Department of Environmental Health & Safety

Hazardous Materials Management Manual

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EPA DEFINITION OF A HAZARDOUS WASTE

In defining hazardous wastes, there are several criteria that must be met for the material to meet the definition of a hazardous waste. First, a material must be a waste. A material is a waste if it is not fit for its intended use or is not able to be used for another purpose. If a material becomes a waste, then we must determine if it is a hazardous waste.

The hazardous waste laws are defined in the federal statute contained in 40 CFR Part 260, also known as The Resource Conservation and Recovery Act (RCRA). RCRA is a US law that provides, in broad terms, the general guidelines for the waste management program envisioned by Congress. The State of Ohio is tasked with enforcing the law in Ohio, and has developed regulations to accomplish this.

There are two basic methods the Ohio EPA uses to classify wastes as hazardous. First, there are certain chemical characteristics (chemical composition, pH, reactivity, etc) that make a material a “characteristic hazardous waste.” The material is a hazardous waste if it is a waste, and it possesses those characteristics.

A waste 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) sections 3745-51-21 to 3745-51-24.

Secondly, a waste can be a hazardous waste if it is the product of certain listed processes. These are called Listed Wastes.

A waste stream is a “listed hazardous waste” if it falls under the requirements for one of the lists in OAC 3745-51-30 to -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 time 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 to -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 Ohio 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 or needed, 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 will be collected by the Environmental Health & Safety (EHS) Office for proper disposal. EHS will make the determination if a waste is a hazardous waste or not. This may involve a review of the Material Safety Data Sheet(s) (MSDS), process review, analytical testing, or other determination methods as necessary.

In general, the Ohio EPA (RCRA) considers a waste chemical to be hazardous if it meets the following criteria:

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^{o}C (140^{o}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 at a rate greater than 1/4 inch per year at a temperature of 55 degrees C (130 degrees F).

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

(In-use containers): 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:

- the words “HAZARDOUS WASTE”
- the contents of the waste in the container

Labels are available from EHS for marking the containers.

(Filled Containers): Fill out and attach a Hazardous/Chemical Waste Disposal Label (http://ohio.edu/ehs). Use only generic names - ***do not abbreviate***. Unlabeled or mislabeled wastes will not be collected for disposal. Containers Labeled as “Unknown” cost approximately five times the normal disposal cost, and may result in the generating department being charged for the disposal.

Disposition

There are several methods for disposition of hazardous waste depending upon their properties.

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 (EHS). These

materials will be periodically collected by EHS personnel providing the following guidelines are met:

- All individual containers of hazardous chemical waste must have an Environmental Health & Safety Hazardous/Chemical Waste Disposal Label attached to the container.
- 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 **(Appendices D & E)** 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.

For generators who anticipate generating large quantities of wastes, please contact EHS to discuss waste characterization procedures and waste minimization efforts.

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 B)**. Waste labels must be submitted to Environmental Health & Safety for these wastes, also.

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 A for specific procedures.

Compressed Gas Cylinders - See **Appendix G** regarding the disposition of compressed gas cylinders.

Explosives - A list of potentially explosive, shock-sensitive compounds is given in **Appendix C**, 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 may result in legal and financial liabilities for the department and/or researcher.

Mixed Wastes - Hazardous wastes which are also radioactive, (for example: scintillation fluid) should be disposed of through the Radiation Safety Officer in EHS (593-1666). Mixed wastes will be collected for disposal by Environmental Health & Safety.

DISPOSAL OF NON-HAZARDOUS WASTE CHEMICALS

Any waste material that meets the RCRA definition of hazardous waste (listed and or characteristic waste) must be disposed of through the Environmental Health and Safety Department. The four characteristics of a hazardous waste are: Ignitability, Corrosivity, Reactivity, and Toxicity.

The four lists of hazardous waste are (refer to Appendix I 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 may 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. **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 F** 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 Athens Sewer 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 parts of excess water per part of liquid waste (i.e. 100 ml of water per ml of waste).

- 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^{o}F (60^{o}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. Consult with EHS for other metals acceptable to the Athens City Public Works Department.

- Heated solutions at temperatures higher than 150^{o}F (65^{o}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 hazardous by U.S. EPA criteria, must be below 50 mg/l to qualify for drain disposal.

- Water 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 (v/v) or exceeds 300 ppm (v/v) 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 Publicly Owned Treatment Works (POTW), may be drain disposed.

You should also refer to the Material Safety Data Sheet for disposal requirements. If you have any questions regarding the disposition of any material, please call EHS at 593-1666.

Empty Hazardous Waste Containers:

Containers that held a hazardous waste are considered "empty" (per RCRA and 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 *acutely hazardous waste* (wastes in the P-List or F020 - F023, F026, and F027 – **Please see page 20 and go to OAC 3745-51-33 for P-List and 3745-51-31 for F-List**), to be considered *empty*, the following must occur:

- 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. 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.

APPENDIX A: NEUTRALIZATION PROCEDURES

Treatment of corrosive waste is permitted under Ohio Hazardous Waste Rules if the waste is not a hazardous waste (ie. the pH of the material is between 2 and 12). The waste must not be hazardous by corrosivity.

Corrosive wastes that contain listed wastes or other hazardous constituents cannot be neutralized and drain disposed. E.g., Hydrofluoric acid is corrosive but is also listed (U134) because of its toxicity. Nitric acid (>70%) and perchloric acid (>10%) are 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 properly functioning and certified, 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 controls 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 (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 HCl or citric acid.

When a pH of 8 or less is achieved, dispose of solution into sewer followed by water (one part solution with 20 parts water).

APPENDIX B: BULK STORAGE OF SOLVENT-TYPE LIQUID ORGANIC HAZARDOUS CHEMICAL WASTES

Certain Ohio 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 Environmental Health & Safety (EHS), 593-1666, with questions regarding suitability.

- Completing the waste label, which indicates the quantity and type(s) of chemical(s) to be bulked.

- Notifying EHS of Wastes to be picked up. EHS will schedule a time for waste transference 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 (currently conducted by University Medical Associates), and respirator fit testing. Contact Human Resources Benefits at 597-1994 to schedule physicals, and EHS at 593-1666 to schedule fit testing.

- Maintaining current training requirements for OSHA Hazard Communication and EPA Resource Conservation and Recovery Act (RCRA). Contact EHS at (740) 593-1666 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 **(i.e. peroxide-formers Appendix D)**
- Acutely toxic chemicals.
- Dioxins or PCB's
- 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 non-hazardous used oil.

In general, used Aircraft engine oil is a hazardous waste because of it’s lead content, and may not be combined with other non-hazardous used oils.

APPENDIX C: DISPOSAL OF EXPLOSIVES

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

Although these are rarely used in at the University, the potential danger associated with these compounds is great, and care must be exercised when they are used or produced.

SHOCK-SENSITIVE COMPOUNDS

- 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 $AgClO_2$ and $Hg(ClO_2)_2$
- Diazo compounds such as CH_2N_2
- Diazonimum salts, when dry
- Fulminates (silver fulminate, 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

Peroxidizable Compounds - EHS is encouraging use of The National Safety Council's method for labeling peroxide forming compounds:

EHS will not collect (for disposal) peroxide-formers that are not labeled as indicated, 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.

List A: Severe Peroxide Hazard On Storage With Exposure To Air
(Discard within 3 months)

These compounds should be labeled with the following information :

Date received _____ Date opened_____
Discard or test within 3 months after opening

Compounds:
Diisopropyl ether (isopropyl ether)
Divinylacetylene (DVA)[a]
Potassium metal
Potassium amide
Sodium amide (sodamide)
Vinylidene chloride (l,l-dichloroethylene)[a]

List B & C: 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)

These compounds should be labeled with the following information :

Date received _____ Date opened_____
Discard or test within 6 months after opening

The following list of materials is representative of those compounds, which form peroxides:
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[a]

LIST C: Hazard Of Rapid Polymerization Initiated By Internally Formed Peroxides[a]

a. Normal Liquids; Discard or test for peroxides after 6 months[b]

Chloroprene (2-chloro-l,3-butadiene)[c]
Styrene
Vinyl acetate
Vinylpyridine

b. Normal Gases; Discard after 12 months

Butadiene[c]
Chlorotrifluoroethylene[c]
Tetrafluoroethylene (TFE)[c]
Vinylacetylene (MVA)[c]
Vinyl chloride

[a] Polymerizable monomers should be stored with a polymerization inhibitor from which the monomer can be separated by distillation just before use.

[b] 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.

[c] 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 D: INCOMPATIBLE CHEMICALS & STORAGE

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[a]

Acids	Bases
Alkali and alkaline earth metals	Water
carbides	Acids
hydrides	Halogenated organic compounds
hydroxides	Oxidizing Agents[b]
oxides	Chromated
peroxides	Dichromates, CrO_3
Inorganic azides	Acids, Heavy metals and their salts, Oxidizing agents[b]
Inorganic nitrites	Acids, Oxidizing agents[b]
Inorganic cyanides	Acids, strong bases
Inorganic nitrates	Acids, Metals, Nitrites, Sulfur
Inorganic sulfides	Acids
Organic compounds	Oxidizing agents[b]
Powdered metals	Acids, Oxidizing agents[b]
Linsdeed Oil	Air
Aluminum metal	Organic halogen compounds

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, storage area, or cold room.

- Acids:
  Store large bottles on low shelves or in acid cabinets. Segregate acids from active metals such a 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.

- Bases:
  Segregate bases from acids and other reactive compounds.

- Flammables:
  Store in approved safety cans or cabinets. Segregate from oxidizing acids and oxidizers. Keep away from any source of ignition: heat, sparks, or open flames.

- Oxidizers:
  Store 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:
  These 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.

- Pyrophoric Substances:
  Materials that will react with air to ignite when exposed, e.g., white phosphorus. Store in a cool, dry place-making provisions for an airtight seal.

[a] Chemicals in columns A and B should be kept separate

[b] Oxidizing agents include the type of compounds listed in the entry for alkali and alkaline earth metals, etc.

APPENDIX E: 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_2, Br_2, I_2
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, $SOCL_2$, or $POCL_3$
Dimethyl sulfoxide + CrO_3
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

APPENDIX F: CHEMICALS FOR REGULAR TRASH DISPOSAL

Any material considered for regular trash disposal must not be regulated by the EPA as a hazardous waste (RCRA) or hazardous substance (CERCLA – Superfund Act) or by the Department of Transportation as a hazardous material. You must also refer to the MSDS for disposal requirements. Contact Environmental Health and Safety at (740) 593-1666 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
Guar Gum	Guaic Gum,
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
Wax, Bee's Wax
Urea

APPENDIX G: DISPOSITION OF COMPRESSED GAS CONTAINERS

INTRODUCTION

Eventually, it becomes desirable to dispose of compressed gas cylinders or other containers because they are no longer considered serviceable or the gas is no longer needed. Cylinders may fail to qualify for further use under the Department of Transportation's 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.

There are three primary considerations that relate to hazardous wastes and gas cylinders. These are:

1. Is the gaseous content a hazardous waste?

2. Is the container material a hazardous waste?

3. Is the cylinder or container explosive as it currently exists, thus making it a hazardous waste?

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 personnel. Ohio University 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 Ohio University has established the following guidelines for disposition of Unserviceable cylinders.

A. Individuals responsible for ordering compressed gas cylinders shall bear the responsibility for determining the route of disposal for the cylinder when it becomes unserviceable.

B. The manufacturer or distributor should be requested to remove the cylinder from Ohio University property for proper disposal.

C. 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 Environmental Health & Safety (593-1666) for

assistance in proper DOT packaging.

D. 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 Environmental Health & Safety 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.

E. 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 Environmental Health & Safety 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 H: Acutely Hazardous Substance List (P-listed Wastes)

Hazardous waste No.	Chemical abstracts No.	Substance
P023	107–20–0	Acetaldehyde, chloro-
P002	591–08–2	Acetamide, N-(aminothioxomethyl)-
P057	640–19–7	Acetamide, 2-fluoro-
P058	62–74–8	Acetic acid, fluoro-, sodium salt
P002	591–08–2	1-Acetyl-2-thiourea
P003	107–02–8	Acrolein
P070	116–06–3	Aldicarb
P203	1646–88–4	Aldicarb sulfone.
P004	309–00–2	Aldrin
P005	107–18–6	Allyl alcohol
P006	20859–73–8	Aluminum phosphide (R,T)
P007	2763–96–4	5-(Aminomethyl)-3-isoxazolol
P008	504–24–5	4-Aminopyridine
P009	131–74–8	Ammonium picrate (R)
P119	7803–55–6	Ammonium vanadate
P099	506–61–6	Argentate(1-), bis(cyano-C)-, potassium
P010	7778–39–4	Arsenic acid H_3AsO_4
P012	1327–53–3	Arsenic oxide As_2O_3
P011	1303–28–2	Arsenic oxide As_2O_5
P011	1303–28–2	Arsenic pentoxide
P012	1327–53–3	Arsenic trioxide
P038	692–42–2	Arsine, diethyl-
P036	696–28–6	Arsonous dichloride, phenyl-
P054	151–56–4	Aziridine
P067	75–55–8	Aziridine, 2-methyl-
P013	542–62–1	Barium cyanide
P024	106–47–8	Benzenamine, 4-chloro-
P077	100–01–6	Benzenamine, 4-nitro-
P028	100–44–7	Benzene, (chloromethyl)-
P042	51–43–4	1,2-Benzenediol, 4-[1-hydroxy-2-(methylamino)ethyl]-, (R)-
Hazardous waste No.	**Chemical abstracts No.**	**Substance**
P046	122–09–8	Benzeneethanamine, alpha,alpha-dimethyl-
P014	108–98–5	Benzenethiol

P127	1563–66–2	7-Benzofuranol, 2,3-dihydro-2,2-dimethyl-, methylcarbamate.
P188	57–64–7	Benzoic acid, 2-hydroxy-, compd. with (3aS-cis)-1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethylpyrrolo[2,3-b]indol-5-yl methylcarbamate ester (1:1).
P001	[1]81–81–2	2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenylbutyl)-, & salts, when present at concentrations greater than 0.3%
P028	100–44–7	Benzyl chloride
P015	7440–41–7	Beryllium powder
P017	598–31–2	Bromoacetone
P018	357–57–3	Brucine
P045	39196–18–4	2-Butanone, 3,3-dimethyl-1-(methylthio)-, O-[(methylamino)carbonyl] oxime
P021	592–01–8	Calcium cyanide
P021	592–01–8	Calcium cyanide $Ca(CN)_2$
P189	55285–14–8	Carbamic acid, [(dibutylamino)- thio]methyl-, 2,3-dihydro-2,2-dimethyl- 7-benzofuranyl ester.
P191	644–64–4	Carbamic acid, dimethyl-, 1-[(dimethyl-amino)carbonyl]- 5-methyl-1H- pyrazol-3-yl ester.
P192	119–38–0	Carbamic acid, dimethyl-, 3-methyl-1- (1-methylethyl)-1H- pyrazol-5-yl ester.
P190	1129–41–5	Carbamic acid, methyl-, 3-methylphenyl ester.
P127	1563–66–2	Carbofuran.
P022	75–15–0	Carbon disulfide
P095	75–44–5	Carbonic dichloride
P189	55285–14–8	Carbosulfan.
P023	107–20–0	Chloroacetaldehyde
Hazardous waste No.	**Chemical abstracts No.**	**Substance**
P024	106–47–8	p-Chloroaniline
P026	5344–82–1	1-(o-Chlorophenyl)thiourea
P027	542–76–7	3-Chloropropionitrile
P029	544–92–3	Copper cyanide
P029	544–92–3	Copper cyanide Cu(CN)
P202	64–00–6	m-Cumenyl methylcarbamate.
P030		Cyanides (soluble cyanide salts), not otherwise specified

P031	460–19–5	Cyanogen
P033	506–77–4	Cyanogen chloride
P033	506–77–4	Cyanogen chloride (CN)Cl
P034	131–89–5	2-Cyclohexyl-4,6-dinitrophenol
P016	542–88–1	Dichloromethyl ether
P036	696–28–6	Dichlorophenylarsine
P037	60–57–1	Dieldrin
P038	692–42–2	Diethylarsine
P041	311–45–5	Diethyl-p-nitrophenyl phosphate
P040	297–97–2	O,O-Diethyl O-pyrazinyl phosphorothioate
P043	55–91–4	Diisopropylfluorophosphate (DFP)
P004	309–00–2	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa-chloro-1,4,4a,5,8,8a,-hexahydro-, (1alpha,4alpha,4abeta,5alpha,8alpha,8abeta)-
P060	465–73–6	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa-chloro-1,4,4a,5,8,8a-hexahydro-, (1alpha,4alpha,4abeta,5beta,8beta,8abeta)-
P037	60–57–1	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta,2aalpha,3beta,6beta,6aalpha,7beta, 7aalpha)-

Hazardous waste No.	Chemical abstracts No.	Substance
P051	[1]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
P044	60–51–5	Dimethoate
P046	122–09–8	alpha,alpha-Dimethylphenethylamine
P191	644–64–4	Dimetilan.
P047	[1]534–52–1	4,6-Dinitro-o-cresol, & salts
P048	51–28–5	2,4-Dinitrophenol
P020	88–85–7	Dinoseb
P085	152–16–9	Diphosphoramide, octamethyl-
P111	107–49–3	Diphosphoric acid, tetraethyl ester
P039	298–04–4	Disulfoton
P049	541–53–7	Dithiobiuret
P185	26419–73–8	1,3-Dithiolane-2-carboxaldehyde, 2,4-dimethyl-, O-[(methylamino)- carbonyl]oxime.
P050	115–29–7	Endosulfan
P088	145–73–3	Endothall
P051	72–20–8	Endrin
P051	72–20–8	Endrin, & metabolites
P042	51–43–4	Epinephrine
P031	460–19–5	Ethanedinitrile
P194	23135–22–0	Ethanimidothioic acid, 2-(dimethylamino)-N-[[(methylamino) carbonyl]oxy]-2-oxo-, methyl ester.
P066	16752–77–5	Ethanimidothioic acid, N-[[(methylamino)carbonyl]oxy]-, methyl ester
P101	107–12–0	Ethyl cyanide
P054	151–56–4	Ethyleneimine
P097	52–85–7	Famphur
P056	7782–41–4	Fluorine
Hazardous waste No.	**Chemical abstracts No.**	**Substance**
P057	640–19–7	Fluoroacetamide
P058	62–74–8	Fluoroacetic acid, sodium salt
P198	23422–53–9	Formetanate hydrochloride.

P197	17702–57–7	Formparanate.
P065	628–86–4	Fulminic acid, mercury(2+) salt (R,T)
P059	76–44–8	Heptachlor
P062	757–58–4	Hexaethyl tetraphosphate
P116	79–19–6	Hydrazinecarbothioamide
P068	60–34–4	Hydrazine, methyl-
P063	74–90–8	Hydrocyanic acid
P063	74–90–8	Hydrogen cyanide
P096	7803–51–2	Hydrogen phosphide
P060	465–73–6	Isodrin
P192	119–38–0	Isolan.
P202	64–00–6	3-Isopropylphenyl N-methylcarbamate.
P007	2763–96–4	3(2H)-Isoxazolone, 5-(aminomethyl)-
P196	15339–36–3	Manganese, bis(dimethylcarbamodithioato-S,S′)-,
P196	15339–36–3	Manganese dimethyldithiocarbamate.
P092	62–38–4	Mercury, (acetato-O)phenyl-
P065	628–86–4	Mercury fulminate (R,T)
P082	62–75–9	Methanamine, N-methyl-N-nitroso-
P064	624–83–9	Methane, isocyanato-
P016	542–88–1	Methane, oxybis[chloro-
P112	509–14–8	Methane, tetranitro- (R)
P118	75–70–7	Methanethiol, trichloro-
P198	23422–53–9	Methanimidamide, N,N-dimethyl-N′-[3-[[(methylamino)-carbonyl]oxy]phenyl]-, monohydrochloride.
P197	17702–57–7	Methanimidamide, N,N-dimethyl-N′-[2-methyl-4-[[(methylamino)carbonyl]oxy]phenyl]-

Hazardous waste No.	Chemical abstracts No.	Substance
P050	115–29–7	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide
P059	76–44–8	4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-
P199	2032–65–7	Methiocarb.
P066	16752–77–5	Methomyl
P068	60–34–4	Methyl hydrazine
P064	624–83–9	Methyl isocyanate
P069	75–86–5	2-Methyllactonitrile
P071	298–00–0	Methyl parathion
P190	1129–41–5	Metolcarb.
P128	315–8–4	Mexacarbate.
P072	86–88–4	alpha-Naphthylthiourea
P073	13463–39–3	Nickel carbonyl
P073	13463–39–3	Nickel carbonyl $Ni(CO)_4$, (T-4)-
P074	557–19–7	Nickel cyanide
P074	557–19–7	Nickel cyanide $Ni(CN)_2$
P075	[1]54–11–5	Nicotine, & salts
P076	10102–43–9	Nitric oxide
P077	100–01–6	p-Nitroaniline
P078	10102–44–0	Nitrogen dioxide
P076	10102–43–9	Nitrogen oxide NO
P078	10102–44–0	Nitrogen oxide NO_2
P081	55–63–0	Nitroglycerine (R)
P082	62–75–9	N-Nitrosodimethylamine
P084	4549–40–0	N-Nitrosomethylvinylamine
P085	152–16–9	Octamethylpyrophosphoramide
P087	20816–12–0	Osmium oxide OsO_4, (T-4)-
P087	20816–12–0	Osmium tetroxide
Hazardous waste No.	**Chemical abstracts No.**	**Substance**
P088	145–73–3	7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid
P194	23135–22–0	Oxamyl.
P089	56–38–2	Parathion

P034	131–89–5	Phenol, 2-cyclohexyl-4,6-dinitro-
P048	51–28–5	Phenol, 2,4-dinitro-
P047	[1]534–52–1	Phenol, 2-methyl-4,6-dinitro-, & salts
P020	88–85–7	Phenol, 2-(1-methylpropyl)-4,6-dinitro-
P009	131–74–8	Phenol, 2,4,6-trinitro-, ammonium salt (R)
P128	315–18–4	Phenol, 4-(dimethylamino)-3,5-dimethyl-, methylcarbamate (ester).
P199	2032–65–7	Phenol, (3,5-dimethyl-4-(methylthio)-, methylcarbamate
P202	64–00–6	Phenol, 3-(1-methylethyl)-, methyl carbamate.
P201	2631–37–0	Phenol, 3-methyl-5-(1-methylethyl)-, methyl carbamate.
P092	62–38–4	Phenylmercury acetate
P093	103–85–5	Phenylthiourea
P094	298–02–2	Phorate
P095	75–44–5	Phosgene
P096	7803–51–2	Phosphine
P041	311–45–5	Phosphoric acid, diethyl 4-nitrophenyl ester
P039	298–04–4	Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)ethyl] ester
P094	298–02–2	Phosphorodithioic acid, O,O-diethyl S-[(ethylthio)methyl] ester
P044	60–51–5	Phosphorodithioic acid, O,O-dimethyl S-[2-(methylamino)-2-oxoethyl] ester
P043	55–91–4	Phosphorofluoridic acid, bis(1-methylethyl) ester
P089	56–38–2	Phosphorothioic acid, O,O-diethyl O-(4-nitrophenyl) ester
Hazardous waste No.	**Chemical abstracts No.**	**Substance**
P040	297–97–2	Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester
P097	52–85–7	Phosphorothioic acid, O-[4-[(dimethylamino)sulfonyl]phenyl] O,O-dimethyl ester
P071	298–00–0	Phosphorothioic acid, O,O,-dimethyl O-(4-nitrophenyl) ester
P204	57–47–6	Physostigmine.
P188	57–64–7	Physostigmine salicylate.
P110	78–00–2	Plumbane, tetraethyl-

P098	151–50–8	Potassium cyanide
P098	151–50–8	Potassium cyanide K(CN)
P099	506–61–6	Potassium silver cyanide
P201	2631–37–0	Promecarb
P070	116–06–3	Propanal, 2-methyl-2-(methylthio)-, O-[(methylamino)carbonyl]oxime
P203	1646–88–4	Propanal, 2-methyl-2-(methyl-sulfonyl)-, O-[(methylamino)carbonyl] oxime.
P101	107–12–0	Propanenitrile
P027	542–76–7	Propanenitrile, 3-chloro-
P069	75–86–5	Propanenitrile, 2-hydroxy-2-methyl-
P081	55–63–0	1,2,3-Propanetriol, trinitrate (R)
P017	598–31–2	2-Propanone, 1-bromo-
P102	107–19–7	Propargyl alcohol
P003	107–02–8	2-Propenal
P005	107–18–6	2-Propen-1-ol
P067	75–55–8	1,2-Propylenimine
P102	107–19–7	2-Propyn-1-ol
P008	504–24–5	4-Pyridinamine
P075	[1]54–11–5	Pyridine, 3-(1-methyl-2-pyrrolidinyl)-, (S)-, & salts
P204	57–47–6	Pyrrolo[2,3-b]indol-5-ol, 1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethyl-, methylcarbamate (ester), (3aS-cis)-.
Hazardous waste No.	**Chemical abstracts No.**	**Substance**
P114	12039–52–0	Selenious acid, dithallium(1+) salt
P103	630–10–4	Selenourea
P104	506–64–9	Silver cyanide
P104	506–64–9	Silver cyanide Ag(CN)
P105	26628–22–8	Sodium azide
P106	143–33–9	Sodium cyanide
P106	143–33–9	Sodium cyanide Na(CN)
P108	[1]57–24–9	Strychnidin-10-one, & salts
P018	357–57–3	Strychnidin-10-one, 2,3-dimethoxy-
P108	[1]57–24–9	Strychnine, & salts
P115	7446–18–6	Sulfuric acid, dithallium(1+) salt
P109	3689–24–5	Tetraethyldithiopyrophosphate
P110	78–00–2	Tetraethyl lead
P111	107–49–3	Tetraethyl pyrophosphate
P112	509–14–8	Tetranitromethane (R)

P062	757–58–4	Tetraphosphoric acid, hexaethyl ester
P113	1314–32–5	Thallic oxide
P113	1314–32–5	Thallium oxide Tl_2O_3
P114	12039–52–0	Thallium(I) selenite
P115	7446–18–6	Thallium(I) sulfate
P109	3689–24–5	Thiodiphosphoric acid, tetraethyl ester
P045	39196–18–4	Thiofanox
P049	541–53–7	Thioimidodicarbonic diamide $[(H_2N)C(S)]_2NH$
P014	108–98–5	Thiophenol
P116	79–19–6	Thiosemicarbazide
P026	5344–82–1	Thiourea, (2-chlorophenyl)-
P072	86–88–4	Thiourea, 1-naphthalenyl-
P093	103–85–5	Thiourea, phenyl-
P185	26419–73–8	Tirpate.
P123	8001–35–2	Toxaphene
P118	75–70–7	Trichloromethanethiol
P119	7803–55–6	Vanadic acid, ammonium salt
Hazardous waste No.	**Chemical abstracts No.**	**Substance**
P120	1314–62–1	Vanadium oxide V_2O_5
P120	1314–62–1	Vanadium pentoxide
P084	4549–40–0	Vinylamine, N-methyl-N-nitroso-
P001	[1]81–81–2	Warfarin, & salts, when present at concentrations greater than 0.3%
P205	137–30–4	Zinc, bis(dimethylcarbamodithioato-S,S′)-,
P121	557–21–1	Zinc cyanide
P121	557–21–1	Zinc cyanide $Zn(CN)_2$
P122	1314–84–7	Zinc phosphide Zn_3P_2, when present at concentrations greater than 10% (R,T)
P205	137–30–4	Ziram.

APPENDIX I: OHIO REGULATIONS

Currently Effective Hazardous Waste, Universal Waste and Used Oil Laws
www.epa.ohio.gov/dhwm/laws_regs.aspx