



## ADVISORY 7.3 MANAGEMENT OF CHEMICAL WASTES

### **EPA DEFINITION OF A HAZARDOUS CHEMICAL WASTE**

A waste stream is a **characteristic hazardous waste** if it meets the qualifications for the characteristics of ignitability, corrosivity, reactivity, or toxicity as defined in Ohio Administrative Code ([OAC](#)) [3745-51-21 through 24](#).

A waste stream is a **listed hazardous waste** if it falls under the requirements for one of the lists in OAC 3745-51-30 through 33. Specifically, the "F" listed wastes in [3745-51-31](#) refer to spent or used streams which either contain one or more of the chemicals listed under that waste code or are generated from non-specific operations or processes. The "K" listed wastes in [3745-51-32](#) refer to waste streams generated from specific sources or processes.

The "P" and "U" listed wastes in [3745-51-33](#) refer to unused or virgin chemicals which become wastes when they are determined to no longer be useful (past expiration date, etc.) and are intended to be disposed. Virgin material containing one or more of the chemicals listed on the "P" or "U" lists then becomes a hazardous waste at the point when it is intended to be disposed.

In summary, spent or used wastes may be classified as regulated hazardous wastes by one of two methods. If the waste meets any of the characteristics listed in 3745-51-21 through 24, then it is a hazardous waste and will have a "D" waste code. If the waste falls under the requirements of the listed wastes in 3745-51-31 or -32, then it is a hazardous waste and will have either an "F" or "K" waste code. The wastes listed in 3745-51-32 refer to specific industrial processes and the "K" waste code generally will not apply to wastes generated at the University.

Virgin materials or products containing chemicals on the "P" or "U" lists in 3745-51-33 are hazardous wastes at the point when they are determined to no longer be useful and are identified for disposition. The "P" and "U" waste codes do not apply to wastes which are spent or used materials.

### **IDENTIFICATION OF HAZARDOUS CHEMICAL WASTE**

Chemical wastes identified as hazardous by the EPA criteria outlined above will be collected by the Environmental Health & Safety Office for proper disposal. The EPA (under the Resource Conservation and Recovery Act [RCRA]) considers a waste chemical hazardous when the following criteria are met:

It is **ignitable**, as defined by any of the following:

- It is a liquid other than an aqueous solution containing less than 24% alcohol by volume and has a flash point less than 60°C (140°F).
- It is not a liquid and is capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture or spontaneous chemical changes and, when ignited, burns so vigorously and persistently that it creates a hazard.
- It is an oxidizer as defined by [49 CFR 173.127](#) (substances such as a chlorate, permanganate, inorganic peroxide or a nitrate that yields oxygen readily to stimulate the combustion of organic matter).
- It is an ignitable compressed gas.

It is **corrosive**, as defined by either of the following:

- It is aqueous and has a pH less than or equal to 2 or greater than or equal to 12.5.
- It is a liquid that corrodes steel.

It is **reactive**, as defined by any of the following:

- It is normally unstable and readily undergoes violent change without detonating.
- It reacts violently with water.
- It forms potentially explosive mixtures with water.
- When mixed with water, it generates toxic gases, vapors or fumes in a quantity sufficient to present a danger to human health or the environment.
- It is a cyanide- or sulfide-bearing waste which, when exposed to pH conditions between 2 and 12.5,



can generate toxic gases, fumes or vapors in a quantity sufficient to present a danger to human health or the environment.

- It is capable of detonation or explosive reaction if it is subjected to a strong initiating source or if heated under confinement.
- It is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure.
- It is a forbidden explosive as defined by [49 CFR 173.54](#), or meets the definition of class/division 1.1, 1.2, or 1.3 explosive as defined in [49 CFR 173.50](#).

It is **toxic** as defined by any of the following:

- It contains any of the chemicals listed in Table 1 in OAC 3745-51-24 at or above their regulatory limit.
- It has been found to be fatal to humans in low doses.
- In the absence of data on human toxicity, it has been shown in studies to have an oral LD 50 (rat) of less than 50 mg/kg, an inhalation LC toxicity (rat) of less than 2 mg/liter, or a dermal LD 50 toxicity (rabbit) of less than 200 mg/kg.
- Is otherwise capable of causing or significantly contributing to an increase in serious irreversible or incapacitating reversible illness.
- It is a listed waste in OAC 3745-51-30 to -33.

## **LABELING AND DISPOSITION OF HAZARDOUS CHEMICAL WASTE**

### **Labeling**

For containers currently in use, all containers used for hazardous waste must be clean and compatible with the waste material it will hold. The generator of the waste must mark on the container with the words "HAZARDOUS WASTE", and the label must describe the contents of the waste in the container.

For containers that have been filled, complete and attach a [Hazardous/Chemical Waste Disposal Label](#). Use only generic names – **DO NOT** abbreviate. Unlabeled or mislabeled wastes will not be collected for disposal.

### **Disposal**

There are several methods for disposition of waste hazardous chemicals depending upon their properties, which are described below.

- **Disposal by a Commercial Contractor** - Waste hazardous chemicals that do not qualify for bulking or in-house treatment must be disposed of by a commercial contractor coordinated through Environmental Health & Safety (EH&S). These materials will be periodically collected by EH&S personnel providing the following guidelines are met:
  - All individual containers of hazardous chemical waste must have an EH&S [Hazardous/Chemical Waste Disposal Label](#) attached.
  - Ensure that proper containers are used for the hazards that are inherent to the chemical compound or waste material. Repackage all materials which are cracked, leaking, corroded, or poorly sealed in a secure, secondary container.
  - Package all labeled, segregated (see **Appendices A & B**) waste containers in boxes capable of supporting the weight (unbreakable containers of 5 gallons or more need not be boxed). Place dividers between all containers to insulate them from shock using paper, excelsior, cardboard, etc. Containers larger than 5 gallons liquid or 50 pounds solid must have an attached quantitative lab analysis.
- **Bulk Storage** - Certain solvent-type, organic hazardous chemicals can be incinerated for energy recovery and must be transferred to bulk storage for transport to the incineration site (see **Appendix C**). Waste labels must be submitted to EH&S for these wastes.
- **In-House Treatment** - Corrosive chemicals can be safely neutralized in-house. The non-hazardous reaction product can then be disposed of via the sanitary sewer or regular trash. Refer to **Appendix D** for specific procedures.
- **Compressed Gas Cylinders** - See **Appendix E** regarding the disposition of compressed gas



cylinders.

- **Explosives** - A list of potentially explosive, shock-sensitive compounds is given in **Appendix F**, together with certain specific disposal procedures. It is the responsibility of the researcher to determine the proper disposal of these compounds prior to purchase. Failure to adhere to proper disposal guidelines, furnished by EH&S, may result in legal and financial liabilities for the department and/or researcher.
- **Mixed Wastes** - Hazardous wastes which are radioactive (i.e., scintillation fluid) should be disposed of through the Radiation Safety Office (558-4110). Mixed wastes which have decayed to background levels, as defined by the Radiation Safety Office and all pertinent regulations, will be collected for disposal by EH&S.

### **DISPOSAL OF NON-HAZARDOUS WASTE CHEMICALS**

Any waste material that meets the RCRA definition of hazardous waste (listed or characteristic waste) must be disposed of through the EH&S Office. The four characteristics of a hazardous waste are: Ignitability, Corrosivity, Reactivity, and Toxicity. The four lists of hazardous waste are (refer to **Appendix G** for a complete list):

- **F-List:** wastes from non-specific sources, including spent solvents, plating and metal-finishing wastes, phenolic wastes bearing the TCDD form of dioxin, and the F039 mixed bag code for leachate from hazardous and solid waste landfills.
- **K-List:** wastes from specific industrial processes; these are grouped roughly according to SIC code (e.g., steel refining, ink formulation, pesticide manufacture)
- **P-List:** "acutely toxic" unused off-specification chemical products. The F-Listed dioxin-bearing wastes are also considered acute hazardous waste.
- **U-List:** unused off-specification chemical products. Both the P- and U- Lists are reserved for raw materials which contain solely the listed constituent, or in which the listed constituent is the sole active ingredient.

Mixtures of characteristic wastes with non-hazardous wastes or other materials, and wastes derived from characteristic wastes, are no longer hazardous if the characteristic is no longer present, though dilution to render a waste non-hazardous is prohibited. Mixtures of listed waste with anything else, and wastes derived from listed wastes, retain the listing forever.

If a solid chemical waste is not considered hazardous by the EPA criteria, it may be disposed in the normal trash in tightly capped containers of good integrity. **Appendix H** lists some of the more common items which may be disposed in this manner.

If a liquid chemical waste is not considered hazardous by the EPA criteria, it may qualify for disposal via the sanitary sewer system provided all of the following Metropolitan Sewer District restrictions are met:

- The compound is water-soluble. Mixtures of soluble and insoluble compounds should not be poured down the drain unless the insoluble component is less than 2%.
- The quantities disposed down the drain must be limited generally to not more than a few hundred milliliters at one time and should be flushed with at least 100 volumes of excess water.
- Malodorous chemicals should not be drain-disposed.
- Acids and bases should be neutralized to a pH range of 6 to 8 before sink disposal. Neutralization procedures are discussed in **Appendix A**.
- Compounds with a flash point of less than 140°F (60°C) must not be disposed via the sanitary sewer.
- Solutions containing metals must be at concentrations below the EPA regulatory limits listed in Table 1 in 40 CFR 261.24 and below 15.0 mg/l for copper, 0.03 mg/l for mercury, 15.0 mg/l for nickel and 15.0 mg/l for zinc as regulated by the Metropolitan Sewer District (MSD).



- Heated solutions at temperatures higher than 150°F (65°C) must not be drain-disposed.
- Water solutions containing floating oils, fat, greases, or containing more than 50 mg/l of petroleum oil, mineral oils or other non-biodegradable oils must not be drain-disposed.
- Solutions containing phenols, which are not considered hazardous by U.S. EPA criteria, must be below 50 mg/l to qualify for drain disposal.
- Water or waste solutions containing dissolved gases (such as, but not limited to, hydrogen sulfide, sulfur oxides, nitrogen oxides and ammonia) in concentrations sufficient to cause toxic or malodorous fumes must not be drain-disposed.
- Water or waste solutions containing volatile organics, which could produce an organic concentration of 450 ppm or exceeds 300 ppm for five consecutive calendar days or more in the vapor space, must not be drain-disposed.
- No ashes, cinders, sand, mud, straw, shavings, metal, glass, rags, etc., or any other solid or viscous substances that may obstruct the flow or interfere with the operation of the MSD treatment works, may be drain-disposed.

You should also refer to the Material Safety Data Sheet (MSDS) for disposal requirements. If you have any questions regarding the disposition of any material, please call EH&S (556-4968).

#### **Empty Hazardous Waste Containers**

Containers that held a hazardous waste are considered "empty" (per RCRA and the Department of Transportation [DOT]) if the container has been cleaned and purged of all waste residues. "Empty" containers may then be discarded into the solid waste. Cross out the label and mark "Empty" on all containers before discarding.

If the container held an **acute hazardous waste**, (defined in the P-List or F020 - F023, F026, or F027. Refer to [OAC 3745-51-33](#) for P-List and [3745-51-31](#) for F-List) the container or the inner lining of the container must be triple rinsed using a solvent capable of removing the product remaining in the container to be considered **empty**. All rinse solvent must then be captured and treated as the waste residue that was in the container. If containers that held hazardous waste have not been emptied in accordance with this definition, the containers must then be managed as hazardous waste.

#### **Decontamination of Plumbing Systems**

A description of procedures for decontaminating plumbing systems that have contained copper or lead azides is included in Appendix I.



APPENDIX A  
INCOMPATIBLE CHEMICALS

Many chemicals, if mixed, will potentially create heat or other dangerous reactions. Chemical waste containers must be properly segregated to prevent this from happening. Refer to the incompatible chemical list before storing different chemicals. Many chemicals can be safely stored together, but others generally should not. The general groupings **NOT TO BE STORED TOGETHER** are as follows:

**GENERAL CLASSES OF INCOMPATIBLE CHEMICALS<sup>a</sup>**

A	B
Acids	Base
<b>Alkali and alkaline earth metals</b> carbides hydrides hydroxides oxides peroxides	Water Acids Halogenated organic compounds <b>Oxidizing Agents<sup>b</sup></b> Chromated Dichromates, CrO <sub>3</sub> Halogens Halogenating agents Hydrogen peroxide and Peroxides
Inorganic azides	Nitric acid, nitrates Perchlorates and chlorates Permanganates Persulfates
Inorganic cyanides Inorganic nitrates	<b>Acids</b> Heavy metals and their salts Oxidizing agents <sup>b</sup> Acids, strong bases
Inorganic nitrites	Acids Metals Nitrites Sulfur Acids Oxidizing agents <sup>b</sup>
Inorganic sulfides <b>Organic compounds</b> Organic acyl halides	Acids Oxidizing agents <sup>b</sup> Bases Organic hydroxy compounds Bases
Organic anhydrides Organic hydroxy compound Organic halogen compounds Organic nitro compounds Powdered metals	Aluminum metal Strong bases Acids Oxidizing agents <sup>b</sup>



Additional information on storage of chemicals and chemical waste:

- Carcinogens or suspect carcinogens must be stored in a secure area and clearly marked **"CARCINOGEN"** or **"SUSPECT CARCINOGEN"**.
- Highly toxic chemicals must be stored in sealed jars clearly marked as **"HIGHLY TOXIC-POISON"** and stored in a clearly marked and separate area from other reagents in laboratory or cold room.
- Store large bottles containing acids on low shelves or in acid cabinets. Segregate acids from active metals such as sodium, potassium, or magnesium.
- Segregate oxidizing acids from organic acids, flammable and combustible materials.
- Segregate acids from chemicals that could generate toxic or flammable gases upon contact, such as sodium cyanide, iron sulfide, and calcium carbide.
- Segregate bases from acids and other reactive compounds.
- Store flammables in approved safety cans or cabinets. Segregate from oxidizing acids and oxidizers. Keep away from any source of ignition, such as heat, sparks, or open flames.
- Store oxidizers in a cool, dry place. Keep away from combustible and flammable materials. Keep away from reducing agents such as zinc, alkaline metals, and formic acid.
- Water-reactive chemicals are generally reactive metals, not often used by general laboratories. Store in a cool, dry place away from any water source. Have a Class D fire extinguisher available in case of fire.
- Materials that will react with air to ignite when exposed (e.g., white phosphorus) are referred to as pyrophoric substances. Store in a cool, dry place-making provisions for an airtight seal.

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<sup>a</sup> Chemicals in columns A and B should be kept separate

<sup>b</sup> Oxidizing agents include the type of compounds listed in the entry for alkali and alkaline earth metals, etc.



APPENDIX B  
EXPLOSIVE COMBINATIONS OF COMMON REAGENTS

**POTENTIALLY EXPLOSIVE COMBINATIONS OF SOME COMMON REAGENTS**

Acetone + chloroform in the presence of base  
Acetylene + copper, silver, mercury, or their salts  
Ammonia (including aqueous solutions) + Cl<sub>2</sub>, Br<sub>2</sub>, I<sub>2</sub>  
Carbon disulfide + sodium azide  
Chlorine + an alcohol  
Chloroform or carbon tetrachloride + powdered Al or Mg  
Decolorizing carbon + an oxidizing agent  
Diethyl ether + chlorine (including a chlorine atmosphere)  
Dimethyl sulfoxide + an acyl halide, SOCl<sub>2</sub>, or POCl<sub>3</sub>  
Dimethyl sulfoxide + CrO<sub>3</sub>  
Ethanol + calcium hypochlorite  
Ethanol + silver nitrate  
Nitric acid + acetic anhydride or acetic acid  
Picric acid + a heavy-metal salt, such as Pb, Hg, or Ag  
Silver oxide + ammonia + ethanol  
Sodium + a chlorinated hydrocarbon  
Sodium hypochlorite + an amine

**REFERENCES**

1. L. Bretherick, Handbook of Reactive Chemical Hazards, 4th ed., Butterworths, London-Boston, 1990.
2. Fire Protection Guide on Hazardous Materials, National Fire Protection Association, NFPA 325M/49/704, NFPA, Batterymarch Park, Quincy, Mass., 02269.



**APPENDIX C**  
**BULK STORAGE OF SOLVENT-TYPE LIQUID ORGANIC HAZARDOUS CHEMICAL WASTES**

Certain University colleges have facilities designated for bulk storage of some liquid hazardous organic chemical wastes (see below). Each locked facility contains separate drums for halogenated and non-halogenated organic chemical wastes, which can be incinerated for energy recovery in accordance with EPA RCRA regulations. The individual researcher is responsible for:

- Segregating the liquid organic chemical waste according to whether it is halogenated or non-halogenated (inseparable mixtures of the two are considered halogenated) and determining if it is suitable for bulk storage according to the criteria listed below. Contact EH&S (556-4968) with questions regarding suitability.
- Completing the waste label which indicates the quantity and type(s) of chemical(s) to be bulked.
- Transferring the waste into the proper bulk storage drum. EH&S will schedule a time for waste transferal once a copy of the waste label has been received.
- Complying with requirements of Advisory 11.1 (Respiratory Protection Guidelines). This includes, but is not limited to, completing a medical questionnaire, medical evaluation through University Health Services, and respirator fit testing.
- Maintaining current training requirements for OSHA Hazard Communication and EPA RCRA. Contact EH&S (556-4968) to schedule this training.

**Hazardous Chemical Wastes Suitable for Bulk Storage**

Liquid halogenated and non-halogenated solvent-type organic chemicals can be bulk stored for incineration **EXCEPT** those that contain:

- Water or solids
- Corrosive chemicals
- Reactive chemicals or those capable of forming reactive compounds (refer to **Appendix D**)
- Acutely toxic chemicals
- Dioxins or PCBs
- Radioactive materials
- Infectious materials

**Used Oil**

Drums used to bulk oil that is not hazardous (is not characteristic or listed and does not contain PCBs) must be marked as "USED OIL". Oil that is hazardous or contains PCBs must be handled separately and not mixed with used oil.





## APPENDIX D NEUTRALIZATION PROCEDURES

Treatment of corrosive waste is permitted under the Ohio Division of Materials and Waste Management. The waste must be hazardous only because it is corrosive.

Corrosive wastes that contain listed wastes or other hazardous constituents cannot be neutralized and drain-disposed. For example, hydrofluoric acid is corrosive but is also a U-listed (U134) waste because of its toxicity. Nitric acid (>70%) and perchloric acid (>10%) are corrosive and also classified as oxidizers (D001). Chromic acid may be classified as an oxidizer or toxic for chromium (D007). These wastes cannot be neutralized and drain-disposed.

Please see **Appendix I** for links to all listed wastes.

### **GENERAL PROCEDURES**

- Perform neutralizations in a ventilated hood behind a safety shield as fumes and heat may be generated. Protective clothing must be worn (minimum of gloves, lab coat and face shield).
- Perform all steps **SLOWLY**.
- Start with small quantities to gain familiarity with the reaction.
- Always add acid to water to reduce splashing and heat.
- Keep containers cool while neutralizing.
- Collect any precipitate for disposal as hazardous waste.
- Have adequate spill control materials available in the event of a spill or splash (absorbent, neutralizer, emergency eyewash/shower, etc.).

### **ACID NEUTRALIZATION**

- While stirring, add acids to large amounts of an ice water solution of base such as sodium carbonate (soda ash), calcium hydroxide (slaked lime), or 8M sodium hydroxide.
- When a pH of at least 6 is achieved, dispose of the solution into the sewer followed by water solution (one part solution with 20 parts water).

### **BASE NEUTRALIZATION**

- Neutralize by first adding the base to a large container with water. Slowly add a 1M solution of hydrochloric or citric acid.
- When a pH of 8 or less is achieved, dispose of solution into sewer followed by water solution (one part solution with 20 parts water).



**APPENDIX E**  
**DISPOSITION OF COMPRESSED GAS CYLINDERS**

**INTRODUCTION**

Eventually it becomes desirable to dispose of compressed gas cylinders because they are no longer considered serviceable, or the gas is no longer needed. Some of the unserviceable cylinders fail to qualify for further use under the DOTs maintenance requirements. In other cases, the cylinders are containers such as those made to DOT Specifications 39, 40 and 41 (non-reusable or non-refillable containers). Occasionally, cylinders are found which appear to have been out of service for a long time, are inadequately marked, and/or are unsafe for further use. The following describes how these cylinders should be properly disposed.

**DISPOSITION**

The proper safe disposal of these cylinders is important as a very substantial potential hazard exists if they are left to collect in a laboratory or stockroom. These hazards include: gas under pressure, flammable gas, explosive mixtures, poisonous or toxic material, and corrosive, oxidizing or reactive materials. Disposal of these cylinders should only be done by qualified and trained personnel. The University of Cincinnati recognizes this principle and does not intend for laboratory personnel to perform in-house disposal of cylinders. Many distributors and manufacturers of compressed gases also recognize this hazard and will accept for return cylinders that were purchased from them. It is with this intention that the University has established the following guidelines for disposition of unserviceable cylinders.

1. Individuals responsible for ordering compressed gas cylinders shall bear the responsibility for determining the route of disposal for the cylinder when it becomes unserviceable.
2. The manufacturer or distributor should be requested to remove the cylinder from University property for proper disposal. Some contacts are listed below:
  - Matheson Gas Products: contact the local distributor
  - Wright Brothers, Inc., (731-2222)
  - Liquid Carbonic (contact Prax-Air at 821-2192)
  - AGA Gas (563-9400)
3. If this option is not possible, request whether the manufacturer or distributor will accept for proper disposal their unserviceable cylinder if it is sent by freight transport. Determine whether the manufacturer will allow the item to be shipped freight collect or whether shipping costs must be borne by the University. Contact EH&S for assistance in proper DOT packaging.
  - Pressure Chemical (Pittsburgh, PA) will accept for disposal their non-reusable cylinders if they are shipped by the University to their facility.
4. If these options are not available, investigate other sources of the material or request from the manufacturer or distributor in writing the appropriate instructions and supervision for the safe disposal and/or destruction of the cylinder. These recommendations are intended for use by EH&S in obtaining a disposal company, which can handle the product and are not intended for use by laboratory personnel. This option should only be used as a last measure, as it is time consuming and costly.
5. It is absolutely essential that cylinder contents be identified before steps for the disposition of the cylinder are taken. The cylinder should be marked with the chemical name of the commodity contained by means of stenciling or a product label. If such marking is not on the cylinder or is illegible, **DO NOT** place reliance upon the color of the cylinder or other color-coding to determine the cylinder content identification. Instead, contact EH&S for assistance, and be prepared to provide the name of the supplier, if available. The department will be responsible for bearing all costs associated with identification of gas if it cannot be returned to the manufacturer. When a cylinder bears adequate product labeling, it is reasonable to rely upon the labels for the identity of cylinder content.



APPENDIX F  
DISPOSAL OF EXPLOSIVES

**THE FOLLOWING SHOCK-SENSITIVE COMPOUNDS ARE POTENTIALLY  
EXPLOSIVE AND MUST BE DISPOSED OF ACCORDINGLY:**

- Acetylenic compounds, especially polyacetylenes, haloacetylenes, and heavy metal salts of acetylenes (copper, silver, and mercury salts are particularly sensitive)
- Acyl nitrates
- Alkyl nitrates, particularly polyol nitrates such as nitrocellulose and nitroglycerine
- Alkyl and acyl nitrites
- Alkyl perchlorates
- Ammine metal oxosalts: metal compounds with coordinated ammonia, hydrazine, or similar nitrogenous donors and ionic perchlorate, nitrate, permanganate, or other oxidizing group
- Azides, including metal, nonmetal, and organic azides
- Chlorite salts of metal, such as  $\text{AgClO}_2$  and  $\text{Hg}(\text{ClO}_2)_2$
- Diazo compounds such as  $\text{CH}_2\text{N}_2$
- Diazonium salts, when dry
- Fulminates (silver fulminate,  $\text{AgCNO}$ , can form in the reaction mixture from the Tollens test for aldehydes if it is allowed to stand for some time; this can be prevented by adding dilute nitric acid to the test mixture as soon as the test has been completed)
- Hydrogen peroxide becomes increasingly treacherous as the concentration rises above 30%, forming explosive mixtures with organic materials and decomposing violently in the presence of traces of transition metals
- *N*-Halogen compounds such as difluoroamino compounds and halogen azides
- *N*-Nitro compounds such as *N*-nitromethylamine, nitrourea, nitroguanidine, and nitric amide
- Oxo salts of nitrogenous bases: perchlorates, dichromates, nitrates, iodates, chlorites, chlorates, and permanganates of ammonia, amines, hydroxylamine, guanidine, etc.
- Perchlorate salts. Most metal, nonmetal, and amine perchlorates can be detonated and may undergo violent reaction in contact with combustible materials
- Peroxides and hydroperoxides organic
- Peroxides (solids) that crystallize from or are left from evaporation of peroxidizable solvents
- Peroxides, transition-metal salts
- Picrates, especially salts of transition and heavy metals, such as Ni, Pb, Hg, Cu, and Zn; picric acid is explosive but is less sensitive to shock or friction than its metal salts and is relatively safe as a water-wet paste
- Picryl Chloride
- Polynitroalkyl compounds such as tetranitromethane and dinitroacetonitrile
- Polynitroaromatic compounds especially polynitro hydrocarbons, phenols, and amines

**CATEGORIES OF PEROXIDIZABLE COMPOUNDS**

The following list of materials is representative of those compounds which form peroxides:

- **List A: Severe Peroxide Hazard On Storage With Exposure To Air** (Discard within 3 months)
  - Diisopropyl ether (isopropyl ether)
  - Divinylacetylene (DVA)<sup>a</sup>
  - Potassium metal
  - Potassium amide
  - Sodium amide (sodamide)
  - Vinylidene chloride (1,1-dichloroethylene)<sup>a</sup>
- **List B: Peroxide Hazard On Concentration; Do Not Distill Or Evaporate Without First Testing For The Presence Of Peroxides** (Discard or test for peroxides after 6 months)
  - Acetaldehyde diethyl acetal (acetal)
  - Cumene (isopropylbenzene)
  - Cyclohexene
  - Cyclopentene
  - Decalin (decahydronaphthalene)



- Dioxane
- Diacetylene (butadiene)
- Dicyclopentadiene
- Diethyl ether (ether)
- Diethylene glycol dimethyl ether (diglyme)
- Ethylene glycol dimethyl ether (glyme)
- Ethylene glycol ether acetates
- Ethylene glycol monoethers (cellosolves)
- Furan
- Methylacetylene
- Methylcyclopentane
- Methyl isobutyl ketone
- Tetrahydrofuran (THF)
- Tetralin (tetrahydronaphthalene)
- Vinyl ethers<sup>a</sup>

➤ **LIST C: Hazard of Rapid Polymerization Initiated By Internally Formed Peroxides<sup>a</sup>**

- Normal Liquids (Discard or test for peroxides after 6 months)<sup>b</sup>
  - Chloroprene (2-chloro-1,3-butadiene)<sup>c</sup>
  - Styrene
  - Vinyl acetate
  - Vinylpyridine
- Normal Gases (Discard after 12 months)
  - Butadiene<sup>c</sup>
  - Chlorotrifluoroethylene<sup>c</sup>
  - Tetrafluoroethylene (TFE)<sup>c</sup>
  - Vinylacetylene (MVA)<sup>c</sup>
  - Vinyl chloride

**DISPOSAL OF EXPLOSIVES**

EH&S is requiring the National Safety Council's method for labeling peroxidizable compounds:

List A (see below)

**PEROXIDIZABLE COMPOUND**

Date received \_\_\_\_\_ Date opened \_\_\_\_\_ Discard or test within 3 months after opening

Lists B/C (see below)

**PEROXIDIZABLE COMPOUND**

Date received \_\_\_\_\_ Date opened \_\_\_\_\_ Discard or test within 6 months after opening

EH&S will not collect (for disposal) peroxide-formers that are not labeled as above or have expired according to above discard dates unless proof of absence of peroxides is demonstrated (commercial test paper is available for detection of organic peroxides in peroxidizable compounds).

Small quantities of ethyl ether can be evaporated in a chemical fume hood (no heat source in the hood) if the ether is free of peroxides and/or contains an inhibitor (i.e., BHT). The empty cans (or bottles) should be rinsed and disposed of in the regular trash.

<sup>a</sup> Polymerizable monomers should be stored with a polymerization inhibitor from which the monomer can be separated by distillation just before use.

<sup>b</sup> Although common acrylic monomers such as acrylonitrile, acrylic acid, ethyl acrylate, and methyl methacrylate can form peroxides, they have not been reported to develop hazardous levels in normal use and storage.

<sup>c</sup> The hazard from peroxides in these compounds is substantially greater when they are stored in the liquid phase, and if so stored without an inhibitor they should be considered as in **List A**.



APPENDIX G  
OHIO REGULATIONS

**Hazardous Waste Management Standards:**

- [Characteristic of Ignitability](#)
- [Characteristic of Corrosivity](#)
- [Characteristic of Reactivity](#)
- [Characteristic of Toxicity](#)

**LISTED WASTES**

[Lists of hazardous wastes- general](#)

[Appendix- Basis for Listing Hazardous Waste](#)

[Hazardous waste from non-specific sources](#)

[Hazardous waste from specific sources](#)

[Discarded commercial chemical products, off-specification species, container residues and residues thereof](#)

**LIST OF REFERENCES**

- 1) *Prudent Practices in the Laboratory: Handling and Disposal of Chemicals*, National Research Council, National Academy Press, Washington, D.C., 1995.
- 2) *Handbook of Laboratory Waste Disposal*, Martin J. Pitt and Eva Pitt, Halsted Press, New York, NY, 1985.
- 3) *Destruction of Hazardous Chemicals in the Laboratory*, 2<sup>nd</sup> Edition, George Lunn and Eric B. Sansone, John Wiley and Sons, Inc., New York, NY, 1994.
- 4) *CRC Handbook of Laboratory Safety*, 5<sup>th</sup> Edition, A. Keith Furr, Ph.D. editor, CRC Press, Inc., Boca Raton, Florida, 2000.
- 5) [Rules and Regulations – Governing the Design, Construction, Maintenance, Operation and Use of Sanitary and Combined Sewers](#), The Metropolitan Sewer District of Greater Cincinnati, 2001.



APPENDIX H  
CHEMICALS FOR REGULAR TRASH DISPOSAL

Any material considered for regular trash disposal must **NOT** be regulated by the EPA as a hazardous waste (under RCRA), a hazardous substance (under CERCLA – Superfund Act), or by the DOT as a hazardous material. You must also refer to the MSDS for disposal requirements. Contact EH&S (556-4968) for CERCLA and Department of Transportation information.

A partial list of materials that may be considered for regular trash disposal include:

Acid, Ascorbic	Acid, Boric
Acid, Casamino	Acid, Citric
Acid, Lactic	Acid, Phosphotungstic
Acid, Salicylic	Acid, Silicic
Acid, Stearic	Acid, Succinic
Acid, Tartaric	Aluminum Metal
Ammonium Chloride	Ammonium Phosphate
Ammonium Sulfate	Beef Extract
Bromophenol Blue	Broth Powder
Buffer Solution	Calcium Carbonate
Calcium Chloride	Calcium Lactate
Calcium Phosphate	Calcium Sulfate
Dextrose	Drierite
Extract Malt	Extract, Yeast
Galactose	Gelatin
Graphite	Gum, Arabic
Gum, Guar	Gum, Guaic
Kaolin	Lactose
Lithium Carbonate	Lithium Chloride
Lithium Sulfate	Litmus
Magnesium Carbonate	Magnesium Chloride
Magnesium Oxide	Magnesium Sulfate
Maltose	Manganese Chloride
Manganese Sulfate	Methylene Blue
Paraffin wax (solid)	Pepsin
Petroleum Jelly	Potassium Acetate
Potassium Bicarbonate	Potassium Bisulfate
Potassium Bitartrate	Potassium Bromide
Potassium Carbonate	Potassium Chloride
Potassium Citrate	Potassium Iodide
Potassium Phosphate	Potassium Sodium Tartrate
Potassium Sulfate	Potassium Sulfite
Potassium Sulfocyanate	Pumice
SDS (Sodium Dodecyl Sulfate)	Sodium Acetate
Sodium Ammonium Phosphate	Sodium Benzoate
Sodium Bicarbonate	Sodium Borate
Sodium Bromide	Sodium Carbonate
Sodium Chloride	Sodium Citrate
Sodium Formate	Sodium Iodide
Sodium Lactate	Sodium Salicylate
Sodium Silicate	Sodium Succinate
Sodium Sulfate	Sodium Sulfite
Sodium Tartrate	Sodium Thioglycolate
Sodium Thiosulfate	Sodium Tungstate
Stannous Chloride	Sucrose
Talcum Powder	Thymol, Blue (aq.)
Tin Metal	Trypticase



Tryptone  
Urea

Wax, Bee's



APPENDIX I  
PROCEDURES FOR THE DECONTAMINATION OF PLUMBING SYSTEMS CONTAINING  
COPPER AND/OR LEAD AZIDES

The information described below is based on information provided by that National Institute of Occupational Safety and Health (NIOSH) in 1976.

**DECONTAMINATION PROCEDURES FOR AZIDE CONTAMINATED PLUMBING**

The following procedure<sup>1</sup> has been suggested by the Center for Disease Control, U.S. Public Health Service, for use in its laboratories:

1. Prepare 1 to 2 liters of 10% sodium hydroxide solution (100 g NaOH per liter of water).
2. Siphon all liquid from the trap and drain using a soft rubber or plastic hose. Use proper precautions against any hazardous chemicals, which may be present.
3. Slowly pour the sodium hydroxide solution into the trap.
4. Tape to the sink a warning sign reading:

**DO NOT USE SINK - CONTAINS CAUSTIC MATERIAL**

5. Allow the solution to remain in the trap for a minimum of 16 hours.
6. Flush the drain with water for a minimum of 15 minutes.
  - If the drain will not flow, the sodium hydroxide should be removed by siphoning, if possible, then diluting with water. Maintenance personnel should be advised that the drain is potentially contaminated with explosive agents and caustic material.

The above procedure is designed to decontaminate a drain trap. Longer lengths of drain lines can be decontaminated with a similar procedure after plugging the drain below the point at which any azide contamination is likely to have occurred and then filling the entire length of pipe with 10% sodium hydroxide solution. Where it is not possible for a drain line to remain filled with sodium hydroxide solution for at least 16 hours, Coulter Electronics, Inc. has suggested the following:<sup>2</sup>

1. Pour five gallons of sodium hydroxide solution into the piping rapidly enough to simulate the flushing action of a toilet.
2. Use signage that reads:

**CAUTION  
THE SOLUTION IS CAUSTIC!**

3. Allow the pipe to remain undisturbed by water or other effluents for at least 16 hours.
4. Flush with copious amounts of water.
5. Repeat steps 1, 2, and 3 two more times at intervals of a week or so.

Descriptions of several other procedures which have been suggested for the decontamination of azides are listed in the *Journal of Chemical Education*.<sup>3</sup>

**PRECAUTIONS**

Because the possibility of residual sodium hydroxide will always exist, personnel should wear gloves and face shields when breaking the drain line or trap for maintenance. (This equipment should be worn when breaking any laboratory drain, as the presence of hazardous chemicals should always be suspected). Extreme caution should be exercised when plugging a drain line potentially contaminated with heavy metal azides.

References:

Manual Guide-Safety Management No. CDC-22, Decontamination of Laboratory Sink Drains to Remove Azide Salts, Center for Disease Control, Atlanta, Georgia, April 30, 1976.





<sup>2</sup> Personal Communication from Coulter Diagnostics, Inc., June 3, 1976.

<sup>3</sup> James O. Wear, "Azide Hazards with Automatic Blood Cell Counters," *Journal of Chemical Education*, 52, A23-A25, January 1975.