Section 1: Identification of Regulated Wastes

I. Chemical Wastes

II. Biological (or Special) Wastes

III. Radioactive Wastes

IV. Multihazardous 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 Commission on Environmental Quality (TCEQ) 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.

Ignitible 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:

   - *Discharges with a pH below 5.5 or higher than 9.5.*

   - 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 include but is not limited to:

<table>
<thead>
<tr>
<th>Arsenic</th>
<th>Barium</th>
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<tbody>
<tr>
<td>Benzene</td>
<td>Cadmium</td>
</tr>
<tr>
<td>Carbon tetrachloride</td>
<td>Chlordane</td>
</tr>
<tr>
<td>Chlorobenzene</td>
<td>Chloroform</td>
</tr>
<tr>
<td>Chromium (hexavalent)</td>
<td>o-Cresol</td>
</tr>
</tbody>
</table>
m-Cresol  p-Cresol
2,4-Dichlorophenoxyacetic acid  1,4-Dichlorobenzene
1,2-Dichlorethane  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

5. 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.

6. 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  trichloroethylene
     methylene chloride  1,1,1-trichloroethane
     carbon tetrachloride  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  methylene chloride
     trichloroethylene  1,1,1-trichloroethane
     chlorobenzene  1,1,2-trichloro-1,2,2-trifluoroethane
     ortho-dichlorobenzenen  trichlorofluoromethane
     1,1,2-trichloroethan

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

- The **F004 Code** is 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              cresylic acid nitrobenzene

- The **F005 Code** is 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              methyl ethyl ketone
carbon disulfide     isobutanol
pyridine             benzene
2-ethoxyethanol      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 LD50 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 (TCEQ). 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.

D. Universal Waste

The Universal Waste regulations are designed to simplify the requirements for some wastes generated by commercial, agricultural, and community activities that are otherwise subject to full RCRA Subtitle C requirements. The universal waste management program is designed to encourage proper treatment and recycling of specific waste, and is subject to different management requirements. Items allowed to be managed as Universal Waste include:

- Batteries (e.g. nickel cadmium, nickel metal hydride, lithium, lithium polymer, etc.)
- Some recalled pesticides
- Mercury lamps (e.g. fluorescent lamps, projector lamps, etc.)
- Mercury-containing equipment (including thermometers, thermostats, manometers, barometers)
• Paint and paint related waste (e.g. oil based paints, flammable solvent thinning agents, and solvent saturated material waste generated from painting activities)

If you generate any of these items, please Contact the Department of Environmental Health and Safety, or the Hazardous Materials Specialist (ext. 7629) for more information.

It is important to note that Universal Waste is still Hazardous Waste.

II. Biological (or Special) Wastes

Biological (or special) waste has been identified by the Texas Department of State Health Services (TDSHS) 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 (TCEQ) and the (TDSHS). 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
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 TDSHS, 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 in the State of Texas are regulated by the TDSHS and the TCEQ 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 Baylor
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. Uranium compounds used in electron microscopy.

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.