Procedures for Disposal of Hazardous Waste

PREPARED BY THE OFFICE OF ENVIRONMENTAL HEALTH & SAFETY

HAZARDOUS MATERIALS DIVISION

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TABLE OF CONTENTS

CHAPTER FOUR - OTHER LABORATORY WASTES

APPENDICES

Chapter One - The Identification of Regulated Wastes

I. Chemical Wastes

A regulated chemical waste is defined as a waste which, due to its quantity, concentration, or physical and chemical characteristics may

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

The disposal of regulated waste and other unwanted chemicals has become increasingly complicated. The U.S. Environmental Protection Agency and the Texas Natural Resource Conservation Commission regulate the treatment and disposal of chemical wastes in Texas. The purpose of this section is to help you better understand exactly what is and is not a regulated chemical waste. In doing so, we hope that you may be able to design experiments with waste minimization in mind, and dispose of chemical waste generated in your laboratory in a manner consistent with legal requirements.

A. Characteristic Chemical Wastes

In the Code of Federal Regulations (40 CFR 261.20 - 261.24), the Resource Conservation and Recovery Act (RCRA) defines the four fundamental characteristics of regulated waste as:

1. Ignitability - Ignitable materials are defined as materials exhibiting one or more of the following characteristics:

   - Liquids that have a flash point less than 60˚C (140˚F).
   - 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.
   - Flammable compressed gases, including those that form flammable mixtures with air.
   - Oxidizers that stimulate combustion of organic materials.

   Ignitable materials include most common organic solvents, gases such as hydrogen and hydrocarbons, and certain nitrate salts.

2. Corrosivity - Corrosive materials are defined as materials meeting one or more of the following criteria:

   - Aqueous solutions with a pH of less than or equal to 2 or greater than or equal to 12.5.
   - Liquid substances which corrode steel at a rate greater than 6.35 millimeters (0.250 inches) per year at a test temperature of 55˚C (130˚F).

   Most common laboratory acids and bases are corrosive, as well as some amines and solutions of certain metal salts (e.g., a 0.1M aqueous solution of ferric chloride has a pH of 2.0).

3. Reactivity - Reactive materials are defined as materials meeting one or more of the following criteria:

   - 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, vapors, 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, and cyanide and sulfide compounds are classified as reactives.

4. Toxicity - Toxicity is established through the Toxicity Characteristic Leaching Procedure (TCLP), which measures the tendency of certain toxic materials to be leached (extracted) from the waste material under conditions that the waste would be exposed to in a landfill. The current list of toxic substances published by the Environmental Protection Agency includes:

Arsenic	Barium
Benzene	Cadmium
Carbon tetrachloride	Chlordane
Chlorobenzene	Chloroform
Chromium (hexavalent)	o-Cresol
m-Cresol	p-Cresol
2,4-Dichlorophenoxyacetic acid	1,4-Dichlorobenzene
1,2-Dichloroethane	1,1-Dichloroethylene
2,4-Dinitrotoluene	Endrin
Heptachlor (and its epoxide)	Hexachlorobenzene
Hexachlorobutadiene	Hexachloroethane
Lead	Lindane (hexachlorocyclohexane)
Mercury	Methoxychlor
Methyl ethyl ketone	Nitrobenzene
Pentachlorophenol	Pyridine
Selenium	Silver
Tetrachloroethylene	Toxaphene (chlorinated camphene)
Trichloroethylene	2,4,5-Trichlorophenol
2,4,6-Trichlorophenol	2-(2,4,5-Trichlorophenoxy)propionic acid (Silvex)
Vinyl chloride	

   The levels at which these chemicals are regulated in mixtures varies from 0.2 ppm to 400 ppm. For example, solutions that contain mercury at levels above 0.2 ppm are hazardous waste. These levels are very low, so if a waste contains one or more of these components it should be considered to be a hazardous waste unless analysis following the TCLP method shows that its concentration is below the regulatory limit.

   Note that the eight metals listed here are regulated in both their pure forms and as compounds (e.g. lead, lead paint, lead oxide, and tetraethyl lead are all regulated wastes).

B. Listed Chemical Wastes

In addition to defining the characteristics of regulated waste, RCRA also defines (or lists) certain specific waste materials as being regulated. These materials are listed in 40 CFR sections 261.31 (the F List), 261.32 (the K list), and 261.33 (the P and U Lists).

1. The **F List** addresses wastes from nonspecific sources (e.g., spent solvents) and is broken down into several subcategories (or codes). Five codes that are commonly applicable to laboratory wastes are:

   The **F001** Code - Applicable to all spent solvent mixtures and blends used for degreasing which contained, before use, a total of ten percent or more (by volume) of one or more of the following halogenated solvents:

   tetrachloroethylene
   methylene chloride
   carbon tetrachloride
   trichloroethylene
   1,1,1-trichloroethane
   chlorinated fluorocarbons

   The **F002** Code - Applicable to all spent solvent mixtures and blends which contained, before use, a total of ten percent or more (by volume) of one or more of the following halogenated solvents:

   tetrachloroethylene
   trichloroethylene
   chlorobenzene
   ortho-dichlorobenzene
   1,1,2-trichloroethane
   methylene chloride
   1,1,1-trichloroethane
   1,1,2-trichloro-1,2,2-trifluoroethane
   trichlorofluoromethane

   The **F003** Code - Applicable to all spent solvent mixtures and blends which contained, before use, a total of ten percent or more (by volume) of one or more of the following non-halogenated solvents:

   xylene
   ethyl acetate
   ethyl ether
   n-butyl alcohol
   methanol
   acetone
   ethyl benzene
   methyl isobutyl ketone
   cyclohexanone

   The **F004** Code - Applicable to all spent solvent mixtures and blends which contained, before use, a total of ten percent or more (by volume) of one or more of the following non-halogenated solvents:

   cresols and cresylic acid
   nitrobenzene

   The **F005** Code - Applicable to all spent solvent mixtures and blends which contained, before use, a total of ten percent or more (by volume) of one or more of the following non-halogenated solvents:

   toluene
   carbon disulfide
   pyridine
   2-ethoxyethanol
   methyl ethyl ketone
   isobutanol
   benzene
   2-nitropropane

2. The **K List** addresses waste from specific sources (e.g., pink/red water from TNT operations - K047) and is generally not applicable to wastes generated in research laboratories.

3. The **P List** addresses unused acutely hazardous materials (e.g., laboratory chemicals having an LD_{50} of less than 50 mg/kg (oral; rat)). It is applicable to many surplus chemicals that are disposed of by research laboratories. Some examples are nickel tetracarbonyl, phosphine, and osmium tetroxide.

4. The **U List** 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.

C. Class I Wastes

Class I wastes are wastes which are regulated by the Texas Natural Resource Conservation Commission. They are not considered hazardous by the EPA definition, but must be disposed of at a permitted landfill due to Texas regulations. Examples of wastes which fall under the Class I definition are soils contaminated with petroleum hydrocarbons, sandblasting sand with leachable lead concentrations between 1.5 and 5.0 ppm, used oil, and solids that when mixed with an equal weight of water form a corrosive solution.

II. Biological (or Special) Wastes

Biological (or special) waste has been identified by the Texas Board of Health 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). Biological waste is regulated by the Texas Natural Resource Conservation Commission (TNRCC) and the Texas Department of Health (TDH). This waste is comprised of the following:

A. Microbiological Waste

Microbiological waste includes:

1. discarded cultures and stocks of infectious agents and associated biologicals;
2. discarded cultures of specimens from medical, pathological, pharmaceutical, research, clinical, commercial, and industrial laboratories;
3. discarded live and attenuated vaccines, but excluding the empty containers thereof;
4. discarded, used disposable culture dishes; and
5. discarded, used disposable devices used to transfer, inoculate, or mix cultures.

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

B. Animal Waste

Animal waste includes:

1. carcasses of animals;
2. body parts of animals;
3. whole blood, serum, plasma, and/or other blood components from animals; and
4. bedding of animals intentionally exposed to pathogens.

C. Human Blood and Blood Products

Human blood and blood products include:

1. human blood, serum, plasma, other blood components, and body fluids; and
2. disposable items contaminated with human blood or body fluids.

D. Pathological Waste

Pathological waste includes but is not limited to:

1. human materials removed during surgery, labor and delivery, autopsy, embalming, or biopsy, including: body parts and tissues or fetuses;
2. products of spontaneous or induced human abortions, regardless of the period of gestation, including: body parts, tissues or fetuses, organs, and bulk blood and body fluids;
3. laboratory specimens of blood and tissue after completion of laboratory examination; and
4. anatomical remains.

E. Sharps

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

1. hypodermic needles;
2. hypodermic syringes with attached needles;
3. scalpel blades;
4. razor blades, disposable razors, and disposable scissors used in surgery or other medical procedures; and
5. glass Pasteur pipettes.

Sharps include but are not limited to the following, **when contaminated:**

1. glass pipettes;
2. broken glassware;
3. specimen tubes;
4. blood culture bottles; and
5. microscope slides.

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

III. Radioactive Wastes

Radioactive waste generated by laboratories is usually limited to low-level radioactive waste from the use of by-product material and naturally occurring or accelerator-produced radioactive material (NARM). By-product material, as defined by the U.S. Nuclear Regulatory Commission (U.S. NRC), is reactor-produced radioactive material and includes most purchased radiolabelled chemicals; NARM includes uranium and thorium salts. The use and disposal of by-product material are regulated by the U.S. NRC and usually require a license. Common waste management methods for low-level radioactive waste from laboratories include storage for decay and indefinite on-site storage, burial at a low-level radioactive waste site, incineration, and sanitary sewer disposal. For further information regarding The University's radiation safety and radioactive waste program, please refer to The Manual of Radiation Safety.

IV. Multihazardous Wastes

Multihazardous waste is waste that contains any combination of chemical, radioactive, or biological hazards. Although many of the principles discussed for chemically hazardous waste earlier in this chapter also apply here, multihazardous waste requires special management considerations because the treatment method for one of the hazards may be inappropriate for the treatment of another.

Chemical--Radioactive (mixed) waste is defined by the Environmental Protection Agency as "wastes that contain a chemically hazardous waste component regulated under the Resource Conservation and Recovery Act and a radioactive component consisting of source, special nuclear, or byproduct material regulated under the Atomic Energy Act." Examples of laboratory mixed wastes include:

1. Used flammable liquid scintillation cocktail.
2. Phenol-chloroform mixtures from extraction of nucleic acids from radiolabelled cell components.
3. Certain gel electrophoresis waste (e.g., methanol or acetic acid containing radionuclides).
4. Lead contaminated with radioactivity.

Mixed waste produced at universities and medical research laboratories are typically a mixture of a low-level radioactive waste and chemically hazardous waste. Disposal options for mixed waste are usually very expensive. For many types of mixed waste, there are no management options other than indefinite storage on site.

Chapter Two - Chemical Wastes

I. Requirements for the Accumulation Area

A. Containers

Containers holding waste must be in good condition, not leaking, and compatible with the waste being stored. The container must always be closed during storage, except when it is necessary to add waste. Hazardous waste must not be placed in unwashed containers that previously held an incompatible material (see Incompatibility chart in APPENDICES).

If a container holding hazardous waste is not in good condition or if it begins to leak, the generator must transfer the waste from this container to a container that is in good condition, overpack the container, or manage the waste in some other way that prevents a potential for a release or contamination. Please contact the OEHS Hazardous Materials Division, 471-7137, if assistance is required.

A storage container holding a hazardous waste that is incompatible with any waste or other materials stored nearby in other containers must be separated from the other materials or protected from them by means of a partition, wall or other device.

All waste containers must be:

1. Clearly labeled, with their contents indicated. **No** container should be marked with the words "hazardous waste" or "non-hazardous waste". OEHS tags may be used to list the contents. Paint over or remove any old labels.

2. Kept at or near (immediate vicinity) the site of generation and under control of the generator.

3. Compatible with contents (i.e. acid should not be stored in metal cans).

4. Closed at all times except when waste is being added to container.

5. Properly identified with completed waste tags before pickup is requested.

6. Safe for transport with non-leaking screw-on caps.

7. Filled to a safe level (not beyond the bottom of the neck of the container or a 2-inch head space for 55 gallon drums). Over-filled bottles are:

    a. hard to pour safely,
    b. inclined to burst,
    c. apt to leak, and
    d. capable of endangering the technician through splashing or shooting up into one's face upon opening or transporting.

Note: Do not use Red bags or Sharps containers (Biohazard), or Asbestos bags for hazardous chemical waste collection.

B. Accumulation Guidelines

A generator of possible hazardous waste may accumulate up to a total of 55 gallons of waste, which may be determined to be hazardous by the Office of Environmental Health and Safety, or one quart of "listed" acutely hazardous waste (see Appendix IV) at or near the point of generation. If a process will generate more than this volume at one time, the Office of Environmental Health and Safety should be contacted in advance to arrange a special waste pick up.

Whenever possible, keep different hazardous wastes separate so that disposal options remain clearer and more cost effective. In all cases, do not mix incompatible wastes or other materials (see Appendix III) in the same container or place wastes in an unwashed container that previously held an incompatible waste or material. However, if separation is not practical, collect waste in compatible containers and try to keep it segregated into the following categories:

1. Miscellaneous solids, e.g., grossly contaminated gloves, rags or towels, and other grossly contaminated lab equipment should be collected separately from liquid wastes.

2. Halogenated solvents, e.g., methylene chloride, chloroform, carbon tetrachloride.

   Note: Disposal of non-halogenated solvents contaminated with halogens costs 4-5 times as much as non-halogenated solvents.

3. Non-halogenated solvents, e.g., xylene, toluene, alcohols.

4. Waste oil must be kept as uncontaminated as possible in order to be recycled. You should keep oils separate from other chemicals, particularly solvents, pesticides, and PCB's.

5. Acids.

6. Bases.

7. Metal-bearing waste whether dry, flammable, corrosive or other. Specific metals of concern are arsenic, barium, cadmium, chromium, lead, mercury, nickel, selenium, silver, and thallium.

8. Accumulate waste that is both flammable and corrosive separately from waste that is either flammable or corrosive.

9. Special wastes, e.g., cyanide, sulfide, pesticides, oxidizers, organic acids, explosives and peroxides, should be collected individually whenever possible.

10. Mercury and mercury containing compounds. All mixtures containing mercury in any form must be disposed of as mercury contaminated waste.

II. Disposal Procedures for Regulated Wastes

A. Waste Tags and Request for Disposal Forms

Before chemical waste can be picked up by OEHS, a waste tag is required. It should be filled out by the waste generator and attached to each container. The information on the tag is used to categorize and treat the waste. Please fill them out legibly, accurately and completely. Please include the following information:

Generator - Name and telephone number of the individual responsible for supervising the process generating the waste.

Contact - Phone number of generator, building name, and room number for picking up the waste.

Amount - Total volume or weight of the chemical in the container.

Chemical Name - Specific, full chemical name, no formulas or abbreviations. Product names or trade names are acceptable if the manufacturer's name and address or a material safety data sheet can be supplied with the material. Vague statements such as "hydrocarbons", "organic waste", "various salts of …" make it impossible to comply with EPA treatment standards and will delay the pick-up until sufficiently detailed information is submitted to OEHS.

Vol. % - Percentage of the total volume to which each chemical amount is equal (should add up to 100%) or the actual weight or volume of each constituent.

Note: Biological Waste and Sharps containers do not require waste tags.

When your container is ready for disposal and is properly tagged, contact the Hazardous Materials Division of the Office of Environmental Health & Safety by sending a Request for Disposal (see APPENDICES for examples of both a Chemical Waste and a Biological Waste or Sharps Request for Disposal form):

1. via Campus Mail to:
   Hazardous Materials Division
   Office of Environmental Health & Safety
   C2600

   or

2. hand deliver to:
   Hazardous Materials Division
   Office of Environmental Health & Safety
   Service Building, Room 202

   or

3. via Fax to:
   Hazardous Materials Division
   Office of Environmental Health & Safety
   512-471-6918

at least five working days prior to reaching the accumulation limits of 55 gallons of potentially hazardous waste or 1 quart of acutely hazardous waste. The OEHS makes pickups daily and will come to your site as quickly as possible. The information for each container listed on the form must be identical to the information on the waste disposal tag on the container. Please include the following information on a chemical waste Request for Disposal:

Facility - Check the appropriate facility.

Name - Name of the individual responsible for supervising the process of generating the waste. Must be a UT employee.

Department - Name of department generating the waste.

Mail Code - 5 character code for campus mail. See the front of the UT Phone Directory for listing.

Phone Number - Phone number of person to contact regarding waste pickup.

Alternate Contact - Name of individual to contact if primary contact is not available.

Alternate Phone - Phone number of alternate contact.

Location of Pickup - Building and room number where the waste is located. Use official 3-letter designation for building.

Tag Number - Number that is pre-printed on the tag and corresponds to the waste that is described on the form.

Contents - Specific, full chemical name, no formulas or abbreviations. Product names or trade names are acceptable if the manufacturer's name and address or a material safety data sheet can be supplied with the material. Vague statements such as "hydrocarbons", "organic waste", "various salts of …" make it impossible to comply with EPA treatment standards and will delay the pick-up until sufficiently detailed information is submitted to OEHS.

Percentage % - Percentage of the total volume to which each chemical amount is equal (percentages for each tag number should add up to 100%).

Amount - Total volume or weight of the chemical in the container.

Physical State - Indicate if the material is a solid (S) or liquid (L).

Signature - Signature of individual responsible for supervising the process of generating the waste, stating that the materials listed are fully and accurately described and are packaged and labeled according to OEHS procedures. Must be a UT employee (e.g., faculty, staff, TA, or RA).

Date - Date that the form was signed and routed to the Office of Environmental Health and Safety.

III. Disposal Procedures for Non-Regulated Wastes

The following checklist should be used in determining whether or not a waste may be disposed of in the sanitary sewer or municipal trash. This checklist does not apply to wastes which are radioactive or mixed in nature.

Does the material meet any of the following criteria?

_____ Is it ignitable? (see Chapter One, A.1 of this booklet)

_____ Is it corrosive? (see Chapter One, A.2 of this booklet)

_____ Is it reactive? (see Chapter One, A.3 of this booklet)

_____ Is it toxic? (see Chapter One, A.4 of this booklet)

_____ Is it an F listed waste? (see Chapter One, B.1 of this booklet)

If the material has not been used, does it meet any of the following criteria?

_____ Is it a P listed waste? (see Appendix IV)

_____ Is it a U listed waste? (see Appendix V)

If the answer to any of the preceding questions is "**yes**," then the waste is regulated and must not be disposed of via sanitary sewer. Please refer to the disposal procedures outlined in Section II (Disposal Procedures for Regulated Wastes) of this chapter.

If the material is not a hazardous waste, please answer the following questions:

_____ Is the material miscible in all proportions with water?

If the answer to the preceding question is "**no**," then the waste is prohibited by the City of Austin POTW and must not be disposed of via sanitary sewer. Please refer to the disposal procedures outlined in section II of this chapter (Disposal Procedures for Regulated Wastes).

_____ Does the sum of the concentrations of the following constituents in the waste exceed 2 ppm?

Acenaphthene
Acenaphthylene
Acrolein
Acrylonitrile
Aldrin
Anthracene
Benzene
Benzidine
1,2-Benzanthracene
Benzo(a)pyrene
Benzo(b)fluroanthene
1,12-Benzoperylene
Benzo(k)fluoranthene
alpha-BHC
beta-BHC
delta-BHC
gamma-BHC
Bis(2-chloroethyl)ether
Bis(2-chloroethoxy)methane
Bis(2-chloroisopropyl)ether
Bis(2-ethylhexyl)phthalate
Bromoform
Bromomethane
4-Bromophenylphenylether
Butylbenzylphthalate
Carbon tetrachloride
Chlordane
Chlorobenzene
Chlorodibromomethane
Chloroethane
2-Chloroethylvinylether
Chloroform
Chloromethane
2-Chloronapthalene
2-Chlorophenol
4-Chlorophenylphenylether
Chrysene
4,4'-DDD
4,4'-DDE
4,4'-DDT
1,2,5,6-Dibenzanthracene
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
3,3'-Dichlorobenzidine
Dichlorobromomethane
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethene
trans-1,2-Dichloroethene
2,4-Dichlorophenol
1,2-Dichloropropane
cis-1,3-Dichloropropene
trans-1,3-Dichloropropene
Dieldrin
Diethylphthalate
2,4-Dimethylphenol
Dimethylphthalate
Di-n-butylphthalate
Di-n-octylphthalate
4,6-Dinitro-o-cresol
2,4-Dinitrophenol
2,4-Dinitrotoluene
2,6-Dinitrotoluene
1,2-Diphenylhydrazine
alpha-Endosulfan
beta-Endosulfan
Endosulfan sulfate
Endrin
Endrin aldehyde
Ethylbenzene
Fluoranthene
Fluorene
Heptachlor
Heptachlor epoxide
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Indeno(1,2,3,c,d,)pyrene
Isophorone
Methylene chloride
Naphthalene
Nitrobenzene
2-Nitrophenol
4-Nitrophenol
N-Nitrosodi-n-propylamine
N-Nitosodiphenylamine
Parachlorometa cresol
PCB-1016
PCB-1221
PCB-1232
PCB-1242
PCB-1248
PCB-1254
PCB-1260
Pentachlorophenol
Phenanthrene
Phenol
Pyrene
2,3,7,8-Tetrachlorodibenzo-p-dioxin
1,1,2,2-Tetrachloroethane
Tetrachloroethylene
Toluene
Toxaphene
1,2,4-Trichlorobenzene
1,1,1-Trichlorethane
1,1,2-Trichlorethane
Trichloroethylene
2,4,6-Trichlorophenol
Vinyl chloride

_____ Does the waste contain any of the following constituents at levels greater than the specified amount?

Copper	1.9 mg/L
Nickel	1.6 mg/L
Zinc	2.3 mg/L
Fluorides	65 mg/L
Cyanides	1.0 mg/L

_____ Is it extremely toxic or a known carcinogen or mutagen?

If the answers to the two preceding questions are "**yes**," then the waste is prohibited by the City of Austin POTW and must not be disposed of via sanitary sewer. Please refer to the disposal procedures outlined in section II of this chapter (Disposal Procedures for Regulated Wastes). Otherwise, the material is acceptable for sanitary sewer disposal if it is a liquid or for trash disposal if it is a solid. The discharge of wastes to the sanitary sewer should be accompanied with copious amounts of water - a good rule of thumb is to use a 100-fold excess of water when discharging wastes to the sanitary sewer.

Examples of Non-Regulated Chemicals

The following are examples of nonhazardous chemicals which may be disposed of either in the general trash (for solids) or the sanitary sewer (for liquids). For a more complete list, please consult Appendix I.

Adenosine 3'-monophosphate, sodium salt
Albumin, bovine, methylated
Bacto peptone; Peptone
Carbachol chloride
2-Deoxy-D-ribose
D-Erythrose
Glutamic acid
Hexokinase
Sodium citrate

IV. Disposal Procedures for Empty Containers

Disposal procedures for empty containers depends on the previous contents and the efficiency of emptying them. Containers of pourable contents must be completely emptied. Containers of thick or solidified materials must be scraped out or drained until no more than one inch of material remains in the bottom of the container or no more than 3% of the original weight of the contents remains, whichever is less. Chemical containers that meet these criteria are considered empty and may be disposed of by placing the container in the hallway, next to the lab door after 5:00 p.m., given the following provisions:

- if the container labels are made unreadable by affixing an "Empty" sticker over the previous label (stickers are available from OEHS),
- if the container cap is removed and discarded in the normal trash, and
- if the sole active ingredient of the previous contents was not acutely hazardous (see list of acutely hazardous waste in Appendix IV).

Note: 55 gallon drums must be rendered unusable to be disposed of through the normal trash collection procedures. To render a drum unusable it should either be crushed or the sides should be obviously punctured.

If containers are not or cannot be emptied or if they contained acutely hazardous waste, submit them to the OEHS Hazardous Materials Division as waste in accordance with the procedures described in this manual. You can also utilize a used container to hold waste for pick up if the waste is compatible with the residue in the container, the label is defaced, and the container is in good condition and not leaking.

Containers that held compressed gases are considered empty if valve has been removed. Empty cylinders should be tagged in the same manner as other waste, with the previous contents listed and the notation (EMPTY) on both the tag and the RFD.

V. Waste Minimization

A. Methods for Treating Hazardous Wastes in the Laboratory

Scientific and engineering research and teaching activities in academic institutions can result in the generation of relatively small quantities of a wide variety of waste and surplus chemicals. The small-scale treatment and deactivation of these sorts of chemical products and by-products as part of the experimental plan (i.e., as part of the routine procedure) is one approach that can be used to address the problem of waste minimization at the laboratory level. Several texts have been published that deal with this issue - two particularly good examples are:

1. George Lunn and Eric Sansone. 1994. Destruction of Hazardous Chemicals in the Laboratory, 2nd Edition. Frederick, Maryland: Wiley-Interscience Publications.

2. Margaret A. Armour. 1991. Hazardous Laboratory Chemicals - A Disposal Guide. Edmonton, Alberta, Canada: CRC Press.

B. Five Examples of Reagent Substitutions that Result in Less Hazardous and/or Less Costly Waste

To enhance safety and minimize the environmental consequences of an experiment, careful thought should be given to the materials to be used and the scale of the experiment. Traditionally, chemists have chosen reagents and materials for experiments to meet scientific criteria without always giving careful consideration to waste minimization or environmental objectives. In synthetic procedures, overall yield and purity of the desired product were usually regarded as the most important factors. Material substitution emerged as an important consideration in manufacturing process design because of the large quantities of chemicals involved. The following questions should now be considered when choosing a material to be used as a reagent or solvent in an experimental procedure:

- Can this material be replaced by one that will expose the experimenter, and others who handle it, to a lower order of potential hazard?

- Can this material be replaced by one that will reduce or eliminate the generation of hazardous waste and the consequent cost of waste disposal?

The following examples illustrate applications of these principles to common laboratory procedures:

1. Phosgene is a highly toxic gas used as a reagent in many organic transformations. Its use requires proper precautions to deal with the containment of the gas and the handling and disposal of cylinders. Commercially available substitutes such as diphosgene (trichloro-methyl)chloroformate, a liquid, or triphosgene bis(trichloromethyl)carbonate, a low-melting solid, can often be substituted for phosgene by appropriate adjustment of experimental conditions or can be used to generate phosgene only on demand. Both chemicals are highly toxic themselves, but they offer a means to avoid the problems associated with handling a toxic gas.

2. Many widely used reagents contain toxic heavy metals, such as chromium and mercury. Waste containing these materials cannot be incinerated and must be handled separately for disposal. Thus, substitution of other reagents for heavy metal reagents will almost always be beneficial with respect to hazard and waste minimization. Chromic acid cleaning solutions for glassware can be replaced by proprietary detergents used in conjunction with ultrasonic baths. Various chromium (VI) oxidants have been important in synthetic organic chemistry, but their use can often be avoided through the substitution of organic oxidants. The Swern oxidation of alcohols (oxalyl chloride/DMSO) produces relatively innocuous byproducts, which can be handled with other organic waste. Other oxidation reagents tailored to the specific needs of a given transformation are available.

3. Fluorine and fluorinating reagents such as perchloryl fluoride are among the most demanding of reagents to handle because of their high reactivity and toxicity. Accordingly, there has been considerable incentive to develop substitutes for these materials. One example is F-TEDA-BF_4, or 1-chloromethyl-4-fluoro-1,4-diazonia[2.2.2]bicycloctane bis(tetrafluoroborate). This reagent can be substituted for more hazardous reagents in many fluorination procedures.

4. Organic solvents for liquid-liquid extraction or chromatography can often be replaced by other solvents with significant benefit. Benzene, once a widely used solvent, is now recognized as a human carcinogen and must be handled accordingly. Toluene can often serve as a satisfactory substitute. Diethyl ether is a flammable solvent whose handling must take into account its tendency to form explosive peroxides. Methyl t-butyl ether offers only slight advantages over diethyl ether with respect to flammability, but its greatly reduced tendency to form peroxides eliminates the need to monitor peroxide formation during handling and storage.

5. The technology for handling supercritical fluids has developed rapidly in recent years. Supercritical carbon dioxide can replace organic solvents for high-performance chromatography and is beginning to find use as a reaction medium. While supercritical solvents require specialized equipment for handling, they offer the potential benefit of large reductions in organic solvent waste.

6. Mercury thermometers are widely used and easily broken, which results in worker exposure to mercury, release of the vapor to the environment, and increased waste disposal costs as all of the cleanup material must be disposed of as mercury contaminated waste. Substitution of alcohol thermometers for mercury thermometers eliminates these problems. Thermometers containing alcohol are as accurate and have as wide a temperature range as mercury thermometers, and the waste from the cleanup of broken alcohol thermometers can be thrown in the regular trash. Moreover, the breakage of alcohol thermometers does not expose the lab personnel to poisonous vapors.

Chapter Three - Biological Wastes

I. Microbiological Waste

Microbiological waste can either be treated on-site in the lab or can be given to OEHS 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 of 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 shall 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. OEHS has a program in place for the testing of autoclaves.

C. Treatment Methods

Acceptable methods of treatment of microbiological waste include:

Steam Disinfection

a. To allow for sufficient steam access to or penetration of the waste, the waste shall be:

   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) and the Texas Department of Agriculture 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.

D. 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 "treated in accordance with 1.136 of the TAC SWFHCRF" (available from OEHS, Hazardous Materials Division), and

b. Place the bag or other container into another bag or container that is a different color 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.

II. Animal Waste

Disposal

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 OEHS or transferred to the Animal Resources Center. Carcasses and body parts of animals that have been preserved must be separated from the preservative (refer to the chemical waste section of this manual for the disposal requirements of the preservative) and double bagged to prevent leakage. Submit a Biological Wastes and Sharps Request for Disposal form to OEHS 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 OEHS. Place into a non-breakable, closeable container. If you need advice on what kind of container to use, call the OEHS Lab & Biosafety Coordinator at 471-3511. Submit a Biological Wastes and Sharps Request for Disposal form to OEHS 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 OEHS for disposal. Place the waste into a Biohazard bag (these bags are available at OEHS). Submit a Biological Wastes and Sharps Request for Disposal form to OEHS when the waste is ready for pick-up.

III. Human Blood and Blood Products Waste

Disposal

Human Blood, Serum, Plasma, other Blood Components, and Body Fluids
All should be disposed of through OEHS. Place into a non-breakable, closeable container. If you need advice on what kind of container to use, call OEHS Hazardous Materials Division at 471-3511. Submit a Biological Wastes and Sharps Request for Disposal form to OEHS when the waste is ready for pick-up.

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 OEHS for disposal. Place the waste into a Biohazard bag (these bags are available at OEHS). Submit a Biological Wastes and Sharps Request for Disposal form to OEHS when the waste is ready for pick-up.

Sharp items: Follow the procedures listed under Sharps in the next chapter.

IV. Pathological Waste

Disposal

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

Chapter Four - Other Laboratory Wastes

I. MOU Glassware

The Texas Department of Public Safety (DPS) and the Texas Higher Education Coordinating Board (THECB) have developed a Memorandum of Understanding (MOU) as required by the Texas Safety and Health Code. Under the MOU, certain laboratory apparatus is prohibited from being sold or transferred to any person or entity not holding a DPS permit or waiver. Therefore, this laboratory apparatus cannot be sent to Surplus for sale to the public nor can it be given to anyone outside of The University. The following items are identified by this MOU as controlled:

- adapter tubes
- distilling apparatus
- encapsulating machines
- filter, buchner, and separatory funnels
- heating mantles
- tableting machines
- transformers
- condensers
- distilling flasks
- Erlenmeyer, two-necked, single neck, round bottom, thermometer, and filtering flasks
- flask heaters
- Soxhlet extractors
- three-necked flasks
- vacuum dryers

To dispose of the above listed items, first try to find another lab group at The University that can use them. If that is not possible, contact OEHS HazMat Division at 471-3511. They can be disposed of in the "glass only" buckets if they are **broken and unusable.**

II. Broken Glassware

Five gallon plastic buckets are provided to laboratories for the storage and removal of discarded glassware. This program is operated through Custodial Services at 471-5072. The buckets are usually identified with a "glass only" label. As the buckets become full, Custodial Services will empty them. Call Custodial Services if you need a bucket for discarded glassware.

Most discarded and empty glassware should be placed into the "glass only" buckets. **Do not** put the following items into a "glass only" bucket:

- Intact, empty chemical containers (affix an "Empty" label to the bottle, then place in the hallway or in the regular trash can)
- Pasteur pipettes - (put in OEHS sharps containers)
- glassware that is contaminated with a potentially infectious material - (put in OEHS sharps containers)
- empty chemical containers that held an acutely hazardous chemical - (dispose of as chemical waste, following OEHS procedures)
- any unbroken and usable glassware listed in the MOU - (carefully break the glassware to render it unusable or call OEHS at 471-3511 for pick-up)

III. Sharps

For a formal definition of sharps, please see Chapter One, II.E

Disposal

All sharps must be placed into sharps containers provided by OEHS. When a sharps container is ready for pick-up, submit a Request for Disposal form for Biological Wastes and Sharps to OEHS. If you need a replacement container, please note this on the form or pick one up at SER 202.

OEHS currently carries four sizes of sharps containers: 1 gallon, 2 gallons, 14 quart (or 3.2 gallons), and 7.5 gallons.

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.

IV. Mixed Wastes

Call OEHS Chemical Safety Coordinator at 471-3511 for counseling.

APPENDICES

Appendix I - Examples of Nonhazardous Chemicals

This list is not all-inclusive.

A

Acid waste (aqueous), neutralized to a pH between 5 and 11.5
(does not contain As, Ba, Cd, Cr, Pb, Hg, Se, Ag, Mn, Ni, Cu, or Zn)
Actin
A-Adenosine, free base
Adenosine 2' & 3'-monophosphate, disodium salt
Adenosine 2' & 3'-monophosphate, free acid
Adenosine 2',3'-cyclic monophosphate, sodium salt
Adenosine 3',5'-cyclic monophosphate, sodium salt
Adenosine 3'-monophosphate, sodium salt
Adenosine 5'-diphosphate, sodium salt
Adenosine 5'-monophosphate
Adenosine 5'-monophosphate, disodium salt
Adenosine 5'-monophosphate, sodium salt
Adonitol; Ribitol
Agar; Bacto agar
Agarose
Alginic acid, sodium salt; Sodium alginate
β-Alanine
DL-Alanine
L-Alanine
Albumin, bovine
Albumin, bovine, methylated
Albumin, human
Alcohol dehydrogenase
Aldolase, type X
DL-Aminobutyric acid; GABA
4-Amino-2-methyl-1-naphthol; Vitamin K5
Amylase
α-Amylase, type II-A
α-Amylase, type VI-B
β-Amylase, sweet potato
Amyloglucosidase
Amylose
Apyrase, grade VI
D-Arabinose
L(+) Arabinose
D-Arabitol
Arginase
Arginine
L-(+)-Arginine
D-Asparagine, monohydrate
DL-Asparagine
L-Asparagine
Aspartamene; Asp-phe methyl ester; L-Aspartyl-L-phenylalanine methyl ester
D-Aspartic acid
DL-Aspartic acid
L-Aspartic acid
L-Aspartic acid, monosodium salt
Autex developer and replenisher

B

Baclofen
Bacto peptone; Peptone
Base waste (aqueous), neutralized to a pH between 5 and 11.5 (does not contain As, Ba, Cd, Cr, Pb, Hg, Se, Ag, Mn, Ni, Cu, or Zn)
Bayberry wax
Bentonite
β-Glucuronidase, type VIII
Betaine
Bicuculline
Bile salts
Biocytin
Bromelain

C

Calcium citrate
Calcium phosphate, monobasic
Calcium sulfate (Drierite)
Carbachol chloride
Carbonic anhydrase
Carboxymethyl cellulose
Carboxypeptidase B, type I
Carboxypeptidase Y
Carminic acid
Carrageenan, type II
β-Carotene type IV; Carotene type III; Carotene, trans-β
Carrageenan, type IV
Casein
Cellobiose, D(+)
Cellulase type I, II, V, VI, and VII
Cellulose
Chalk; Protexulate; Calcium carbonate
Chitin
2-Chloroadenosine (upto 15 mM)
Chondroitin sulfate A, sodium salt
CM Cellulose powder
L-Citrulline
Cocarboxylase
Coenzyme A, sodium salt
Collagen
Collagenase
α-Chymotrypsinogen A
DL-Cystine
Cytidine 2'&3'-monophosphate, free acid
Cytidine 2'-monophosphate, sodium salt
Cytidine 5'-triphosphate, sodium salt
Cytosine

D

Dehydroisoandrosterone 3-sulfate, sodium salt dihydrate
2'-Deoxyadenosine 5'-triphosphate
Deoxyepinephrine hydrochloride
Deoxyribonucleic acid, type XV
2-Deoxy-D-ribose
Deuterium oxide
Dextran
Dextrose
2',4'-Dimethylacetophenone
DNA Polymerase I

E

EDTA
Egg albumin
Elastase, type III
Elastin-orcein
Enolase
D-Erythrose

F

Fibrin
Fibrinogen, human type I
Fibronectin
Flavin adenine dinucleotide
Folic acid
Fomblin oil
D-Fructose
β-D(-)-Fructose
D-Fructose-1,6-diphosphatase
Fumaric acid, potassium salt
Fumaric acid, sodium salt

G

Gelatin
Glass beads
α-Glucosidase, type I
β-Glucosidase
β-D(+)Glucose
L-Glucose
Glucose 6-phosphate dehydrogenase
Glucose-6-phosphate
Glutamic acid
D-Glutamic acid
DL-Glutamic acid
L-Glutamic acid
DL-Glutamic acid, monohydrate
L-Glutamine in saline
Glycerin
D-glycogen
Guanosine 3',5'-cyclic monophosphate, sodium salt
Guanosine 3'-monophosphate, sodium salt
Guanosine 5'-monophosphate
Guar gum
Gum, karaya
Gum, xanthan

H

Heavy water (deuterium oxide)
Hematin
Hemin
Hemoglobin
Hexokinase
Histone
Hyaluronidase, type I-S
Hydrocortisone
Hydrocortisone acetate
DL-Histidine
DL-Homoserine
Hydrogen peroxide (3% or below)

I-J

Immunoglobulins (IgA, IgM, IgG, IgD, IgE)
Ilford ID 11 (working solution concentration)
Ilford 2000 RT developer #741759 (working solution concentration)
Ilford 2150 XL developer #741816 (working solution concentration)
Insulin
Invertase, grade V
Iron filings
DL-Isoleucine
Isoproterenol (up to 150 mM)

K

Kaolin
Kodak developer D-11 (working solution concentration)
Kodak developer D-19 (working solution concentration)
Kodak developer D-76 (working solution concentration)
Kodak dektol developer (working solution concentration)
Kodak microdol X-developer (working solution concentration)
Kodak Technidol developer (working solution concentration)
Kodalith developer A:B = 1:1 (working solution concentration)

L

L-Lactic dehydrogenase, type XI
L-Proline
L-Serine
L-Sorbose
L-Threonine
L-Valine
D-Lactic dehydrogenase
Lactoferrin
β-Lactoglobulin
α-Lactose
Lectin
Lectin from glycine max
Lectin from triticum vulgaris peroxidase labeled
DL-Leucine
Locust bean gum (carob flour)
Lysozyme, grade I (chicken egg)

M

Magnesium hydroxide
Magnesium sulfate
D-(+)-Maltose, monohydrate
α-D(+)-Melibiose
Methyl cellulose
Monoamine oxidase
MXR RP-HC developer (working solution concentration)
Myoglobin, human
Myokinase

N - O

A-NADP, tetrasodium salt; A-Nicotinamide adenine dinucleotide phosphate
NADP; Nicotinamide adenine dinucleotide phosphate
B-Nicotinamide adenine dinucleotide agarose
B-Nicotinamide adenine dinucleotide phosphate, tetrasodium salt
B-Nicotinamide adenine dinucleotide, disodium salt
B-Nicotinamide mononucleotide
Naloxone
Nerve growth factor
Neuraminidase, type X and type VIII
Nifedipine
Nimodipine

P - Q

p-Hydroxybenzoic acid propyl ester
Pantothenic acid
Pantothenic acid, hemicalcium salt; Calcium pantothenate; Vitamin B5, calcium salt
DL-Pantothenic acid, hemicalcium salt
Pectin
Pectinase
Penicillinase, type I
Phentalamine (up to 1500 mM)
Phenylephrine (up to 200 mM)
Phosphatase alkaline, type VII-NT, bovine
Phosphodiesterase
Phosphodiesterase 3',5'-cyclic nucleotide
Polymeric materials, epoxys, adhesives and glues (Hardened, reacted, dried or solidified)
Polyethylene glycol
Polyvinyl alcohol
Potassium bitartarate; Potassium hydrogen tartarate; Cream of Tartar
Potassium sulfate
Potassium thiosulfate
Proline
DL-Proline
Propylene glycol
Prostaglandin F1A antiserum from rabbit
Protease inhibitor from rabbit skeletal muscle
Pyridoxal phosphate

R

Rennin
Riboflavin
D-Ribose 5-phosphate, disodium salt
Ribonuclease A; Ribonuclease S; Ribonuclease T1
Rosin gum; Rosin wood

S

Saline solution (Less than 50% sodium chloride in water)
Sarcosine
DL-Serine
Sodium ascorbate; Vitamin C, sodium
Sodium chloride
Sodium citrate
Sodium phosphate
Sodium sulfate
D-Sorbitol
Starch
Streptokinase
Strontium sulfate
Succinamide
Sucrose; table sugar

T-U

DL-Threonine
Thyroglobulin, bovine
Tragacanth gum
Transferrin, human
Triethylene glycol
Triolein
Tris buffer (up to 0.1 M)
Tropomyosin
Trypsin inhibitor

V-W

Valine
D-Valine
Vitamin K1; Phylloquinone; 2-methyl-3-phytyl-1,4-naphthoquinone

X-Y-Z

Xanthine oxidase
Xylitol
D-Xylose

Appendix II - 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 III - 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

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

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

Appendix IV - The Environmental Protection Agency's P List (Acutely Hazardous Chemicals)

CAS Number	Chemical Name
107-20-0	Acetaldehyde, chloro-
591-08-2	Acetamide, N-(aminothioxomethyl)-
640-19-7	Acetamide, 2-fluoro-
62-74-8	Acetic acid, fluoro-, sodium salt
591-08-2	1-Acetyl-2-thiourea
107-02-8	Acrolein
116-06-3	Aldicarb
309-00-2	Aldrin
107-18-6	Allyl alcohol
20859-73-8	Aluminum phosphide
2763-96-4	5-(Aminomethyl)-3-isoxazolol
504-24-5	4-Aminopyridine
131-74-8	Ammonium picrate
7803-55-6	Ammonium vanadate
506-61-6	Argentate (1-), bis(cyano-C)-, potassium
7778-39-4	Arsenic acid
1327-53-3	Arsenic oxide
1303-28-2	Arsenic pentoxide
1327-53-3	Arsenic trioxide
692-42-2	Arsine, diethyl-
696-28-6	Arsonous dichloride, phenyl-
151-56-4	Aziridine
75-55-8	Aziridine, 2-methyl-
542-62-1	Barium cyanide
106-47-8	Benzeneamine, 4-chloro-
100-01-6	Beneneamine, 4-nitro-
100-44-7	Benzene, (chloromethyl)-
51-43-4	1,2-Benzenediol, 4-[1-hydroxy-2-(methylamino)ethyl]-
12-09-8	Benzeneethanamine, alpha, alpha-dimethyl-
108-98-5	Benzenethiol
81-81-2	2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenylbutyl)-, & salts
100-44-7	Benzyl chloride
7440-41-7	Beryllium powder
598-31-2	Bromoacetone
357-57-3	Brucine
39196-18-4	2-Butanone, 3,3-dimethyl-1-(methylthio)-O-[(methylamino)carbonyl]oxime
592-01-8	Calcium cyanide
75-15-1	Carbon disulfide
75-44-5	Carbonic dichloride
107-20-0	Chloroacetaldehyde
106-47-8	p-Chloroaniline
5344-82-1	1-(o-Chlorophenyl)thiourea
542-76-7	3-Chloropropionitrile
544-92-3	Copper cyanide
----------	Cyanide salts (soluble)
460-19-5	Cyanogen
506-77-4	Cyanogen chloride
131-89-5	2-Cyclohexyl-4,6-dinitrophenol
542-88-1	Dichloromethyl ether
696-28-6	Dichlorophenylarsine

CAS Number	Chemical Name
60-57-1	Dieldrin
692-42-2	Diethylarsine
311-45-5	Diethyl-p-nitrophenyl phosphate
297-97-2	O,O-Diethyl O-pyrazinyl phosphorothioate
55-91-4	Diisopropylfluorophosphate (DFP)
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)-
465-73-6	1,4,5,8-Dimethanonaphtahalen, 1,2,3,4,10,10,hexa- chloro-1,4,4a,5,8,8a-hexahydro-, (1alpha, 4alpha, 4abeta, 5beta, 8beta, 8abeta)-
60-57-1	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexa- chloro- 1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta,2aalpha,3beta,6beta,6aalpha,7beta,7aalpha)-
72-20-8	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro- 1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta,2abeta,3alpha,6alpha,6abeta,7beta,7aalpha)- & metabolites
60-51-5	Dimethoate
122-09-8	alpha,alpha-Dimethylphenethylamine
534-52-1	4,6-Dinitro-o-cresol, & salts
51-28-5	2,4-Dinitrophenol
88-85-7	Dinoseb
152-16-9	Diphosphoramide, octamethyl-
107-49-3	Diphosphoric acid, tetratethyl ester
298-04-4	Disulfoton
541-53-7	Dithiobiuret
115-29-7	Endosulfan
145-73-3	Endothall
72-20-8	Endrin & metabolites
51-43-4	Epinephrine
460-19-5	Ethanedinitrile
16752-77-5	Ethanimidothioic acid, N[[(methylamino)carbonyl] oxy]-, methyl ester
107-12-0	Ethyl cyanide
151-56-4	Ethyleneimine
52-85-7	Famphur
7782-41-4	Fluorine
640-19-7	Fluoroacetamide
62-74-8	Fluoroacetic acid, sodium salt
628-86-4	Fulminic acid, mercury(2+) salt
76-44-8	Heptachlor
757-58-4	Hexaethyl tetraphosphate
79-19-6	Hydrazinecarbothioamide
60-34-4	Hydrazine, methyl-
74-90-8	Hydrocyanic acid
74-90-8	Hydrogen cyanide
7803-51-2	Hydrogen phosphide
465-73-6	Isodrin
2763-96-4	3(2H)-Isoxazolone, 5-(aminomethyl)-
62-38-4	Mercury, (aceto-O)phenyl-
628-86-4	Mercury fulminate
62-75-9	Methanamine, N-methyl-N-nitroso-
624-83-9	Methane, isocyanato-
542-88-1	Methane, oxybis(chloro-
509-14-8	Methane, tetranitro-
75-70-7	Methanethiol, trichloro-
115-29-7	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexacloro- 1,5,5a,6,9,9a-hexahydro-, 3-oxide
76-44-8	4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-

CAS Number	Chemical Name
16752-77-5	Methomyl
60-34-4	Methyl hydrazine
624-83-9	Methyl isocyanate
75-86-5	2-Methyllactonitrile
298-00-0	Methyl parathion
86-88-4	alpha-Naphthylthiourea
13463-39-3	Nickel carbonyl
557-19-7	Nickel cyanide
54-11-5	Nicotine & salts
10102-43-9	Nitric oxide
100-01-6	p-Nitroaniline
10102-44-0	Nitrogen dioxide
10102-43-9	Nitrogen oxide
55-63-0	Nitroglycerine
62-75-9	N-Nitrosodimethylamine
4549-40-0	N-Nitrosomethylvinylamine
152-16-9	Octamethylpyrophosphoramide
20816-12-0	Osmium oxide
20816-12-0	Osmium tetroxide
145-73-3	7-Oxabicyclo(2,2,1)heptane-2,3-dicarboxylic acid
56-38-2	Parathion
131-89-5	Phenol, 2-cyclohexyl-4,6-dinitro-
51-28-5	Phenol, 2,4-dinitro-
534-52-1	Phenol, 2-methyl-4,6-dintro-, & salts
88-85-7	Phenol, 2-(1-methylpropyl)-4,6-dinitro-
131-74-8	Phenol, 2,4,6-trinitro- , ammonium salt
62-38-4	Phenylmercury acetate
103-85-5	Phenylthiourea
298-02-2	Phorate
75-44-5	Phosgene
7803-51-2	Phosphine
311-45-5	Phosphoric acid, diethyl 4-nitrophenyl ester
298-04-4	Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)ethyl] ester
298-02-2	Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)methyl] ester
60-51-5	Phosphorodithioic acid, O,O-dimethyl S-[2-(methylamino)-2-oxoethyl]ester
55-91-4	Phosphorofluoridic acid, bis(1-methylethyl) ester
56-38-2	Phosphorothioic acid, O,O-diethyl O-(4-nitrophenyl) ester
297-97-2	Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester
52-85-7	Phosphorothioic acid, O-[4-[(dimethylamino)sulfonyl]phenyl] O,O-dimethyl ester
298-00-0	Phosphorothioic acid, O,O,-dimethyl O-(4-nitrophenyl) ester
78-00-2	Plumbane, tetraethyl-
151-50-8	Potassium cyanide
506-61-6	Potassium silver cyanide
116-06-3	Propanal, 2-methyl-2-(methylthio)-O-[(methylamino)carbonyl] oxime
107-12-0	Propanenitrile
542-76-7	Propanenitrile,3-chloro
75-86-5	Propanenitrile, 2-hydroxy-2-methyl
55-63-0	1,2,3-Propanetriol, trinitrate
598-31-2	2,Propanone, 1-bromo
107-19-7	Propargyl alcohol
107-02-8	2-Propenal
107-18-6	2-Propen-1-ol
75-55-8	1,2-Propylenimine

CAS Number	Chemical Name
107-19-7	2-Propyn-1-ol
504-24-5	4-Pyridinamine
54-11-5	Pyridine,3-(1-methyl-2-pyrrolidinyl)- & salts
12039-52-0	Selenious acid, dithallium (1+) salt
630-10-4	Selenourea
506-64-9	Silver cyanide
26628-22-8	Sodium azide
143-33-9	Sodium cyanide
57-24-9	Strychnidin-10-one, & salts
357-57-3	Strychnidin-10-one, 2,3-dimethoxy-
57-24-9	Strychnine, & salts
7446-18-6	Sulfuric acid, dithallium (1+) salt
3689-24-5	Tetraethyldithiopyrophosphate
78-00-2	Tetraethyl lead
107-49-3	Tetraethyl pyrophosphate
509-14-8	Tetranitromethane
757-58-4	Tetraphosphoric acid, hexaethyl ester
1314-32-5	Thallic oxide
12039-52-0	Thallium(I) selenite
7446-18-6	Thallium(I) sulfate
3689-24-5	Thiodiphosphoric acid, tetraethyl ester
39196-18-4	Thiofanox
541-53-7	Thioimidodicarbonic diamide
108-98-5	Thiophenol
79-19-6	Thiosemicarbazide
5344-82-1	Thiourea, (2-chlorphenyl)-
86-88-4	Thiourea, 1-naphthalenyl-
103-85-5	Thiourea, phenyl-
8001-35-2	Toxaphene
75-70-7	Trichloromethanethiol
7803-55-6	Vanadic acid, ammonium salt
1314-62-1	Vandium oxide
1314-62-1	Vanadium pentoxide
4549-40-0	Vinylamine, N-methyl-N-nitroso-
81-81-2	Warfarin, & salts, greater than 0.3%
557-21-1	Zinc cyanide
1314-84-7	Zinc phosphide

Appendix V - The Environmental Protection Agency's U List

Comment: For the convenience of the regulated community, the primary hazardous properties of these materials have been indicated by the letters T (Toxicity), R (Reactivity), I (Ignitability) and C (Corrosivity). Absence of a letter indicates that the compound is only listed for toxicity.

Chemicals in bold are commonly found in laboratories.

CAS Number	Chemical Name
30558-43-1	A2213
75-07-0	**Acetaldehyde (I)**
75-87-6	Acetaldehyde, trichloro-
62-44-2	Acetamide, N-(4-ethoxyphenyl)-
53-96-3	Acetamide, N-9H-fluoren-2-yl-
94-75-7	Acetic acid, (2,4-dichlorophenoxy)-, salts & esters
141-78-6	Acetic acid, ethyl ester (1)
301-04-2	Acetic acid, lead (2) salt
563-68-8	Acetic acid, thallium (1) salt
93-76-5	Acetic acid. (2,4,5-trichlorophenoxy)
67-64-1	**Acetone (I)**
75-05-8	**Acetonitrile (I,T)**
98-86-2	**Acetophenone**
53-96-3	2-Acetylaminofluorene
75-36-5	**Acetyl chloride (C,R,T)**
79-06-1	Acrylamide
79-10-7	Acrylic acid (I)
107-13-1	Acrylonitrile
61-82-5	Amitrole
62-53-3	**Aniline (I,T)**
75-60-5	Arsinic acid, dimethyl-
492-80-8	Auramine
115-02-6	Azaserine
2212-67-1	H-Azepine 1-carbothioic acid, hexchydro-, S-ethylester.
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-, [laS-(la-alpha, 8beta,8aalpha,8balpha)]-
101-27-9	Barban
22781-23-3	Bendiocarb
22961-82-6	Bendiocarb phenol
17804-35-2	Benomyl
56-49-5	Benz(j)aceanthrylene, 1 2-dihydro-3-methyl-
225-51-4	Benz(c)acridine
98-87-3	Benzal chloride
23950-58-5	Benzamide,3,5-dichloro-N-(l,l-dimethyl-2-propynyl)-
56-55-3	Benz(a)anthracene
57-97-6	Benz(a)anthracene, 7,12-dimethyl-
62-53-3	Benzenamine (I,T)
492-80-8	Benzenamine, 4,4'-carbon-imidoylbis(N,N-dimethyl-
3165-93-3	Benzenamine, 4-chloro-2-methyl-, hydrochloride
60-11-7	Benzenamine, N-N-dimethyl-4-(phenylazo)-
95-53-4	Benzenamine, 2-methyl-
106-49-0	Benzenamine, 4-methyl-
101-14-4	Benzenamine 4,4'-methylene-bis(2-chloro-
636-21-5	Benzenamine 2-methyl-,hydrochloride

CAS Number	Chemical Name
99-55-8	Benzenamine, 2-methyl-5-nitro
71-43-2	**Benzene** (I,T)
510-15-6	Benzeneacetic acid, 4-chloro-alpha-(4-chlorophenyl)-alpha-hydroxy-, ethyl ester
101-55-3	Benzene, 1-bromo-4-phenoxy
305-03-3	Benzenebutanoic acid, 4-(bis(2-chloroethyl)amino)
108-90-7	Benzene, chloro
25376-45-8	Benzenediamine, armethyl
117-81-7	1 2-Benzenedicarboxylic acid, bis(2-ethylhexyl)ester
84-74-2	1 2-Benzenedicarboxylic acid, dibutyl ester
84-66-2	1 2,-Benzenedicarboxylic acid, diethyl ester
131-11-3	1,2-Benzenedicarboxylic acid, dimethyl ester
117-84-0	1 2-Benzenedicarboxylic acid, dioctyl ester
95-50-1	Benzene, 12-dichloro
541-73-1	Benzene, 1,3-dichloro
106-46-7	Benzene, 1,4-dichloro
72-54-8	Benzene, 1, 1'-(2,2-dichloro-ethylidene)bis(4-chloro
98-87-3	Benzene, (dichloromethyl)
26471-62-5	Benzene 1,3-diisocyanato-methyl-(R,T)
1330-20-7	Benzene, dimethyl-(I,T)
108-46-3	1,3-Benzenediol
118-74-1	Benzene, hexachloro-
110-82-7	Benzene, hexahydro- (I)
108-88-3	Benzene, methyl-
121-14-2	Benzene, l-methyl-2,4-dintro-
606-20-2	Benzene, 2-methyl-1, 3-dinitro-
98-82-8	Benzene, (l-methylethyl)- (I)
98-95-3	Benzene, nitro-
608-93-5	Benzene, pentachloro-
82-68-8	Benzene, pentachloronitro-
98-09-9	Benzenesuffonic acid chloride (C,R)
98-09-9	Benzenesulfonyl Chloride (C,R)
95-94-3	Benzene, 1,2,4,5-tetrachloro-
50-29-3	Benzene, 1,1'-(2,2,2-trichloroethylidene)bis(4-chloro-
72-43-5	Benzene, 1,1'(2,2,2-trichloroethylidene)bis (4methoxy-
98-07-7	Benzene, (trichloromethyl)-
99-35-4	Benzene, 1,3,5-trinitro- (R,T)
92-87-5	Benzidine
181-07-2	1,2-Benzisothiazol-3(2H)-one, 1,1-dioxide and salts
94-59-7	1,3-Benzadioxole, 5-(2-pro-penyl)-
120-58-1	1,3-Benzodioxole, 5-(1-pro-penyl)-
94-58-6	1,3-Benzodioxole, 5-propyl-
22781-23-3	1,3 Benzodioxol-4 ol, 2,2-dimethyl-, methyl carbamate
22961-82-6	1,3 Benzodioxol-4 ol, 2,2-dimethyl-,
1563-38-8	7-Benzofuranol, 2,3-dihydro-2,2-dimethyl
189-55-9	Benzo(rst)pentaphene
181-81-2	2H-1-Benzopyran-2-one, 4–hydroxy-3-(3-oxo-1-pheny-butyl), & salts, when present at concentrations of 0.3% or less
50-32-8	Benzo(a)pyrene
106-51-4	p-Benzoquinone
98-07-7	Benzotrichloride (C,R,T)
1464-53-5	2,2'-Bioxirane
92-87-5	(1,1 '-Biphenyl)-4,4'diamine
91-94-1	(1,1'Biphenyl)-4,4'-diamine,3,3'-dichloro-

CAS Number	Chemical Name
119-90-4	(1,1'-Biphenyl)-4,4'-diamine,3,3'-dimethoxy-
119-93-7	(1,1'-Biphenyl)-4,4'-diamine, 3,3'-dimethyl
75-25-2	Bromoform
101-55-3	4-Bromophenyl phenyl ether
87-68-3	1,3-Butadiene, 1,1,2,3,4,4-hexacloro-
924-16-3	1-Butanamine, N-butyl-N-nitroso-
71-36-3	**1-Butanol** (I)
78-93-3	2-Butanone (I,T)
1338-23-4	2-Butanone, peroxide (R,T)
4170-30-3	2-Butenal
764-41-0	2-Butene, 1,4-dichloro- (I,T)
303-34-4	2-Butenoic acid,2-methyl-, 7-[(2,3-dihydroxy-2-(1-methoxyethyl)-3-methyl-1-oxobutoxy) methyl]-2,3,5,7a-tetrahydro-1-pyrrolizin-l-yl ester, (lS-(lalpha(Z), 7(2S*, 3R*), 7aalpha
71-36-3	**n-Butyl alcohol** (I)
2008-41-5	Butylate
75-60-5	Cacodylic acid
13765-19-0	Calcium chromate
51-79-6	Carbamic acid, ethyl ester
615-53-2	Carbamic acid, methylnitroso-, ethyl ester
10605-21-7	Carbamic acid, 1 H-benzimidazol-2yl, methyl ester
17804-35-2	Carbamic acid, (l-[(butylamino)carbonyl)]-H-benzimidazol-2-yl)-, methyl ester
55406-53-6	Carbamic acid, butyl-,3-iodo-2-propynyl ester
101-27-9	Carbamic acid, (3-chlorophenyl)-, 4-chloro-2-butynyl ester
122-42-9	Carbamic acid, phenyl-, 1-methylethyl ester
23564-05-8	Carbamic acid, [1,2-phenylenebis (iminocarbonothioyl) bis-, dimethyl ester
79-44-7	Carbamic chloride, dimethyl-
136-30-1	Carbamodithioic acid, dibutyl, sodium salt
95-06-7	Carbamodithioic acid, diethyl-,2-chloro-2-propenyl ester
148-18-5	Carbamodithioic acid, diethyl-, sodium salt
128-03-0	Carbamodithioic acid, dimethyl, potassium salt
128-04-1	Carbamodithioic acid, dimethyl, sodium salt
144-34-3	Carbamodithioic acid, dimethyl, tetraanhydrosulfide with orthothioselenious acid
1111-54-6	Carbamodithioic acid, 1,2-ethane-diylbis-,salts and esters
51026-28-9	Carbamodithioic acid, (hydroxymethyl)methyl-, monopotassium salt
137-42-8	Carbamodithioic acid, methyl-, monosodium salt
137-41-7	Carbamodithioic acid, methyl-, monopotassium salt
2303-16-4	Carbamothioic acid, bis(l-methylethyl)-, S-(2,3-dichloro-2-propenyl) ester
2303-17-5	Carbamothioic acid. bis(l-methylethyl)-, S-(2,3,3-trichloro-2-propenyl) ester
2008-41-5	Carbamothioic acid bis(2-methylpropyl)-, S-ethyl ester
1114-71-2	Carbamothioic acid, butylethyl-, S-propyl ester
1134-23-2	Carbamothiolc acid, cyclohexylethy-, S-ethyl ester
759-94-4	Carbamothioic acid, dipropyl-, S-ethyl ester
52888-80-9	Carbamothioic acid, dipropyl-, S-(phenylmethyl) ester
1929-77-7	Carbamothioic acid, dipropyl-, S-propyl ester
63-25-2	Carbaryl
10605-21-7	Carbendazim
1563-38-8	Carbofuran phenol
6533-73-9	Carbonic acid, dithallium (1+) salt
353-50-4	Carbonic difluoride
79-22-1	Carbonochloridic acid, methyl ester (I.T)
353-50-4	Carbon oxyfluoride (R,T)
56-23-5	**Carbon tetrachloride**
75-87-6	Chloral

CAS Number	Chemical Name
305-03-3	Chlorambucil
57-74-9	Chlordane, alpha & gamma isomers
494-03-1	Chlornaphazin
108-90-7	**Chlorobenzene**
510-15-6	Chlorobenzilate
59-50-7	p-Chloro-m-cresol
110-75-8	2-Chloroethyl vinyl ether
67-66-3	**Chloroform**
107-30-2	Chloromethyl methyl ether
91-58-7	beta-Chloronaphthalene
95-57-8	o-Chlorophenol
3165-93-3	4-Chloro-o-toluidine, hydrochloride
13765-19-0	**Chromic acid** H2CrO4, calcium salt
218-01-9	Chrysene
137-29-1	Copper, bis(dimethylcarbamodithioato-S,S')-
137-29-1	Copper dimethyldithiocarbamate
	Creosote
1319-77-3	Cresols (Cresylic acid)
4170-30-3	Crotonaldehyde
98-82-8	Cumene (I)
506-68-3	Cyanogen bromide (CN)Br
1134-23-2	Cycloate
106-51-4	2,5-Cyclohexadiene-1,4-dione
110-82-7	**Cyclohexane** (I)
58-89-9	Cyclohexane, 1,2,3,4,5,6-hexachloro-(1alpha,2alpha, 3beta,4alpha,5alpha, 6beta)-
108-94-1	Cyclohexanone (I)
77-47-4	1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-
50-18-0	Cyclophosphamide
194-75-7	2,4-D, salts and esters
533-74-4	Dazomet
20830-81-3	Daunomycin
72-54-8	DDD
50-29-3	DDT
2303-16-4	Diallate
53-70-3	Dibenz(a.h)anthracene
189-55-9	Dibenzo(a,i)pyrene
96-12-8	1,2-Dibromo-3-chloropropane
84-74-2	Dibutyl phthalate
95-50-1	o-Dichlorobenzene
541-73-1	m-Dichlorobenzene
106-46-7	p-Dichlorobenzene
91-94-1	3,3'-Dichlorobenzidine
764-41-0	1,4-Dichloro-2-butene (I,T)
75-71-8	Dichlorodifluoromethane
75-35-4	1,1-Dichloroethylene
156-60-5	1,2-Dichloroethylene
111-44-1	Dichloroethyl ether
108-60-1	Dichloroisopropyl ether
111-91-1	Dichloromethoxy ethane
120-83-2	2,4-Dichlorophenol
87-65-0	2,6-Dichlorophenol
78-87-5	1,2-Dichloropropane
542-75-6	1,3-Dichloropropene

CAS Number	Chemical Name
1464-53-5	1,2:3,4-Diepoxybutane (I,T)
123-91-1	1,4-Diethyleneoxide
5952-26-1	Diethylene glycol, dicarbamate
117-81-7	Diethylhexyl phthalate
1615-80-1	N,N'-Diethylhydrazine
3288-58-2	O,O-Diethyl S-methyl dithiophosphate
84-66-2	Diethyl phthalate
56-53-1	Diethylstilbesterol
94-58-6	Dihydrosafrole
119-90-4	3,3'-Dimethoxybenzidine
124-40-3	Dimethylamine (I)
60-11-7	p-Dimethylaminoazobenzene
57-97-6	7,12-Dimethylbenz(a) anthracene
119-93-7	3,3'-Dimethylbenzidine
80-15-9	alpha,alpha-Dimethylbenzyl hydroperoxide (R)
79-44-7	Dimethylcarbamoyl chloride
540-73-8	1,1-Dimethylhydrazine
540-73-8	1,2-Dimethylhydrazine
105-67-9	2,4-Dimethylphenol
131-11-3	Dimethyl phthalate
77-78-1	**Dlmethyl sulfate**
121-14-2	2,4-Dinitrotoluene
606-20-2	2,6-Dinitrotoluene
117-84-0	Di-n-octyl phthalate
123-91-1	**1,4-Dioxane**
122-66-7	**1,2-Diphenylhydrazine**
142-84-7	Dipropylamine (I)
97-77-8	Disulfiram
621-64-7	Di-n-propylnitrosamine
106-89-8	Epichlorohydrin
759-94-4	EPTC
75-07-0	Ethanal (I)
55-18-5	Ethanamine, N-ethyl-N-nitroso-
101-44-8	Ethanamine, N,N-diethyl-
91-80-5	1,2-Ethanediamine, N,N-dimethyl-N'-2-pyridinyl-N'-(2-thienylmethyl)
106-93-4	Ethane,1,2-dibromo-
75-34-3	Ethane, 1,1-dichloro-
107-06-2	Ethane, 1,2-dichloro-
67-72-1	Ethane, hexachloro-
111-91-1	Ethane, 1,1'-(methylenebis-(oxy))bis(2-chloro-
60-29-7	Ethane, 1,1'-oxybis- (I)
111-44-4	Ethane, 1,1'-oxybis(2-chloro-
76-01-7	Ethane, pentachloro-
630-20-6	Ethane, 1,1,1,2-tetrachloro-
79-34-5	Ethane, 1,1,2,2-tetrachloro-
62-55-5	Ethanethioamide
71-55-6	Ethane, 1,1,1-trichloro-
79-00-5	Ethane, 1,1,2-trichloro-
59669-26-0	Ethanimidothioic acid, N,N'-(thiobis((methylimino)carbonyloxy)) bis-, dimethyl ester
30558-43-1	Ethanimidothioic acid, 2-(dimethylamino)-N-hydroxy-2-oxo-, methyl ester
110-80-5	Ethanol, 2-ethoxy-
1116-54-7	Ethanol, 2,2'-(nitrosoimino)bis
5952-26-1	Ethanol, 2,2'-oxybis-, dicarbamate

CAS Number	Chemical Name
98-86-2	Ethanone, 1-phenyl-
75-01-4	Ethene, chloro-
110-75-8	Ethene, (2-chloroethoxy)-
75-35-4	Ethene, 1,1-dichloro-
156-60-5	Ethene, 1,2-dichloro-,(E)
127-18-4	Ethene, tetrachloro-
79-01-6	Ethene, trichloro-
141-78-6	**Ethyl acetate** (I)
140-88-5	Ethyl acrylate (I)
51-79-6	Ethyl carbamate (urethane)
60-29-7	**Ethyl ether** (I)
14324-55-1	Ethyl Ziram
111-54-6	Ethylenebisdithiocarbamic acid, salts and esters
106-93-4	Ethylene dibromide
107-06-2	Ethylene dichloride
110-80-5	Ethylene glycol monoethyl ether
75-21-8	Ethylene oxide (I,T)
96-45-7	Ethylenethiourea
75-34-3	Ethylidene dichloride
97-63-2	Ethyl methacrylate
62-50-0	Ethyl methanesulfonate
14484-64-1	Ferbam
206-44-0	Fluoranthene
50-00-0	**Formaldehyde**
64-18-6	**Formic acid** (C,T)
110-00-9	Furan (I)
98-01-1	2-Furancarboxaldehyde (I)
108-31-6	2,5-Furandione
109-99-9	Furan, tetrahydro- (I)
98-01-1	Furfural (I)
110-00-9	Furfuran (I)
18883-66-4	Glucopyranose, 2-deoxy-2-(3-methyl-3-nitrosoureido)-D-
18883-66-4	D-Glucose 2-deoxy-2-(((methylnitroso-amino)-carbonyl)amino)-
765-34-4	Glycidylaldehyde
70-25-7	Guanidine, N-methyl-N'-nitro-N-nitroso-
118-74-1	Hexachlorobenzene
87-68-3	Hexachlorobutadiene
77-47-4	Hexachlorocylopentadiene
67-72-1	Hexachloroethane
70-30-4	Hexachlorphene
1888-71-7	Hexachloropropene
302-01-2	Hydrazine (R,T)
1615-80-1	Hydrazine, 1,2-diethyl
57-14-7	Hydrazine, 1,1-dimethy
540-73-8	Hydrazine, 1,2-dimethyl
122-66-7	Hydrazine, 1,2-diphenyl
7664-39-3	**Hydrofluoric acid** (C,T)
7664-39-3	Hydrogen fluoride (C,T)
7783-06-4	Hydrogen sulfide
7783-06-4	Hydrogen sulfide H2S
80-15-9	Hydroperoxide, 1-methyl-1-phenylethyl- (R)
96-45-7	2-Imidazolidinethione
193-39-5	Indeno(1 2,3-cd)pyrene

CAS Number	Chemical Name
55406-53-6	3-Iodo-2-propynyl n-butylcarbamate
14484-64-1	Iron, tris (dimethylcarbamodithioato-S,S')-
85-44-9	1,3-Isobenzofurandione
78-83-1	**Isobutyl alcohol** (I,T)
120-58-1	Isosafrole
143-50-0	Kepone
303-34-4	Lasiocarpine
301-04-2	Lead acetate
1335-32-6	Lead, bis(acetato-O)tetra-hydroxytri-
7446-27-7	Lead phosphate
1335-32-6	Lead subacetate
58-89-9	Lindane
70-25-7	MNNG
108-31-6	Maleic anhydride
123-33-1	Maleic hydrazide
109-77-3	Malononitrile
148-82-3	Melphalan
7439-97-6	**Mercury**
137-42-8	Metam Sodium
126-98-7	Methacrylonitrile (I,T)
124-40-3	Methanamine, N-methyl- (I)
74-83-9	Methane, bromo-
74-87-3	Methane, chloro- (I,T)
107-30-2	Methane, chloromethoxy-
74-95-3	Methane, dibromo-
75-09-2	**Methane, dichloro**
75-71-8	Methane, dichlorodifluoro-
74-88-4	Methane, iodo-
62-50-0	Methanesulfonic acid, ethyl ester
56-23-5	Methane, tetrachloro-
74-93-1	Methanethiol (I,T)
75-25-2	Methane, tribromo-
67-66-3	Methane, trichloro-
75-69-4	Methane, trichlorofluoro-
57-74-9	4,7-Methano-1 H-indene,1 2,4,5,6,7,8,8-octachloro-2,3,3a,4,7, 7a-hexahydro-
67-56-1	**Methanol** (I)
91-80-5	Methapyrilene
143-50-0	1,3,4-Metheno-2H-cyclobuta(cd)pentalen-2-one, 1,1a,3,3a, 4,5,5,5a,5b,6-decachlorooctahydro-
72-43-5	Methoxychlor
67-56-1	Methyl alcohol (I)
74-83-9	Methyl bromide
504-60-9	1-Methylbutadiene (I)
74-87-3	Methyl chloride (I,T)
79-22-1	Methylchlorocarbonate (I,T)
71-55-6	Methyl chloroform
56-49-5	3-Methylcholanthrene
101-14-4	4,4'-Methylenebis(2-chloroaniline)
74-95-3	Methylene bromide
75-09-2	Methylene chloride
78-93-3	Methyl ethyl ketone (MEK) (I,T)
7338-23-4	Methyl ethyl ketone peroxide (R,T)
74-88-4	Methyl iodide

CAS Number	Chemical Name
108-10-1	Methyl isobutyl ketone (1)
80-62-6	Methyl methacrylate (I,T)
108-10-1	4-Methyl-2-pentanone (1)
56-04-2	Methylthiouracil
50-07-7	Mitomycin C
2212-67-1	Molinate
20830-81-3	5,12-Naphthacenedione, 8-acetyl-10((3-amino-2,3,6-trideoxy)-alpha-L-lyxohexo-pyranosyl) oxy)-7,8,9,10-tetra-hydro-6,8,11-trihydroxy-1-methoxy-, (8S-cis)-
134-32-7	1 -Naphthalenamine
97-59-8	2-Naphthalenamine
494-03-1	Naphthalenamine, N,N'-bis(2-chloroethyl)-
91-20-3	**Naphthalene**
91-58-7	Naphthalene, 2-chloro-
130-15-4	1,4-Naphthalenedione
72-57-1	2,7-Naphthalenedisulfonic acid, 3,3'-((3,3'dimethyl((1,1'biphenyl)-4,4'-diyl))-bis(azo)bi s(5-amino-4-hydroxy)-,tetrasodium salt
63-25-2	1-Naphthalenol, methylcarbamate
130-15-4	1,4-Naphthoquinone
134-32-7	alpha-Naphthylamine
91-59-8	beta-Naphthylamine
10102-45-1	Nitric acid, thallium (1+) saH
98-95-3	Nitrobenzene (I,T)
100-02-7	p-Nitrophenol
79-46-9	2-Nitropropane (I,T)
924-16-3	N-Nitrosodi-n-butylamine
1116-54-7	N-Nitrosodiethanolamine
55-18-5	N-Nitrosodiethylamine
759-73-9	N-Nitroso-N-ethylurea
684-93-5	N-Nitroso-N-methylurea
615-53-2	N-Nitroso-N-methylurethane
100-75-4	N-Nitrosopiperidine
930-55-2	N-Nitrosopyrrolidine
99-55-8	5-Nitro-o-toluidine
1120-71 -4	1,2-Oxathiolane, 2,2-dioxide
50-18-0	2H-1,3,2-Oxazaphosphorin-2-amine, N,N-bis(2-chloroethyl)tetrahydro-, 2-oxide
75-21-8	Oxirane (I,T)
765-34-4	Oxiranecarboxyaldehyde
106-89-8	Oxirane, (chloromethyl)-
123-63-7	Paraldehyde
1114-71-2	Pebulate
608-93-5	Pentachlorobenzene
76-01-7	Pentachloroethane
82-68-8	Pentachloronitrobenzene(PCNB)
87-86-5	Pentachlorophenol
108-10-1	Pentanol, 4-methyl-
504-60-9	1,3-Pentadiene (I)
62-44-2	Phenacetin
108-95-2	**Phenol**
95-57-8	Phenol, 2-chloro-
59-50-7	Phenol, 4-chloro-3-methyl-
120-83-2	Phenol, 2,4-dichloro-
87-65-0	Phenol, 2,6-dichloro-
56-53-1	Phenol, 4,4'-(1,2-diethyl-1,2-ethenediyl)bis-,(E)-

CAS Number	Chemical Name
105-67-9	Phenol, 2,4-dimethyl-
1319-77-3	Phenol, methyl-
70-30-4	Phenol, 2,2'-methylene-bis(3,4,6-trichloro-
114-26-1	Phenol, 2-(1-methylethoxy)-, methylcarbamate
100-02-7	Phenol, 4-nitro-
87-86-5	Phenol, pentachloro-
58-90-2	Phenol, 2,3,4,6-tetrachloro-
95-95-4	Phenol, 2,4,5-trichloro-
88-06-2	Phenol, 2,4,6-trichloro-
148-82-3	L-Phenylalanine, 4-(bis(2-chloroethyl)amino)-
7446-27-7	Phosphoric acid, lead(2) salt (2:3)
3288-58-2	Phophorodithioic acid, O,O-diethyl-, S-methyl, ester
108-95-2	Phosphorous sulfide (R)
85-44-9	Phthalic anhydride
109-06-8	2-Picoline
100-75-4	Piperidine, 1-nitroso-
120-54-7	Piperidine, 1,1'-(tetrathiodicarbonothioyl)-bis-
128-03-0	Potassium dimethyldithiocarbamate
51026-28-9	Potassium n-hydroxymethyl-n-methyldithiocarbamate
137-41-7	Potassium n-methyldithiocarbamate
23950-58-5	Pronamide
107-10-8	1-Propanamine (I,T)
621-64-7	1-Propanamine, N-nitroso-N-propyl-
142-84-7	1-Propanamine, N-propyl- (I)
78-87-5	Propane, 1,2-dichloro-
109-77-3	Propanedinitrile
79-46-9	Propane, 2-nitro- (I,T)
108-60-1	Propane, 2,2'-oxybis(2-chloro-
1120-71-4	1,3-Propane sultone
93-72-1	Propanoic acid, 2-(2,4,5-trichloro-phenoxy)-
126-72-7	1-Propanol, 2,3-dibromo-,phosphate (3: 1)
78-83-1	1-Propanol, 2-methyl- (I,T)
67-64-1	2-Propanone (I)
79-06-1	2-Propenamide
96-12-8	Propane, 1,2-dibromo-3-chloro-
542-75-6	1-Propane, 1,3-dichloro-
1888-71-7	1-Propene, 1,1,2,3,3,3-hexachloro-
107-13-1	2-Propenenitrile
126-98-7	2-Propenenitrile, 2-methyl-(1,T)
79-10-7	2-Propenoic acid (I)
140-88-5	2-Propenoic acid, ethyl ester (I)
97-63-2	2-Propenoic acid, 2-methyl-, ethyl ester
80-62-6	2-Propenolc acid,2-methyl-, methyl ester (I,T)
112-42-9	Propham
114-26-1	Propoxur
107-10-8	n-Propylamine (I,T)
78-87-5	Propylene dichloride
52888-80-9	Prosulfocarb
123-33-1	3,6-Pyridazinedione, 1,2-dihydro-
110-86-1	**Pyridine**
109-06-8	Pyridine, 2-methyl-
66-75-1	2,4(1H,3H)-Pyrimidinedione, 5-(bis(2-chloroethyl)amino)-
56-04-2	4(1H)-Pyrimidione, 2,3-dihydro-6-methyl-2-thioxo-

CAS Number	Chemical Name
930-55-2	Pyrrolidine, 1-nitroso-
50-55-5	Reserpine
108-46-3	**Resorcinol**
81-07-2	Saccharin and salts
94-59-7	Safrole
7783-00-8	Selenious acid
7783-00-8	Selenium dioxide
7488-56-4	Selenium sulfide
7488-56-4	Selenium sulfide SeS2 (R,T)
144-34-3	Selenium, tetrakis (dimethyldithiocarbamate)
115-02-6	L-Serine, diazoacetate (ester)
93-72-1	Silvex (2,4,5-TP)
136-30-1	Sodium dibutyldithiocarbamate
148-18-5	Sodium diethyldithiocarbamate
128-04-1	Sodium dimethyldithiocarbamate
18883-66-4	Streptozotocin
95-06-7	Sulfallate
77-78-1	Sulfuric acid, dimethyl ester
1314-80-3	Sulfur Phosphide (R)
93-76-5	2,4,5-T
1634-02-2	Tetrabutylthiuram disulfide
95-94-3	1,2,4,5,-Tetrachlorobenzene
630-20-6	1,1,1,2-Tetrachloroethane
79-34-5	1,1,2,2-Tetrachloroethane
127-18-4	Tetrachloroethylene
58-90-2	2,3,4,6-Tetrachlorophenol
109-99-9	**Tetrahydrofuran**
97-74-5	Tetramethylthiuram monosulfide
533-74-4	2H-1,3,5-Thiadiazine-2-thione, tetrahydro-3,5-dimethyl-
563-68-8	Thallium(I) acetate
6533-73-9	Thallium(I) carbonate
7791-12-0	Thallium chloride
7791-12-0	Thallium chloride TlCl
10102-45-1	Thallium(I) nitrate
62-55-5	Thioacetamide
59669-26-0	Thiodicarb
74-93-1	Thiomethanol (I,T)
137-26-8	Thioperoxydicarbonic diamide, [(H2N)C(S)]2S2 tetramethyl-
1634-02-2	Thioperoxydicarbonic diamide, tetrabutyl
97-77-8	Thioperoxydicarbonic diamide, tetraethyl
23564-05-8	Thiophanate-methyl.
62-56-6	Thiourea
137-26-8	Thiram
108-88-3	**Toluene**
25376-45-8	Toluenediamine
26471-62-5	Toluene diisocyanate (R,T)
95-53-4	o-Toluidine
106-49-0	p-Toluidine
636-21-5	o-Toluidine hydrochloride
2303-17-5	Triallate
61-82-5	1H-1,2,4-Triazol-3-amine
71-55-6	1,1,1-Trichloroethane
79-00-5	1,1,2-Trichloroethane

CAS Number	Chemical Name
79-01-6	Trichloroethylene
75-69-4	Trichloromonofluoromethane
95-95-4	2,4,5-Trichlorophenol
88-06-2	2,4,6-Trichlorophenol
101-44-8	Triethylamine
99-35-4	1,3,5-Trinitrobenzene (R,T)
123-63-7	1,3,5-Trioxane, 2,4,6-trimethyl-
126-72-7	Tris (2,3-dibromopropyl) phosphate
72-57-1	Trypan blue
66-75-1	Uracil mustard
759-73-9	Urea, N-ethyl-N-nitroso-
684-93-5	Urea, N-methyl-N-nitroso-
1929-77-7	Vernolate
75-01-4	Vinyl chloride
181-81-2	Warfarin and salts, when present at concentrations of 0.3% or less
1330-20-7	**Xylene** (I)
50-55-5	Yohimban-16-carboxylic acid, 11,17-dimethoxy- 18-((3,4,5-trimethoxybenzoyl)oxy)-, methyl ester, (3beta, 16beta, 17alpha,18beta, 20alpha)-
14324-55-1	Zinc, bis(diethylcarbamodithioato-S,S')-
1314-84-7	Zinc phosphide Zn3P2, when present at concentrations of 10% or less