University of South Carolina

POLICY FOR MINIMIZING HIGH HAZARD WASTE AND UNKNOWNS

Regulatory Reference

The proper treatment, storage, and disposal of hazardous waste is regulated under 40 CFR 260-280, the Resource Conservation and Recovery Act (RCRA). There are two categories of hazardous waste: characteristic wastes and listed wastes. Characteristic hazardous wastes are materials that are known or tested to exhibit one or more of the following four hazardous traits: ignitability, reactivity, corrosivity and toxicity. Listed hazardous wastes are materials specifically listed by regulatory authorities as hazardous wastes which are from non-specific sources, specific sources, or discarded chemical products. Certain hazardous waste from these two categories may pose a significant threat to personnel and environment and as such, they are considered high-hazard wastes.

What is High-Hazard Waste?

High-hazard waste refers to chemicals that are inherently reactive and unstable or have become reactive and unstable due to age or their storage environment. As such, these chemicals need to be stabilized and/or remediated before disposal. For example, an old cylinder that has lost its label needs to be identified and remotely opened. An old cylinder containing a toxic gas whose regulator froze in place needs to be handled by a hazardous materials professional before it can be packed for shipment and disposal. Diethyl ether that has expired needs to be stabilized before it can be safely transported for disposal.

What is an Unknown Waste?

All chemical wastes must be properly identified before they can be disposed of as hazardous waste. Many unknown chemicals are generated due to poor housekeeping and poor laboratory practices. A chemical container that is unlabeled, mislabeled, double-labeled or whose label has deteriorated may fall in the category of unknowns. These unknowns cannot be properly disposed of until the content(s) of the container have been identified or profiled.

Purpose

A very high cost is associated with the disposal of high-hazard waste and unknown waste. Minimization of these types of waste will translate into substantial savings on hazardous waste disposal cost to the University of South Carolina.

Some Examples of High-Cost Hazardous Waste

- Unknowns
- Old cylinder with residual toxic or reactive gas, the supplier of which has gone out of business
- Peroxide formers past their expiration date or pre-determined shelf-life
- Organic peroxides
- Strong oxidizers

- Picric acid (solid)
- Dinitrophenol (solid)
- Water-reactive substances

While these are some commonly known high-hazard wastes, the list is certainly not all-inclusive and there are many others that pose a significant threat.

How to Minimize High-Cost Hazardous Waste

1. Purchase a reasonable amount of chemicals needed for your experiments such that the amount left over is minimal after your research is finished.
2. Properly tag and request a hazardous waste pickup for all chemicals in a lab BEFORE it is vacated so hazardous chemicals are identified and disposed of, not inherited by the next Principal Investigator (PI) assigned to the lab.
3. Eliminate or minimize unknowns.
    - Be vigilant in labeling ALL chemical containers, even those that contain water!
    - Do not use formulas, abbreviations or chemical structures for labeling waste.
    - Relabel containers with deteriorating labels before the label becomes unreadable.
    - Completely deface original labels of containers that will be re-used.
4. Manage the volume purchases, storage, use and inventory of peroxide forming chemicals.
    - Purchase a reasonable amount of the peroxide former so that all of the contents are used up within the expiration date or predetermined shelf life (see Appendix 2), whichever comes first.
    - Label peroxide former containers with cautionary label provided by EH&S (Appendix 4)
    - Dispose of peroxide formers before they expire or before their pre-determined shelf life, whichever comes first.
    - Store under inert gas or purchase peroxide formers with inhibitors, if available and if allowed by your methodology.
    - Keep chemical containers tightly closed, since oxygen is needed for peroxide formation.
    - Store in opaque containers away from sources of light. Exposure to light will accelerate the formation of peroxides. Amber glass is effective to protect the chemical from light exposure while also enabling the user to view the chemical without opening the bottle.
    - Any peroxide forming chemical with visible discoloration or crystallization should be treated as potentially explosive. Do not attempt to move or open these containers.

5. Manage the volume purchases, storage, use and inventory of compressed gases, especially gases that are flammable, corrosive, toxic and/or reactive.
    - Inspect all gas cylinders for intact labels. If the label is compromised, return the cylinder to the vendor immediately.
    - Check the test date stamped on the cylinder. If the cylinder has been stored in your lab long enough so that the hydrostatic test date is outdated, return the cylinder to the vendor immediately. For example, if today is March 1, 2017, all cylinders with stamped date reading

"02-28-2007" and before this date, followed by a star symbol are outdated and need to be returned.

- Remove the regulator from the gas cylinder if the cylinder will not be used for a long time. Keeping the regulator attached to the cylinder for long periods can cause it to freeze in place.

Consequence of Non-Compliance with this Policy:

The Environmental Health and Safety Department (EHS) has the authority and responsibility for the collection, transport, temporary storage, and disposal of hazardous wastes. Individual laboratories are responsible for minimizing high-hazard wastes properly managing the waste generated in their lab by complying with University policies for hazardous waste management. Non-compliance with this policy may result in the accumulation of high-hazard waste and/or unknown waste in your laboratory.

EHS coordinates and pays for the routine disposal of all hazardous waste through the University's hazardous waste vendor if the waste is properly managed in the laboratory. However, when a laboratory generates high-hazard or unknown waste as a result of not following the strategies listed above, the disposal cost for this waste will be charged back to the Department where the waste was generated. EHS may also charge the department when hazardous wastes are not properly tagged for pickup and a waste pickup request is not submitted for all wastes remaining in a lab that has been vacated (e.g., PI retires or relocates to another lab).

Appendix 3 illustrates the estimated cost of disposal for a gas cylinder with a toxic gas and expired peroxide formers.

Appendix 1. Types of Compounds Known to Autoxidize to Form Peroxides

Ethers containing primary and secondary alkyl groups (never distill an ether before it has been shown to be free of peroxide)
Compounds containing benzylic hydrogens
Compounds containing allylic hydrogens (C=C—CH)
Compounds containing a tertiary C—H group (e.g., decalin and 2,5-dimethylhexane
Compounds containing conjugated, polyunsaturated alkenes and alkynes (e.g., 1,3-butadiene, vinyl acetylene)
Compounds containing secondary or tertiary C—H groups adjacent to an amide (e.g., 1-methyl-2-pyrrolidinone)

Source:
Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards: Updated Version.
National Research Council (US) Committee on Prudent Practices in the Laboratory. Washington (DC): National Academies Press (US); 2011.

Appendix 2. Classes of Chemicals That Can Form Peroxides (this list is not inclusive; see table 1)

Class A: SEVERE PEROXIDE HAZARD. Chemicals that form explosive levels of peroxides without concentration. ***Discard within 12 months of date received, within 3 months of date opened, or within manufacturer expiration date, whichever comes first.***	
Isopropyl ether	Sodium amide (sodamide)
Butadiene (liquid monomer)	Tetrafluoroethylene
Chlorobutadiene (chloroprene)	Divinyl acetylene
Potassium amide	Vinylidene chloride
Potassium metal	
Class B: CONCENTRATION HAZARD **These chemicals are a peroxide hazard on concentration (distillation/evaporation).** ***Discard within 12 months of date received, within 6 months of date opened, or within manufacturer expiration date, whichever comes first.***	
Acetal	Dioxane (*p*-dioxane) e.g. **1,4 dioxane**
Cumene	Ethylene glycol dimethyl
Cyclohexene	ether (glyme)
Cyclooctene	Furan
Cyclopentene	Methyl acetylene
Diaacetylene	Methyl cyclopentane
Dicyclopentadiene	Methyl-isobutyl ketone
Diethylene glycol dimethyl	**Tetrahydrofuran**
ether (diglyme)	Tetrahydronaphthalene
Diethyl ether	Vinyl ethers

Cont… Appendix 2

Class C: SHOCK AND HEAT SENSITIVE **Unsaturated monomers that may autopolymerize as a result of peroxide accumulation if inhibitors have been removed or are depleted. DO NOT purchase in uninhibited form!** ***Discard within 12 months of date received, within 6 months of date opened, or within manufacturer expiration date, whichever comes first. If substance does not have inhibitor, discard within 24 hours of opening the container!***	
Acrylic acid	Styrene
Butadiene (gas)	Vinyl acetate
Chlorotrifluoroethylene	Vinyl chloride
Ethyl acrylate	Vinyl pyridine
Methyl methacrylate	

Source:
Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards: Updated Version.
National Research Council (US) Committee on Prudent Practices in the Laboratory. Washington (DC): National Academies Press (US); 2011.

Appendix 3. Sample costs of High-hazard Waste Disposal

Waste	**Stabilization, Remediation**	**Disposal cost in $**
One small cylinder each of diethylsilane and chlorine; regulator frozen in place; cylinders attached to a network of tubings and fittings	Hazmat professional was hired to remove the frozen regulator; cap the cylinder and package them from transport	1995
Expired diethylether	Remote opening and stabilization	1000 per event plus disposal fee for the chemical

⚠ CAUTION ⚠

Class A PEROXIDE FORMER

Important: *Circle earliest discard date.*

Date Received _____ discard by _____

(12 months after date received)

Date Opened _____ discard by _____

(3 months after date opened)

Manufacturer's expiration date _____

Call EH&S 777-5269 if chemical is kept past the earliest discard date.

⚠ CAUTION ⚠

Class B PEROXIDE FORMER

Important: *Circle earliest discard date.*

Date Received _____ discard by _____

(12 months after date received)

Date Opened _____ discard by _____

(6 months after date opened)

Manufacturer's expiration date _____

Call EH&S 777-5269 if chemical is kept past the earliest discard date.

⚠ CAUTION ⚠

Class C PEROXIDE FORMER

Important: *Circle earliest discard date.*

Date Received _____ discard by _____

(12 months after date received)

Date Opened _____ discard by _____

(6 months after date opened)

Manufacturer's expiration date _____

Call EH&S 777-5269 if chemical is kept past the earliest discard date.