosivity
(R) = Reactivity
(T) = Toxicity

U List of Toxic Hazardous Waste

TOXIC WASTES

EPA Hazardous Waste No.	Chemical Abstract No.	Substance
U001	75-07-0	Acetaldehyde (I)
U034	75-87-6	Acetaldehyde, trichloro-
U187	62-44-2	Acetamide, N-(4-ethoxyphenyl)-
U005	53-96-3	Acetamide, N-9H-fluoren-2-yl-
U240	94-75-7	Acetic acid, (2,4-dichlorophenoxy)- salts & esters
U112	141-78-6	Acetic acid ethyl ester (I)
U144	301-04-2	Acetic acid, lead(2+) salt
U214	563-68-8	Acetic acid, thallium(1+) salt
see F027	93-76-5	Acetic acid, (2,4,5-trichlorophenoxy)-
U002	67-64-1	Acetone (I)
U003	75-05-8	Acetonitrile (I,T)
U004	98-86-2	Acetophenone
U005	53-96-3	2-Acetylaminofluorene
U006	75-36-5	Acetyl chloride (C,R,T)
U007	79-06-1	Acrylamide
U008	79-10-7	Acrylic acid (I)
U009	107-13-1	Acrylonitrile
U011	61-82-5	Amitrole
U012	62-53-3	Aniline (I,T)
U136	75-60-5	Arsinic acid, dimethyl-
U014	492-80-8	Auramine
U015	115-02-6	Azaserine
U010	50-07-7	Azirino[2',3':3,4]pyrrolo[1,2-a] indole-4,7-dione, 6-amino-8-[[(aminocarbonyl)oxy]methyl]-1,1a,2, 8,8a,8b-hexahydro-8a-methoxy-5-methyl-, [1aS-(1aalpha, 8beta,8aalpha,8balpha)]-
U157	56-49-5	Benz[j]aceanthrylene, 1,2-dihydro-3- methyl-
U016	225-51-4	Benz[c]acridine
U017	98-87-3	Benzal chloride
U192	23950-58-5	Benzamide, 3,5-dichloro-N-(1,1-dimethyl- 2-propynyl)-
U018	56-55-3	Benz[a]anthracene
U094	57-97-6	Benz[a]anthracene, 7,12-dimethyl-
U012	62-53-3	Benzenamine (I,T)
U014	492-80-8	Benzenamine, 4,4'-carbonimidoylbis [N,N-dimethyl-
U049	3165-93-3	Benzenamine, 4-chloro-2-methyl-, hydrochloride
U093	60-11-7	Benzenamine, N,N-dimethyl-4-(phenylazo)-
U328	95-53-4	Benzenamine, 2-methyl-
U353	106-49-0	Benzenamine, 4-methyl-
U158	101-14-4	Benzenamine, 4,4'-methylenebis[2-chloro-

TOXIC WASTES

EPA Hazardous Waste No.	Chemical Abstract No.	Substance
U222	636-21-5	Benzenamine, 2-methyl-, hydrochloride
U181	99-55-8	Benzenamine, 2-methyl-5-nitro-
U019	71-43-2	Benzene(I,T)
U038	510-15-6	Benzeneacetic acid, 4-chloro-alpha (4-chlorophenyl)-alpha-hydroxy-, ethyl ester
U030	101-55-3	Benzene, 1-bromo-4-phenoxy-
U035	305-03-3	Benzenebutanoic acid, 4-[(bis(2-chloroethyl)amino]-
U037	108-90-7	Benzene, chloro-
U221	25376-45-8	Benzenediamine, ar-methyl-
U028	117-81-7	1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester
U069	84-74-2	1,2-Benzenedicarboxylic acid, dibutyl ester
U088	84-66-2	1,2-Benzenedicarboxylic acid, diethyl ester
U102	131-11-3	1,2-Benzenedicarboxylic acid, dimethyl ester
U107	117-84-0	1,2-Benzenedicarboxylic acid, dioctyl ester
U070	95-50-1	Benzene, 1,2-dichloro-
U071	541-73-1	Benzene, 1,3-dichloro-
U072	106-46-7	Benzene, 1,4-dichloro-
U060	72-54-8	Benzene, 1,1'-(2,2-dichloroethylidene) bis[4-chloro-
U017	98-87-3	Benzene, (dichloromethyl)-
U223	26471-62-5	Benzene, 1,3-diisocyanatomethyl- (R,T)
U239	1330-20-7	Benzene, dimethyl- (I,T)
U201	108-46-3	1,3-Benzenediol
U127	118-74-1	Benzene, hexachloro-
U056	110-82-7	Benzene, Hexahydro- (I)
U220	108-88-3	Benzene, methyl-
U105	121-14-2	Benzene, 1-methyl-2,4-dinitro-
U106	606-20-2	Benzene, 2-methyl- 1,3-dinitro-
U055	98-82-8	Benzene, (1-methylethyl)- (I)
U169	98-95-3	Benzene, nitro-
U183	608-93-5	Benzene, pentachloro-
U185	82-68-8	Benzene, pentachloronitro-
U020	98-09-9	Benzenesulfonic acid chloride (C,R)
U020	98-09-9	Benzenesulfonyl chloride (C,R)
U207	95-94-3	Benzene, 1,2,4,5-tetrachloro-
U061	50-29-3	Benzene, 1,1'-(2,2,2-trichloroethylidene) bis[4-chloro-
U247	72-43-5	Benzene, 1,1'-(2,2,2-trichloroethylidene) bis[4-methoxy-

TOXIC WASTES

EPA Hazardous Waste No.	Chemical Abstract No.	Substance
U023	98-07-7	Benzene, (trichloromethyl)-
U234	99-35-4	Benzene, 1,3,5-trinitro-
U021	92-87-5	Benzidine
U202	81-07-2	1,2-Benzisothiazol-3(2H)-one, 1,1-dioxide, & salts
U203	94-59-7	1,3-Benzodioxole, 5-(2-propenyl)-
U141	120-58-1	1,3-Benzodioxole, 5-(1-propenyl)-
U090	94-58-6	1,3-Benzodioxole, 5-propyl-
U064	189-55-9	Benzo[rst]pentaphene
U248	81-81-2	2H-1-Benzopyran-2-one, 4hydroxy-3-(3-oxo- 1-phenyl-butyl)-, & salts, when present at concentrations of 0.3% or less
U022	50-32-8	Benzo[a]pyrene
U197	106-51-4	p-Benzoquinone
U023	98-07-7	Benzotrichloride (C,R,T)
U085	1464-53-5	2,2'-Bioxirane
U021	92-87-5	[1,1'-Biphenyl]-4,4'-diamine
U073	91-94-1	[1,1'-Biphenyl]-4,4'-diamine, 3,3' -dichloro-
U091	119-90-4	[1,1'-Biphenyl]-4,4'-diamine, 3,3' -dimethoxy-
U095	119-93-7	[1,1'-Biphenyl]-4,4'-diamine, 3,3' -dimethyl-
U225	75-25-2	Bromoform
U030	101-55-3	4-Bromophenyl phenyl ether
U128	87-68-3	1,3-Butadiene, 1,1,2,3,4,4-hexachloro-
U172	924-16-3	1-Butanamine, N-butyl-N-nitroso-
U031	71-36-3	1-Butanol (I)
U159	78-93-3	2-Butanone (I,T)
U160	1338-23-4	2-Butanone, peroxide (R,T)
U053	4170-30-3	2-Butenal
U074	764-41-0	2-Butene, 1,4-dichloro- (I,T)
U143	303-34-4	2-Butenoic acid, 2-methyl-, 7-[[2,3-diihydroxy- 2-(1-methoxyethyl)-3-methyl-1-oxobutoxy] methyl]- 2,3,5,7a-tetrahydro-1H-pyrrolizin-1-yl ester, {1S-[1alpha(Z),7(2S*3R*), 7a alpha]]-
U031	71-36-3	n-Butyl alcohol (I)
U136	75-60-5	Cacodylic acid
U032	13765-19-0	Calcium chromate
U238	51-79-6	Carbamic acid, ethyl ester
U178	615-53-2	Carbamic acid, methylnitroso-, ethyl ester
U097	79-44-7	Carbamic chloride, dimethyl-

TOXIC WASTES

EPA Hazardous Waste No.	Chemical Abstract No.	Substance
U114	111-54-6	Carbamodithioic acid, 1,2-ethanediylbis-, salts & esters
U062	2303-16-4	Carbamothioic acid, bis(1-methylethyl)-, S-(2,3-dichloro-2-propenyl)ester
U215	6533-73-9	Carbonic acid, dithallium(1+)salt
U033	353-50-4	Carbonic difluoride
U156	79-22-1	Carbonochloridic acid, methyl ester, (I,T)
U033	353-50-4	Carbon oxyfluoride (R,T)
U211	56-23-5	Carbon tetrachloride
U034	75-87-6	Chloral
U035	305-03-3	Chlorambucil
U036	57-74-9	Chlordane, alpha & gamma isomers
U026	494-03-1	Chlornaphazin
U037	108-90-7	Chlorobenzene
U038	510-15-6	Chlorobenzilate
U039	59-50-7	p-Chloro-m-cresol
U042	110-75-8	2-Chloroethyl vinyl ether
U044	67-66-3	Chloroform
U046	107-30-2	Chloromethyl methyl ether
U047	91-58-7	beta-Chloronaphthalene
U048	95-57-8	o-Chlorophenol
U049	3165-93-3	4-Chloro-o-toluidine, hydrochloride
U032	13765-19-0	Chromic acid H2Cro4, calcium salt
U050	218-01-9	Chrysene
U051		Creosote
U052	1319-77-3	Cresol (Cresylic acid)
U053	4170-30-3	Crotonaldehyde
U055	98-82-8	Cumene (I)
U246	506-68-3	Cyanogen bromide (CN)Br
U197	106-51-4	2,5-Cyclohexadiene-1,4-dione
U056	110-82-7	Cyclohexane (I)
U129	58-89-9	Cyclohexane, 1,2,3,4,5,6-hexachloro-1alpha,2alpha,3beta,4alpha,5alpha, 6 beta)-
U057	108-94-1	Cyclohexanone (I)
U130	77-47-4	1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-
U058	50-18-0	Cyclophosphamide
U240	94-75-7	2,4-D, salts & esters
U059	20830-81-3	Daunomycin
U060	72-54-8	DDD
U061	50-29-3	DDT
U062	2303-16-4	Diallate
U063	53-70-3	Dibenz[a,h]anthracene
U064	189-55-9	Dibenzo[a,i]pyrene

TOXIC WASTES

EPA Hazardous Waste No.	Chemical Abstract No.	Substance
U066	96-12-8	1,2-Dibromo-3-chloropropane
U069	84-74-2	Dibutyl phthalate
U070	95-50-1	o-Dichlorobenzene
U071	541-73-1	m-Dichlorobenzene
U072	106-46-7	p-Dichlorobenzene
U073	91-94-1	3,3'-Dichlorobenzidine
U074	764-41-0	1,4-Dichloro-2-butene (I,T)
U075	75-71-8	Dichlorodifluoromethane
U078	75-35-4	1,1 Dichloroethylene
U079	156-60-5	1,2-Dichloroethylene
U025	111-44-4	Dichloroethyl ether
U027	108-60-1	Dichloroisopropyl ether
U024	111-91-1	Dichloromethoxy ethane
U081	120-83-2	2,4-Dichlorophenol
U082	87-65-0	2,6-Dichlorophenol
U084	542-75-6	1,3-Dichloropropene
U085	1464-53-5	1,2:3,4-Diepoxybutane (I,T)
U108	123-91-1	1,4-Diethyleneoxide
U028	117-81-7	Diethylhexyl phthalate
U086	1615-80-1	N,N'-Diethylhydrazine
U087	3288-58-2	O,O-Diethyl S-methyl dithiophosphate
U088	84-66-2	Diethyl phthalate
U089	56-53-1	Diethylstilbesterol
U090	94-58-6	Dihydrosafrole
U091	119-90-4	3,3'-Dimethoxybenzidine
U092	124-40-3	Dimethylamine (I)
U093	60-11-7	p-Dimethylaminoazobenzene
U094	57-97-6	7,12-Dimethylbenz[a]anthracene
U095	119-93-7	3,3'-Dimethylbenzidine
U096	80-15-9	alpha,alpha-Dimethylbenzylhydroperoxide (R)
U097	79-44-7	Dimethylcarbamoyl chloride
U098	57-14-7	1,1-Dimethylhydrazine
U099	540-73-8	1,2-Dimethylhydrazine
U101	105-67-9	2,4-Dimethylphenol
U102	131-11-3	Dimethyl phthalate
U103	77-78-1	Dimethyl sulfate
U105	121-14-2	2,4-Dinitrotoluene
U106	606-20-2	2,6-Dinitrotoluene
U107	117-84-0	Di-n-octyl phthalate
U108	123-91-1	1,4-Dioxane
U109	122-66-7	1,2-Diphenylhydrazine
U110	142-84-7	Dipropylamine (I)
U111	621-64-7	Di-n-propylnitrosamine
U041	106-89-8	Epichlorohydrin
U001	75-07-7	Ethanal (I)
U174	55-18-5	Ethanamine, N-ethyl-N-nitroso-

TOXIC WASTES

EPA Hazardous Waste No.	Chemical Abstract No.	Substance
U155	91-80-5	1,2-Ethanediamine, N,N-dimethyl-N'-2-pyridinyl-N'-(2-thienylmethyl)-
U067	106-93-4	Ethane, 1,2-dibromo-
U076	75-34-3	Ethane, 1,1-dichloro-
U077	107-06-2	Ethane, 1,2-dichloro-
U131	67-72-1	Ethane, Hexachloro-
U024	111-91-1	Ethane,1,1'-[methylenebis(oxy)]bis[2-chloro-
U117	60-29-7	Ethane, 1,1' -oxybis-(I)
U025	111-44-4	Ethane, 1,1' -oxybis[2-chloro-
U184	76-01-7	Ethane, pentachloro-
U208	603-20-6	Ethane, 1,1,1,2-tetrachloro-
U209	79-34-5	Ethane, 1,1,2,2-tetrachloro-
U218	62-55-5	Ethanethioamide
U226	71-55-6	Ethane, 1,1,1-trichloro-
U227	79-00-5	Ethane, 1,1,2-trichloro-
U359	110-80-5	Ethanol, 2-ethoxy-
U173	1116-54-7	Ethanol,2,2'-(nitrosoimino)bis-
U004	98-86-2	Ethanone, 1-phenyl-
U043	75-01-4	Ethene, chloro-
U042	110-75-8	Ethene, (2-chloroethoxy)-
U078	75-35-4	Ethene, 1,1-dichloro-
U079	156-60-5	Ethene, 1,2-dichloro- (E)-
U210	127-18-4	Ethene, tetrachloro-
U228	79-01-6	Ethene, trichloro-
U112	141-78-6	Ethyl acetate (I)
U113	140-88-5	Ethyl acrylate (I)
U238	51-79-6	Ethyl carbamate (urethane)
U117	60-29-7	Ethyl ether (I)
U114	111-54-6	Ethylenebisdithiocarbamic acid, salts & esters
U067	106-93-4	Ethylene dibromide
U077	107-06-2	Ethylene dichloride
U359	110-80-5	Ethylene glycol monoethyl ether
U115	75-21-8	Ethylene oxide (I,T)
U116	96-45-7	Ethylenethiourea
U076	75-34-3	Ethylidene dichloride
U118	97-63-2	Ethyl methacrylate
U119	62-50-0	Ethyl methanesulfonate
U120	206-44-0	Fluoranthene
U122	50-00-0	Formaldehyde
U123	64-18-6	Formic acid (C,T)
U124	110-00-9	Furan (I)
U125	98-01-1	2-Furancarboxaldehyde (I)
U147	108-31-6	2,5-Furandione
U213	109-99-9	Furan, tetrahydro-(I)
U125	98-01-1	Furfural (I)
U124	110-00-9	Furfuran (I)

TOXIC WASTES

EPA Hazardous Waste No.	Chemical Abstract No.	Substance
U206	18883-66-4	Glucopyranose, 2-deoxy-2-(3-methyl-3-nitrosoureido)-,D-
U206	18883-66-4	D-Glucose, 2-deoxy-2-[[(methylnitrosoamino)-carbonyl]amino]-
U126	765-34-4	Glycidylaldehyde
U163	70-25-7	Guanidine, N-methyl-N'-nitro-N-nitroso-
U127	118-74-1	Hexachlorobenzene
U128	87-68-3	Hexachlorobutadiene
U130	77-47-4	Hexachlorocyclopentadiene
U131	67-72-1	Hexachloroethane
U132	70-30-4	Hexachlorophene
U243	1888-71-7	Hexachloropropene
U133	302-01-2	Hydrazine (R,T)
U086	1615-80-1	Hydrazine, 1,2-diethyl-
U098	57-14-7	Hydrazine, 1,1-dimethyl-
U099	540-73-8	Hydrazine, 1,2-dimethyl-
U109	122-66-7	Hydrazine, 1,2-diphenyl-
U134	7664-39-3	Hydrofluoric acid (C,T)
U134	7664-39-3	Hydrogen fluoride (C,T)
U135	7783-06-4	Hydrogen sulfide
U135	7783-06-4	Hydrogen sulfide H_2S
U096	80-15-9	Hydroperoxide, 1-methyl-1-phenylethyl-(R)
U116	96-45-7	2-Imidazolidinethione
U137	193-39-5	Indeno[1,2,3-cd]pyrene
U190	85-44-9	1,3-isobenzofurandione
U140	78-83-1	Isobutyl alcohol (I,T)
U141	120-58-1	Isosafrole
U142	143-50-0	Kepone
U143	303-34-4	Lasiocarpine
U144	301-04-2	Lead Acetate
U146	1335-32-6	Lead, bis(acetato-O)tetrahydroxytri-
U145	7446-27-7	Lead phosphate
U146	1335-32-6	Lead subacetate
U129	58-89-9	Lindane
U163	70-25-7	MNNG
U147	108-31-6	Maleic anhydride
U148	123-33-1	Maleic hydrazide
U149	109-77-3	Malononitrile
U150	148-82-3	Melphalan
U151	7439-97-6	Mercury
U152	126-98-7	Methacrylonitrile (I,T)
U092	124-40-3	Methanamine, N-methyl-(I)
U029	74-83-9	Methane, bromo-
U045	74-87-3	Methane, chloro- (I,T)

TOXIC WASTES

EPA Hazardous Waste No.	Chemical Abstract No.	Substance
U046	107-30-2	Methane, chloromethoxy-
U068	74-95-3	Methane, dibromo-
U080	75-09-2	Methane, dichloro-
U075	75-71-8	Methane, dichlorodifluoro-
U138	74-88-4	Methane, iodo-
U119	62-50-0	Methanesulfonic acid, ethyl ester
U211	56-23-5	Methane, tetrachloro-
U153	74-93-1	Methanethiol (I,T)
U225	75-25-2	Methane, tribromo-
U044	67-66-3	Methane, trichloro-
U121	75-69-4	Methane, trichlorofluoro-
U036	57-74-9	4,7-Methano-1H-indene, 1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-
U154	67-56-1	Methanol (I)
U155	91-80-5	Methapyrilene
U142	143-50-0	1,3,4-Metheno-2H-cyclobuta[cd]pentalen-2-one, 1,1a,3,3a,4,5,5,5a,5b,6-decachlorooctahy dro-
U247	72-43-5	Methoxychlor
U154	67-56-1	Methyl alcohol (I)
U029	74-83-9	Methyl bromide
U186	504-60-9	1-Methylbutadiene (I)
U045	74-87-3	Methyl chloride (I,T)
U156	79-22-1	Methyl chlorocarbonate (I,T)
U226	71-55-6	Methyl chloroform
U157	56-49-5	3-Methylcholanthrene
U158	101-14-4	4,4'-Methylenebis(2-chloroaniline)
U068	74-95-3	Methylene bromide
U080	75-09-2	Methylene chloride
U159	78-93-3	Methyl ethyl ketone (MEK) (I,T)
U160	1338-23-4	Methyl ethyl ketone peroxide (R,T)
U138	74-88-4	Methyl iodide
U161	106-10-1	Methyl isobutyl ketone (I)
U162	80-62-6	Methyl methacrylate (I,T)
U161	108-10-1	4-Methyl-2-pentanone (I)
U164	56-04-2	Methylthiouracil
U010	50-07-7	Mitomycin C
U059	20830-81-3	5,12-Naphthacenedione, 8-acetyl-10-[(3-amino-2,3,6-trideoxy)-alpha-L-lyxo-hexopyranosyl)oxy]-7,8,9,10-tetrahydro-6,8,11 -trihydroxy-1 -methyoxy-,(8S-cis)-
U167	134-32-7	1-Naphthalenamine
U168	91-59-8	2-Naphthalenamine
U026	494-03-1	Naphthalenamine, N,N'-bis(2-chloroethyl)-

TOXIC WASTES

EPA Hazardous Waste No.	Chemical Abstract No.	Substance
U165	91-20-3	Naphthalene
U047	91-58-7	Naphthalene, 2-chloro-
U166	130-15-4	1,4-Naphthalenedione
U236	72-57-1	2,7-Naphthalenedisulfonic acid, 3,3'-[(3,3'-dimethyl [1,1'-biphenyl[1,1'-biphenyl]-4,4' -diyl)bis(azo)bis[5-amino -4-hydroxy]-, tetrasodium salt
U166	130-15-4	1,4-Naphthoquinone
U167	134-32-7	alpha-Naphthylamine
U168	91-59-8	beta-Naphthylamine
U217	10102-45-1	Nitric acid, thallium(1+)salt
U169	98-95-3	Nitrobenzene(l,T)
U170	100-02-7	p-Nitrophenol
U171	79-46-9	2-Nitropropane (l,T)
U172	924-16-3	N-Nitrosodi-n-butylamine
U173	1116-54-7	N-Nitrosodiethanolamine
U174	55-18-5	N-Nitrosodiethylamine
U176	759-73-9	N-Nitroso-N-ethylurea
U177	684-93-5	N-Nitroso-N-methylurea
U178	615-53-2	N-Nitroso-N-methylurethane
U179	100-75-4	N-Nitrosopiperidine
U180	930-55-2	N-Nitrosopyrrolidine
U181	99-55-8	5-Nitro-o-toluidine
U193	1120-71-4	1,2-Oxathiolane, 2,2-dioxide
U058	50-18-0	2H- 1,3,2-Oxazaphosphorin-2-amine, N,N-bis(2-chloroethyl)tetrahydro-, 2-oxide
U115	75-21-8	Oxirane (l,T)
U126	765-34-4	Oxiranecarboxyaldehyde
U041	106-89-8	Oxirane, (chloromethyl)-
U182	123-63-7	Paraldehyde
U183	608-93-5	Pentachlorobenzene
U184	76-01-7	Pentachloroethane
U185	82-68-8	Pentachloronitrobenzene(PCNB)
See F027	87-86-5	Pentachlorophenol
U161	108-10-1	Pentanol, 4-methyl-
U186	504-60-9	1,3-Pentadiene (l)
U187	62-44-2	Phenacetin
U188	108-95-2	Phenol
U048	95-57-8	Phenol, 2-chloro-
U039	59-50-7	Phenol, 4-chloro-3-methyl-
U081	120-83-2	Phenol, 2,4-dichloro-
U082	87-65-0	Phenol, 2,6-dichloro-
U089	56-53-1	Phenol 4,4'-(1,2-diethyl-1,2-ethenediyl)bis-, (E)-
U101	105-67-9	Phenol, 2,4-dimethyl-

TOXIC WASTES

EPA Hazardous Waste No.	Chemical Abstract No.	Substance
U052	1319-77-3	Phenol, methyl-
U132	70-30-4	Phenol, 2,2'-methylenebis[3,4,6-trichloro-
U170	100-02-7	Phenol, 4-nitro-
See F027	87-86-5	Phenol, pentachloro-
See F027	58-90-2	Phenol, 2,3,4,6-tetrachloro-
See F027	95-95-4	Phenol, 2,4,5-trichloro-
See F027	88-06-2	Phenol, 2,4,6-trichloro-
U150	148-82-3	L-Phenylalanine, 4-[bis(2-chloroethyl)amino]-
U145	7446-27-7	Phosphoric acid, lead(2+) salt (2:3)
U087	3288-58-2	Phosphorodithioic acid, O,O-diethyl S-methyl ester
U189	1314-80-3	Phosphorus sulfide (R)
U190	85-44-9	Phthalic anhydride
U191	109-06-8	2-Picoline
U179	100-75-4	Piperidine, 1-nitroso-
U192	23950-58-5	Pronamide
U194	107-10-8	1-Propanamine (I,T)
U111	621-64-7	1-Propanamine, N-nitroso-N-propyl-
U110	142-84-7	1-Propanamine, N-propyl- (I)
U066	96-12-8	Propane, 1,2-dibromo-3-chloro-
U083	78-87-5	Propane, 1,2-dichloro-
U149	109-77-3	Propanedinitrile
U171	79-46-9	Propane, 2-nitro- (I,T)
U027	108-60-1	Propane, 2,2'-oxybis[2-chloro-
U193	1120-71-4	1,3-Propane sultone
See	93-72-1	Propanoic acid, -2-(2,4,5-trichlorophenoxy)-
U235	126-72-7	1-Propanol, 2,3-dibromo-, phosphate(3:1)
U140	78-83-1	1-Propanol, 2-methyl- (I,T)
U002	67-64-1	2-Propanone (I)
U007	79-06-1	2-Propenamide
U084	542-75-6	1-Propene, 1,3-dichloro-
U243	1888-71-7	1-Propene, 1,1,2,3,3,3-hexachloro-
U009	107-13-1	2-Propenenitrile
U152	126-98-7	2-Propenenitrile, 2-methyl- (I,T)
U008	79-10-7	2-Propenoic acid (I)
U113	140-88-5	2-Propenoic acid, ethyl ester (I)
U118	97-63-2	2-Propenoic acid, 2-methyl-, ethyl ester

TOXIC WASTES

EPA Hazardous Waste No.	Chemical Abstract No.	Substance
U162	80-62-6	2-Propenoic acid, 2-methyl-, methyl ester (I,T)
U194	107-10-8	n-Proplyamine (I,T)
U083	78-87-5	Propylene dichloride
U148	123-33-1	3,6-Pyridazinedione, 1,2-dihydro-
U196	110-86-1	Pyridine
U191	109-06-8	Pyridine, 2-methyl-
U237	66-75-1	2,4-(1H,3H)-Pyrimidinedione, 5-[bis(2-chloroethyl)amino]-
U164	56-04-2	4(1H)-Pyrimidinone, 2,3-dihydro-6-methyl-2-thioxo-
U180	930-55-2	Pyrrolidine, 1-nitroso-
U200	50-55-5	Reserpine
U201	108-46-3	Resorcinol
U202	81-07-2	Saccharin, & salts
U203	94-59-7	Safrole
U204	7783-00-8	Selenious acid
U204	7783-00-8	Selenium dioxide
U205	7488-56-4	Selenium sulfide
U205	7488-56-4	Selenium sulfide SeS_2 (R,T)
U015	115-02-6	L-Serine, diazoacetate (ester)
See F027	93-72-1	Silvex (2,4,5-TP)
U206	18883-66-4	Streptozotocin
U103	77-78-1	Sulfuric acid, dimethyl ester
U189	1314-80-3	Sulfur phosphide (R)
See F027	93-76-5	2,4,5-T
U207	95-94-3	1,2,4,5-Tetrachlorobenzene
U208	630-20-6	1,1,1,2-Tetrachloroethane
U209	79-34-5	1,1,2,2-Tetrachloroethane
U210	127-18-4	Tetrachloroethylene
See F027	58-90-2	2,3,4,6-Tetrachlorophenol
U213	109-99-9	Tetrahydrofuran (I)
U214	563-68-8	Thallium(I) acetate
U215	6533-73-9	Thallium(I) carbonate
U216	7791-12-0	Thallium(I) chloride
U216	7791-12-0	Thallium chloride Tlcl
U217	10102-45-1	Thallium(I) nitrate
U218	62-55-5	Thioacetamide
U153	74-93-1	Thiomethanol (I,T)
U244	137-26-8	Thioperoxydicarbonic diamide $[(H_2N)C(S)]_2S_2$, tetramethyl-
U219	62-56-6	Thiourea
U244	137-26-8	Thiram
U220	108-88-3	Toluene
U221	25376-45-8	Toluenediamine
U223	26471-62-5	Toluene diisocyanate (R,T)

TOXIC WASTES

EPA Hazardous Waste No.	Chemical Abstract No.	Substance
U328	95-53-4	o-Toluidine
U353	106-49-0	p-Toluidine
U222	636-21-5	o-Toluidine hydrochloride
U011	61-82-5	1H-1,2,4-Triazol-3-amine
U227	79-00-5	1,1,2-Trichloroethane
U228	79-01-6	Trichloroethylene
U121	75-69-4	Trichloromonofluoromethane
See F027	95-95-4	2,4,5-Trichlorophenol
See F027	88-06-2	2,4,6-Trichlorophenol
U234	99-35-4	1,3,5-Trinitrobenzene (R,T)
U182	123-63-7	1,3,5-Trioxane, 2,4,6-trimethyl-
U235	126-72-7	Tris(2,3-dibromopropyl) phosphate
U236	72-57-1	Trypan blue
U237	66-75-1	Uracil mustard
U176	759-73-9	Urea, N-ethyl-N-nitroso-
U177	684-93-5	Urea, N-methyl-N-nitroso-
U043	75-01-4	Vinyl chloride
U248	81-81-2	Warfarin, & salts, when present at concentrations of 0.3% or less
U239	1330-20-7	Xylene(I)
U200	50-55-5	Yohimban-16-carboxylic acid, 11,17-dimethoxy-18-[(3,4,5-trimethoxyben zoyl)oxy]-, methyl ester, 3beta, 16beta, 17alpha, 18beta, 20alpha)-
U249	1314-84-7	Zinc phosphide Zn_3P_2, when present at concentrations of 10% or less

(I) = Ignitability
(C) = Corrosivity
(R) = Reactivity
(T) = Toxicity

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[1] CAS Number given for parent compound only.

F List of Non-Specific Hazardous Waste

B. F Wastes Non-Specific Source Wastes

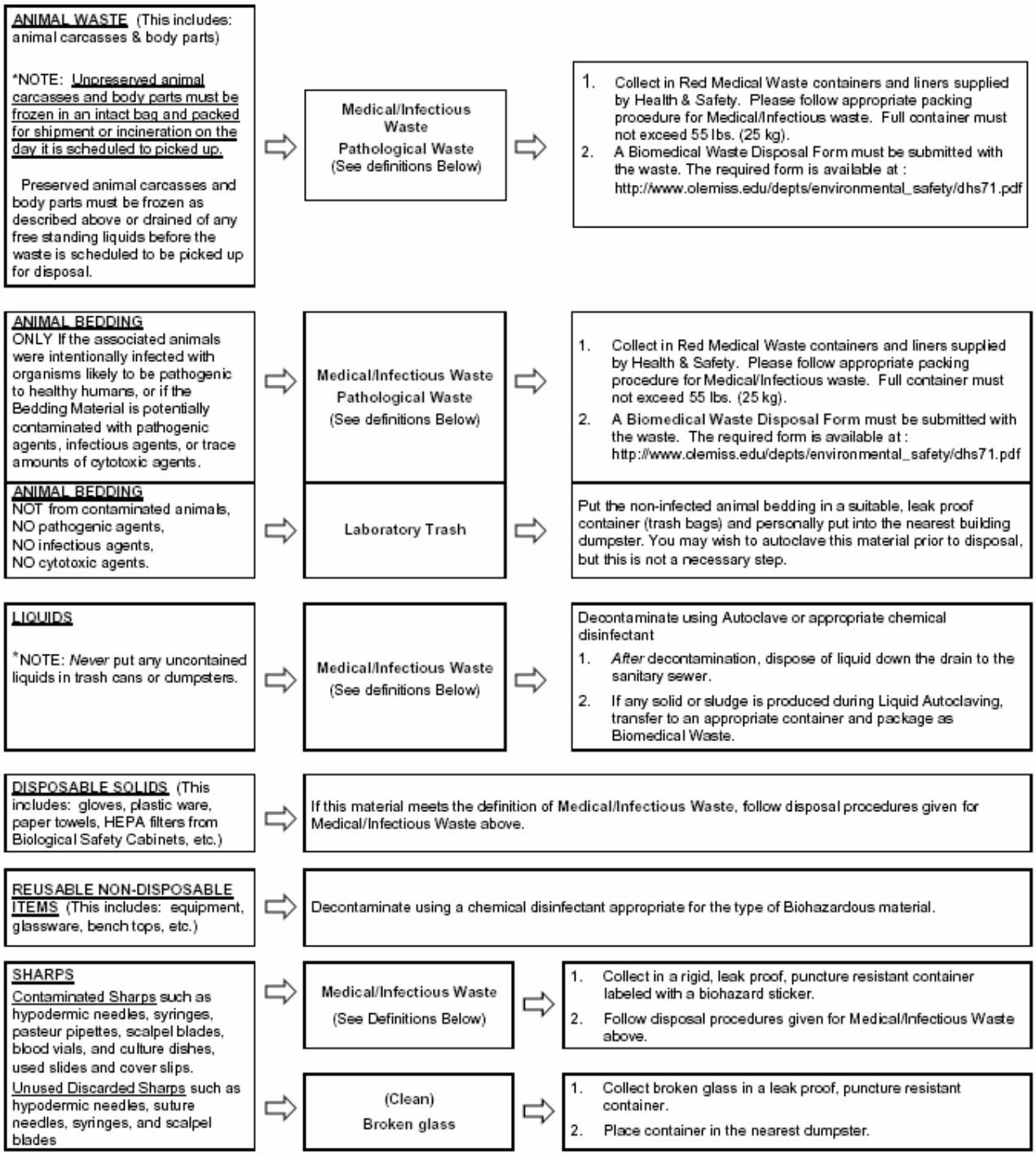
[Note: If the waste is not spent (in its original form) this list does not apply.]

EPA #	Nonspecific Source Waste Description
F001	The following spent halogenated *solvents used in degreasing*: tetrachloroethylene, trichloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and chlorinated fluorocarbons; all spent solvent mixtures/blends used in degreasing containing, before use, a total of ten percent or more (by volume) of one or more of the above halogenated solvents or those solvents listed in F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures
F002	The following *spent halogenated solvents*: tetrachloroethylene, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, chlorobenzene, 1,1,2-trichloro-1,2,2-trifluoroethane, ortho- dichlorobenzene, trichlorofluoromethane, and 1,1,2-trichloroethane; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above halogenated solvents or those listed in F001, F004, or F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures
F003	The following spent non-halogenated solvents: xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexanone, and methanol; all spent solvent mixtures/blends containing, before use, only the above spent non-halogenated solvents; and all spent solvent mixtures/blends containing, before use, one or more of the above non-halogenated solvents, and, a total of ten percent or more (by volume) of one or more of those solvents listed in F001, F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures
F004	The following spent non-halogenated solvents: cresols and cresylic acid, and nitrobenzene; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures
F005	The following spent non-halogenated solvents: toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol, and 2-nitropropane; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, or F004; and still bottoms from the recovery of these spent solvents and spent solvent mixtures

APPENDIX III

SHARPS AND BIOLOGICAL WASTE DISPOSAL FLOW CHART

(Non – Radioactive)



APPENDIX III

المركز القومي للبحوث

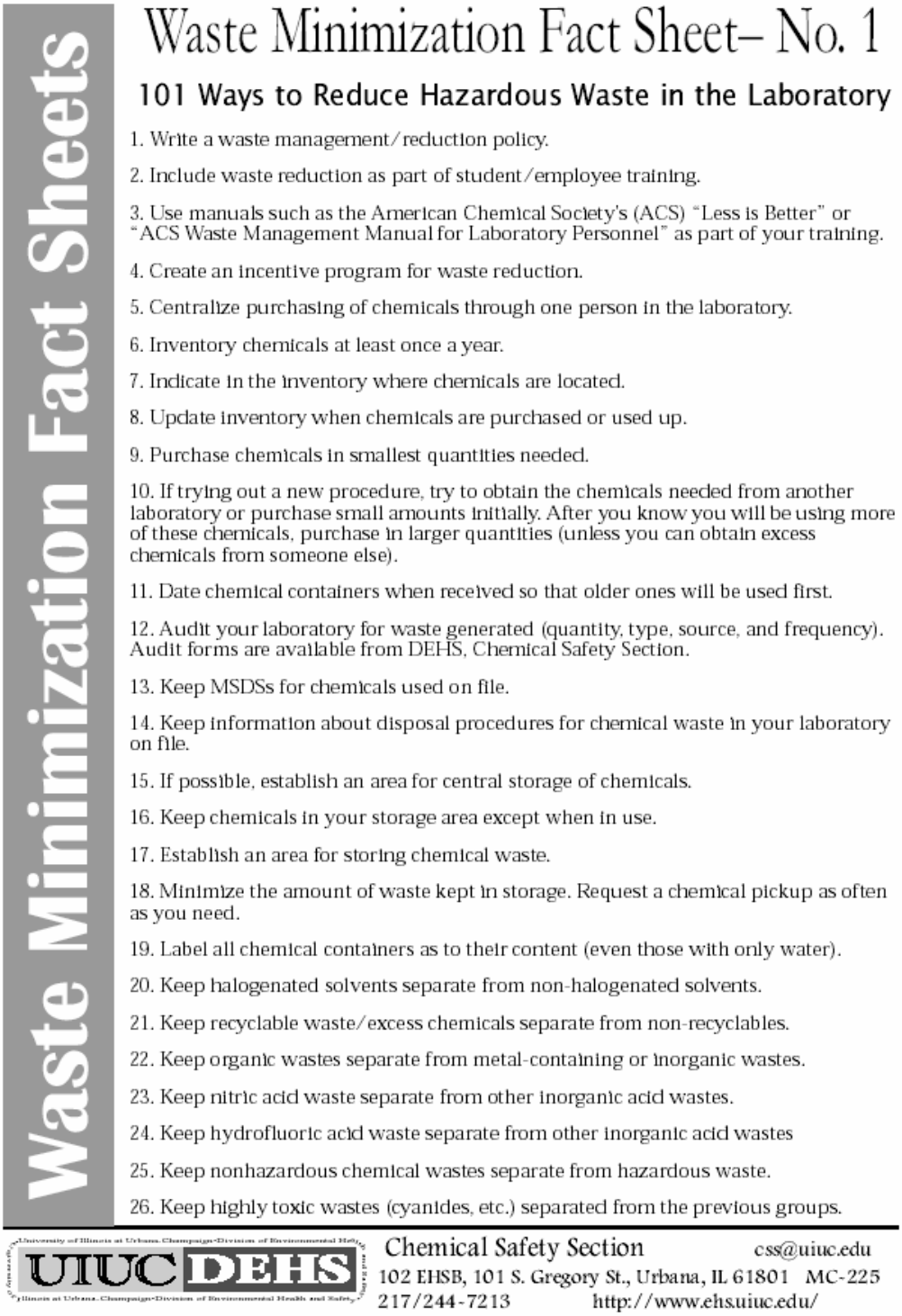
لجنة السلامة و الصحة المهنية

يتم فصل و تجميع المخلفات طبقا للجدول الآتى:

نوع المخلفات البيولوجية	طريقة الفصل	ملاحظات
خلايا، مسحات، قطن ملوث، صديد، دم، أجزاء آدمية، أعضاء، حيوانات تجارب 	حقائب بلاستيكه حمراء 	يستخدم عدد ٢ كيس داخل بعض و تملأ ¾ الحاوية فقط و يتم ربطها بالخيط المرفق جيدا
أدوات حادة و صلبة مثل سنون الحقن، المشارط، زجاج مكسور، أجهزة نقل المحاليل و الدم 	حاوية بلاستيك صفراء اللون 	يتم إغلاقها بإحكام

ملحوظة: من الضروري ملء إستمارة البيانات المرفقة مع كل عينة . و يتم تسليم الأصل الى المسئول عن تخزين المخلفات البيولوجية و يتم حفظ صورة ضوئية منها فى ملف خاص بالمخلفات البيولوجية فى كل معمل.

APPENDIX IV



Waste Minimization Fact Sheets

Waste Minimization Fact Sheet– No. 1

101 Ways to Reduce Hazardous Waste in the Laboratory

1. Write a waste management/reduction policy.
2. Include waste reduction as part of student/employee training.
3. Use manuals such as the American Chemical Society's (ACS) "Less is Better" or "ACS Waste Management Manual for Laboratory Personnel" as part of your training.
4. Create an incentive program for waste reduction.
5. Centralize purchasing of chemicals through one person in the laboratory.
6. Inventory chemicals at least once a year.
7. Indicate in the inventory where chemicals are located.
8. Update inventory when chemicals are purchased or used up.
9. Purchase chemicals in smallest quantities needed.
10. If trying out a new procedure, try to obtain the chemicals needed from another laboratory or purchase small amounts initially. After you know you will be using more of these chemicals, purchase in larger quantities (unless you can obtain excess chemicals from someone else).
11. Date chemical containers when received so that older ones will be used first.
12. Audit your laboratory for waste generated (quantity, type, source, and frequency). Audit forms are available from DEHS, Chemical Safety Section.
13. Keep MSDSs for chemicals used on file.
14. Keep information about disposal procedures for chemical waste in your laboratory on file.
15. If possible, establish an area for central storage of chemicals.
16. Keep chemicals in your storage area except when in use.
17. Establish an area for storing chemical waste.
18. Minimize the amount of waste kept in storage. Request a chemical pickup as often as you need.
19. Label all chemical containers as to their content (even those with only water).
20. Keep halogenated solvents separate from non-halogenated solvents.
21. Keep recyclable waste/excess chemicals separate from non-recyclables.
22. Keep organic wastes separate from metal-containing or inorganic wastes.
23. Keep nitric acid waste separate from other inorganic acid wastes.
24. Keep hydrofluoric acid waste separate from other inorganic acid wastes
25. Keep nonhazardous chemical wastes separate from hazardous waste.
26. Keep highly toxic wastes (cyanides, etc.) separated from the previous groups.

UIUC DEHS
Chemical Safety Section css@uiuc.edu
102 EHSB, 101 S. Gregory St., Urbana, IL 61801 MC-225
217/244-7213 http://www.ehs.uiuc.edu/

27. Avoid experiments that produce wastes that contain combinations of radioactive, biological and/or hazardous chemical waste.

28. Keep chemical wastes separate from normal trash (paper, wood, etc.).

29. Develop procedures to prevent and/or contain chemical spills—purchase spill cleanup kits, contain areas where spills are likely to occur.

30. Use the least hazardous cleaning method for glassware. Use detergents such as Alconox, Micro, RBS35 on dirty equipment before using KOH/ethanol bath, acid bath or No Chromix.

31. Eliminate the use of chromic acid cleaning solutions altogether. (See Waste Minimization Fact Sheet—No. 3 for more information.)

32. Eliminate the use of uranium and thorium compounds (naturally radioactive).

33. Substitute red liquid (spirit-filled), digital, or thermocouple thermometers for mercury thermometers where possible.

34. Use a bimetal or stainless steel thermometer instead of mercury thermometer in heating and cooling units. Stainless steel laboratory thermometers may be an alternative to mercury thermometers in laboratories, as well.

35. Evaluate laboratory procedures to see if less hazardous or nonhazardous reagents could be used.

36. Review the use of highly toxic, reactive, carcinogenic or mutagenic materials to determine if safer alternatives are feasible.

37. Avoid the use of reagents containing: arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver.

38. Consider the quantity and type of waste produced when purchasing new equipment.

39. Purchase equipment that enables the use of procedures that produce less waste.

40. Review your procedures regularly (e.g. annually) to see if quantities of chemicals and/or chemical waste could be reduced.

41. Look into the possibility of including detoxification and/or neutralization steps in laboratory experiments.

42. When preparing a new protocol, consider the kinds and amounts of waste products and determine whether they can be reduced or eliminated.

43. When researching a new or alternative procedure, include consideration of the amount of waste produced as a factor.

44. Examine your waste/excess chemicals to determine if there are other uses in your laboratory. Neighboring laboratories, departments or non-laboratory areas (garage, paint shop, art department) might be able to use them.

45. Review the *ChemCycle* list of chemicals available for redistribution or contact the chemical recycling coordinator (4-7213) to see if chemicals needed are available before purchasing chemicals.

46. Inform the chemical recycling coordinator of the types of materials you can use from the recyclables.

47. Call the chemical recycling coordinator to discuss setting up a locker or shelf for excess chemical exchange in a laboratory, stockroom or hallway in your department.

48. When solvent is used for cleaning purposes, use contaminated solvent for initial cleaning and fresh solvent for final cleaning.

49. Try using detergent and hot water for cleaning of parts instead of solvents.

50. Consider using ozone treatment for cleaning of parts.

51. Consider purchasing a vapor degreaser, vacuum bake or bead blaster for cleaning of parts.

52. Reuse acid mixtures for electropolishing.

53. When cleaning substrates or other materials by dipping, process multiple items in one day.

54. Use the smallest container possible for dipping or for holding photographic chemicals.

55. Store and reuse developer in photo laboratories.

56. Precipitate silver out of photographic solutions for reclamation.

57. Neutralize corrosive wastes that don't contain metals at the laboratory bench.

58. Deactivate highly reactive chemicals in the hood.

59. Evaluate the possibility of redistillation of waste solvents in your laboratory.

60. Evaluate other wastes for reclamation in your laboratory.

61. Scale down experiments producing hazardous waste wherever possible.

62. In teaching laboratories, consider the use of microscale experiments.

63. In teaching laboratories, use demonstrations or video presentations as a substitute for some student experiments that generate chemical wastes.

64. Use pre-weighed or pre-measured reagent packets for introductory teaching laboratories where waste is high.

65. Include waste management as part of the pre- and post-laboratory written student experience.

66. Encourage orderly and tidy behavior in laboratory.

Use the following substitutions where possible:

	Original Material	*Substitute*	*Comments*
67.	Acetamide	Stearic acid	In phase change and freezing point depression
68.	Benzene	Alcohol	
69.	Benzoyl peroxide	Lauryl peroxide	When used as a polymer catalyst
70.	Carbon tetrachloride	Cyclohexane	In test for halide ions
71.	Formaldehyde	Peracetic acid	In cleaning of kidney dialysis machines
72.	Formaldehyde	"Formalternate" (Flinn Scientific)	For storage of biological specimens
73.	Formaldehyde	Ethanol	For storage of biological specimens
74.	Formalin	See Formaldehyde	
75.	Halogenated Solvents	Nonhalogenated Solvents	In parts washers or other solvent processes
76.	Mercuric chloride reagent	Amitrole (Kepro Circuit Systems)	Circuit board etching
77.	Sodium dichromate	Sodium hypochlorite	
78.	Sulfide ion	Hydroxide ion	In analysis of heavy metals
79.	Toluene	Simple alcohols and ketones	
80.	Wood's metal	Onion's Fusible alloy	
81.	Xylene	Simple alcohols and ketones	
82.	Xylene or toluene based liquid scintillation cocktails	Nonhazardous proprietary liquid scintillations cocktails	In radioactive tracer studies
83.	Mercury salts	Mercury-free catalysts (e.g. $CuSO_4$, TiO_2, K_2SO_4)	Kjeldahl digests

84. Use best geometry of substrate carriers to conserve chemicals.

85. Polymerize epoxy waste to a safe solid.

86. Consider using solid phase extractions for organics.

87. Put your hexane through the rotavap for reuse.

88. Destroy ethidium bromide using household bleach—see Waste Minimization Fact Sheet—No. 7.

89. Run mini SDS-PAGE 2d gels instead of full-size slabs.

90. Treat sulfur and phosphorus wastes with bleach before disposal.

91. Treat organolithium waste with water or ethanol.

92. Seek alternatives to phenol extractions (e.g. small scale plasmid prep using no phenol may be found in Biotechnica, Vol. 9, No. 6, pp. 676-678).

93. Collect metallic mercury for reclamation.

94. Investigate possibility for recovering mercury from mercury containing solutions.

95. Recover silver from silver chloride residue waste and gold from gold solutions.

96. Purchase compressed gas cylinders, including lecture bottles, only from manufacturers who will accept the empty cylinders back.

97. When testing experimental products for private companies, limit donations to the amount needed for research.

98. Return excess pesticides to the distributor.

99. Be wary of chemicals donations from outside the University. Accept chemicals only if you will use them within 12 months.

100. Replace and dispose of items containing polychlorinated biphenyls (PCBs).

101. Send us other suggestions for waste reduction by campus mail or email to

css@uiuc.edu

APPENDIX V

AUDIT CHECK MODEL LIST FOR WASTE MINIMIZATION MANGEMENT

Audit check list for Laboratory Manager

Audit subject	Interview	Observation of record
Training requirement		
• arrange the training for research staff and other support staff in laboratory. Keep record of training.		
Chemical management and MSDS		
• establish a file that contains MSDS of all chemical used in the laboratory.		
• provide training on MSDS for all staff in the laboratory		
• update MSDS file whenever necessary		
Chemical inventory management		
• establish chemical inventory in the laboratory		
➢ include ALL chemicals in the laboratory		
➢ both in manual logbook and in computerized		
➢ include following item; • Chemical name • CAS number • Date procured • Date opened • Expire date (if labeled) • Quantity (to be updated every three months with consumption data)		
• submit computerized file of inventory to procurement department.		
Chemical substitution plan		
• make chemical substitution plan		
Solvent recycling program		
• make solvent recycle plan if it is applicable in the laboratory.		

APPENDIX VI

EHS Hazardous Waste labels are required on COLLECTION CONTAINERS:

Examples:

Lab Chemicals

Photographic Chemicals

HAZARDOUS WASTE

This container is to be used solely for the collection of:

Halogenated Solvents Acc. Start Date: *8/23/2001*

CONTENTS	
List Major Components:	Quantity %
methylene chloride	*70-90%*
chloroform	*5-10%*
carbon tetrachloride	*5-10%*
1-bromo-2-chloropropane	*0.1-2%*

Dept. *Chemistry* Room # *Darwin 304*

Satellite Accumulation

Sonoma State University
1801 East Cotati Avenue
Rohnert Park, CA 94928

Physical State: Gas (Liquid) Semi-Solid Solid

Hazard Categories (Check all that apply)

☐ Corrosive ☐ Oxidizer ☐ Irritant
☒ Flammable ☐ Carcinogen ☒ Toxic
☐ Air/Water Reactive ☒ Other: _____

Instructor/ Staff Researcher:
A. Instructor, B. Instructor, C. Research

Class: Chemistry 366, 335A

Process Generating Waste:

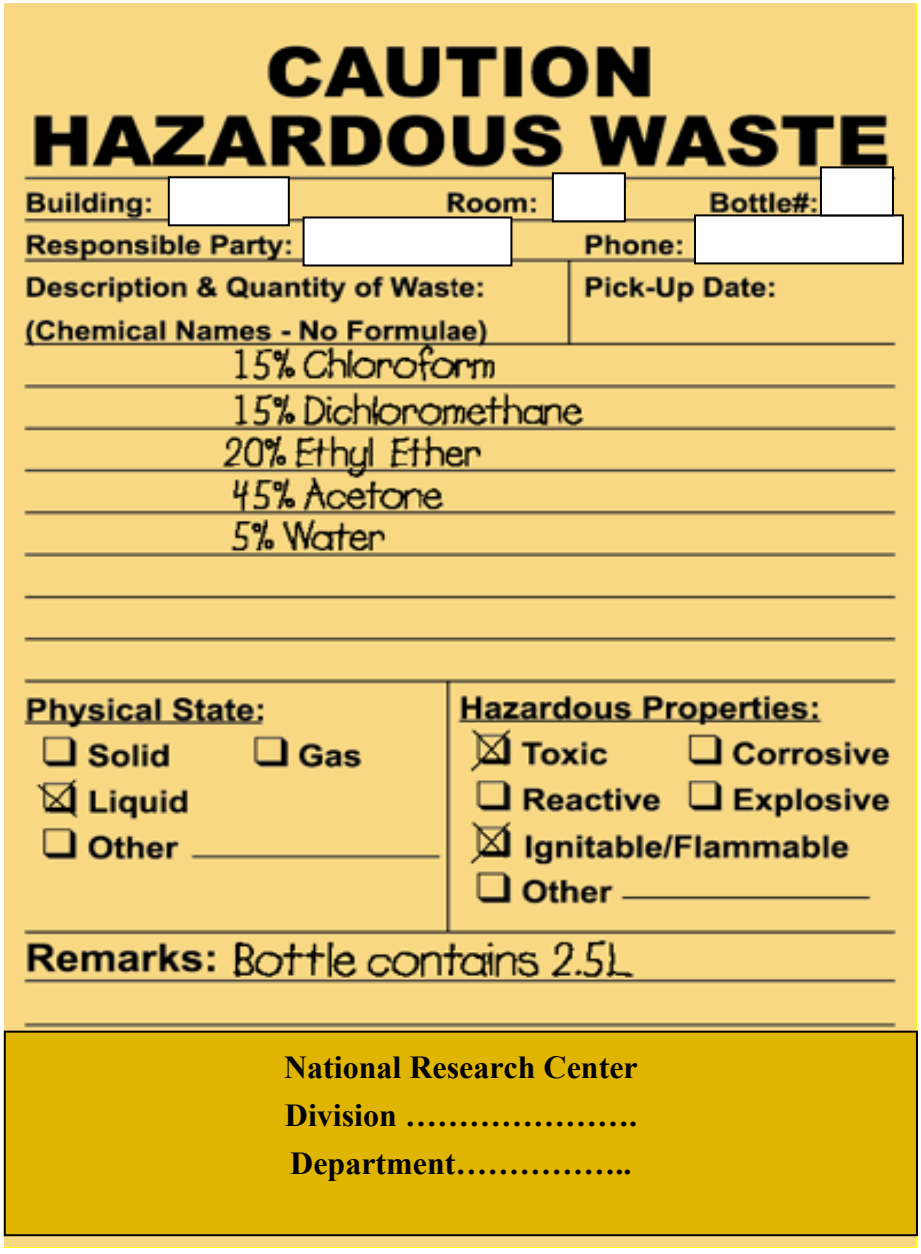
Organic laboratory experiments, Faculty Researc

Accumulation End Date: _____

Total Quantity: 1.3 gallons

Routinely Generated? (Yes) No

APPENDIX VI



CAUTION
HAZARDOUS WASTE

Building: Room: Bottle#:

Responsible Party: Phone:

Description & Quantity of Waste:
(Chemical Names - No Formulae)

Pick-Up Date:

15% Chloroform
15% Dichloromethane
20% Ethyl Ether
45% Acetone
5% Water

Physical State:
- ☐ Solid ☐ Gas
- ☒ Liquid
- ☐ Other

Hazardous Properties:
- ☒ Toxic ☐ Corrosive
- ☐ Reactive ☐ Explosive
- ☒ Ignitable/Flammable
- ☐ Other

Remarks: Bottle contains 2.5L

National Research Center
Division …….
Department……..

APPENDIX VII

Disposal log book model format

National Research Centre

Division of……..Department of ……..……
Research Group…….Number of Room…….……

Waste Collection and storage within the Lab

Date	Container	Quantity		Type of Waste	Onsite Treatment	Waste Handler
		Liter	Kg			

Container shall take one of the following names: Acid for acid waste, Base for alkaline waste, HM for heavy metals containing waste, Organic for organic waste, Bio for biomedical and biological waste (animal tissues, animal remains, animal fluid and blood etc) and Solvent for organic solvent if there.

APPENDIX VIII

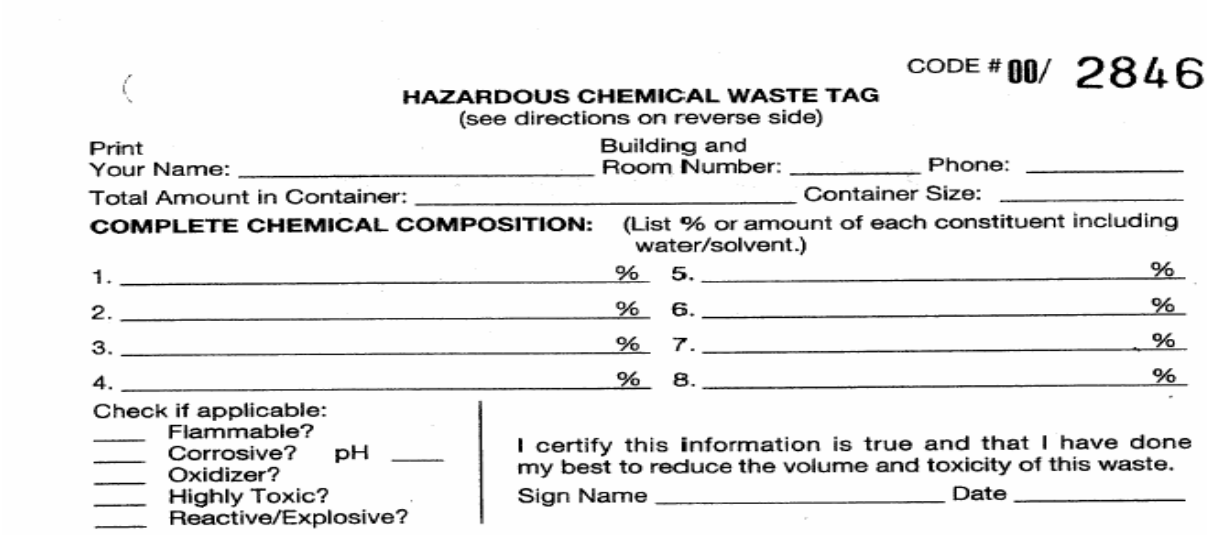
Waste Container/ Solvent Compatibility Chart

Solvent	Steel	Stainless Steel	Polyethylene
Acetic Acid	N	Y	Y
Acetone	Y	Y	Y
Aniline	N	Y	Y
Benzene	N	Y	Y
2-Butanone (MEK)	Y	Y	Y
Butylene	Y	Y	N
Chlorofluorocarbons	N	Y	N
Cyclohexane	Y	N	N
Cyclohexanone	N	Y	N
Ethanol	Y	Y	Y
Ethyl Acetate	N	Y	Y
Ethyl Ether	Y	Y	N
Ethylene Glycol	N	Y	Y
Fuel Oil	Y	Y	Y
Gasoline	Y	Y	Y
Heptane	Y	Y	Y
Hexane	Y	Y	Y
Kerosene	Y	Y	Y
Methanol	Y	Y	Y
Methylene Chloride	N	Y	N
Methyl Isobutyl Ketone	Y	Y	Y
Pentane	Y	N	Y
Petroleum Ether	Y	Y	N
Toluene	Y	Y	Y
Trichloroethylene	N	Y	N
Xylene	Y	Y	Y

APPENDIX IX

Generators Waste Characterization Form

Please post this page in hazardous waste storage areas



CODE # 00/ 2846

HAZARDOUS CHEMICAL WASTE TAG
(see directions on reverse side)

Print Your Name: _____ Building and Room Number: _____ Phone: _____

Total Amount in Container: _____ Container Size: _____

COMPLETE CHEMICAL COMPOSITION: (List % or amount of each constituent including water/solvent.)

1. _____ % 5. _____ %
2. _____ % 6. _____ %
3. _____ % 7. _____ %
4. _____ % 8. _____ %

Check if applicable:
____ Flammable?
____ Corrosive? pH ____
____ Oxidizer?
____ Highly Toxic?
____ Reactive/Explosive?

I certify this information is true and that I have done my best to reduce the volume and toxicity of this waste.
Sign Name _____ Date _____

1. Label all accumulating hazardous waste containers with the words **HAZARDOUS WASTE.**
2. One waste form should be made out for each container.
3. Include the following information:
    a. Name, department, phone number and room number of the principal investigator.
    b. All constituents of the waste and their amounts.
    c. Characteristics of the waste material.
    d. Signature of the person completing the form.
4. Call Committee for Safety and Occupational Health (**CSOH)** for a pickup, or. if you have any questions about hazardous waste management or disposal.
5. All waste will be pickup up from the laboratories. Do not place any chemical waste in corridors.
6. Special pickups for laboratory cleanouts may be arranged with Environmental Health and Safety office

APPENDIX IX

Waste Characterization Form (WCS)

Waste Transportation to the Storage Area

Date	Container	Quantity	Type of	Waste	Final	Waste

Container shall take one of the following names: Acid for acid waste, Base for alkaline waste, HM for heavy metals containing waste, Organic for organic waste, Bio for biomedical and biological waste (animal tissues, animal remains, animal fluid and blood etc) and Solvent for organic solvent if there.

Signature of the Laboratory Manager

APPENDIX IX

المركز القومي للبحوث

لجنة السلامة و الصحة المهنية

إستمـــــــــــارة بيـــانـــــــــــات

عن التخلص من المخلفات البيولوجية

الشعبة: ----------

القسم: ----------

رقـــم المعمـــــــل			
أســـم المسئـــــــول			
نوع المخلفات البيولوجية	مواد صلبة حادة ☐	حيوانات تجارب ☐	أنسجة، دم ، قطن ملوث ☐
تاريخ إرسال العينة			

توقيـــــع رئيـــــس القســـــم:

توقيع المسئول عن مكان التخزين:

APPENDIX X

LABORATORY WASTE MANAGEMENT CHECKLIST

Checklist Item	Notes
1. Determine if your laboratory generates hazardous waste.	
2. Confirm that your Lab has procedures to correctly identify and characterize RCRA hazardous waste.	
3. Assure that the hazardous waste accumulation containers in the laboratory are: • closed, except when adding or removing waste. • in good condition, and properly labeled. • used to consolidate compatible waste only.	
4. Confirm that hazardous waste satellite accumulation areas are limited to 1 quart of acutely hazardous waste and 55 gallons of hazardous waste.	
5. If your site is a CESQG or SQG, confirm that the accumulation of acutely hazardous waste limited to 1 kg.	
6. Confirm that emergency equipment such as spill control equipment, fire extinguishers, and a telephone or two-way radio are present at your hazardous waste accumulation area.	
7. Confirm that once hazardous waste is moved from the laboratory, it is dated and then accumulated on-site for: • less than 90 days for LQG. • less than 180 days for SQGs (unless the TSDF is >200 miles away, then less than 270 days).	
8. Assess how laboratory waste is disposed (e.g., to a RCRA-permitted TSDF, to a landfill, down the drain, treated on site).	
9. Ensure that hazardous waste transported off site is packaged, marked and labeled in accordance with DOT regulations and accompanied by a properly completed hazardous waste manifest.	
10. Ensure that laboratory wastewater discharges are in compliance with applicable standards and permit provisions.	
11. Confirm that laboratory personnel have received training with respect to their waste management responsibilities.	
12. Ensure that the laboratory's Chemical Hygiene Plan includes a procedure for managing lab waste.	
13. Ensure that personnel are investigating improved processes or equipment that might decrease the quantity or toxicity of waste generated by your laboratory.	

CESQG - Conditionally Exempt Small Quantity Generators
DOT - Department of Transportation
LQG -Large Quantity Generator
SQG - Small Quantity Generator
TSDF - Treatment, Storage and/or Disposal Facility(s)