Dealing With Hazardous Waste In A Safer Way!

SAFER SCIENCE: BE PROTECTED

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I. Regulating hazardous laboratory chemical waste

According to the Environmental Protection Agency (EPA), *a waste is determined to be hazardous if it is specifically noted on one of four lists* (the **F, K, P** and **U** lists) found in title 40 of the Code of Federal Regulations (CFR) in section 261. The **F**-list, found at 40 CFR section 261.31, identifies wastes from common manufacturing and industrial processes as hazardous. A few examples include spent solvent wastes and, electroplating and other metal finishing wastes.

The K-list identifies hazardous wastes from specific sectors of industry and manufacturing and, are considered source-specific wastes. There are 13 categories like wood preservation and organic chemicals manufacturing.

The P and **U lists** designate as hazardous waste pure and commercial grade formulations of certain unused chemicals that are being disposed.

Hazardous waste has characteristics or properties

that indicate the waste poses a sufficient threat to merit regulation as hazardous. EPA established four hazardous waste characteristics: *ignitability, corrosivity, reactivity and toxicity.*

Ignitability:

Wastes that are hazardous due to the ignitability characteristic include liquids with flash points below 60 °C, non-liquids that cause fire through specific conditions, ignitable compressed gases and oxidizers. EPA assigned **D001** as the waste code for ignitable hazardous wastes.

Corrosivity:

Wastes that are hazardous due to the corrosivity characteristic include aqueous wastes with a pH of less than or equal to 2, a pH greater than or equal to 12.5 or based on the liquids ability to corrode steel. EPA assigned **D002** as the waste code for corrosive hazardous wastes.

Reactivity:

Wastes that are hazardous due to the reactivity characteristic may be unstable under normal conditions, may react with water, may give off toxic gases and may be capable of detonation or explosion under normal conditions or when heated. EPA assigned **D003** as the waste code for reactive hazardous wastes.

Toxicity:

Wastes that are hazardous due to the toxicity characteristic are harmful when ingested or absorbed. Toxic wastes present a concern as they may be able to leach from waste and pollute groundwater. The toxicity of a waste is determined by the *Toxicity Characteristic Leaching Procedure* (TCLP) (SW-846 Test Method 1311). EPA assigned wastes codes **D004** through **D043** that correspond to a contaminant and its associated TCLP concentration.

Mixed Radiological and Hazardous Waste:

Mixed wastes are hazardous wastes which also contain radioactive material. Mixed waste is regulated under the RCRA and the Atomic Energy Act. The hazardous component of the mixed waste is regulated by EPA under **RCRA.** The radiological component of the mixed waste is regulated by the Department of Energy (DOE) or the Nuclear Regulatory Commission (NRC). The NRC typically regulates waste from commercial and non-DOE facilities while the DOE regulates waste from DOE facilities. (Source and Additional information: https://www.epa.gov/hw/defining-hazardous-waste-listed-characteristic-and-mixed-radiological-wastes#characteristic)

In addition to chemical hazardous waste, nuclear waste itself is regulated. Nuclear waste management is directed by the Nuclear Regulatory Commission under 10 CFR 20 Subpart K. This deals with the disposal of radioactive isotopes.

The Occupational Safety and Health Administration (OSHA) primarily deals with labeling and s
Hazard

Communications Standard and Bloodborne Pathogens Standard apply in these cases.

Shipping of hazardous waste is the responsibility of both the Department of Transportation (DOT) and EPA. Standards for labeling, signage, etc. are addressed.

In addition to federal regulations on waste, state and local regulations exist and should be investigated for applications to school science laboratories.

Given all of these hazardous waste regulations, schools have responsibility in taking care of

Stanford University Compatible Storage Group Classification System
Should be used in conjunction with specific storage conditions taken from the manufacturer's label and MSDS.

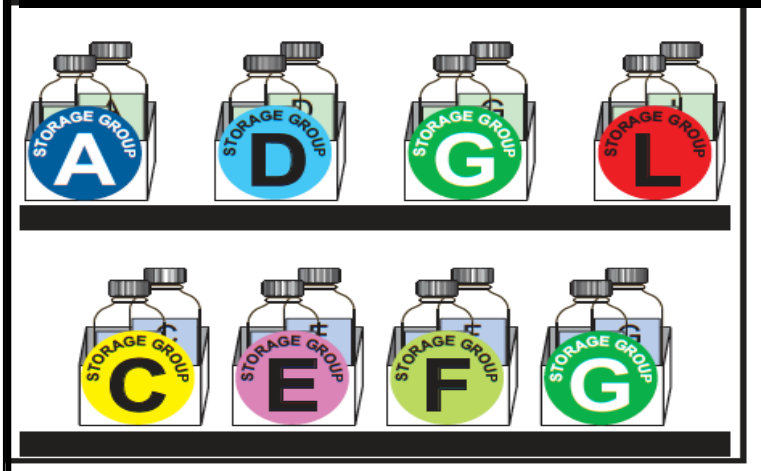
STORAGE GROUPS

Store chemicals in separate secondary containment and cabinets Find Storage Group information in Chemtracker: https://chemtracker.stanford.edu/chemsafet

- **A** Compatible Organic Bases
- **B** Compatible Pyrophoric & Water Reactive Materials
- **C** Compatible Inorganic Bases
- **D** Compatible Organic Acids
- **E** Compatible Oxidizers including Peroxides
- **F** Compatible Inorganic Acids not including Oxidizers or Combustible
- **G** Not Intrinsically Reactive or Flammable or Combustible
- **J*** Poison Compressed Gases Compatible Explosive or other highly Unstable Material
- **K *** Compatible Explosive or other highly Unstable Material
- **L** Non-Reactive Flammable and Combustible, including solvents
- *** X** Incompatible with ALL other storage groups

*Storage Groups J, K and X: Contact EH&S @ 3-0448
For specific storage - consult manufacturer's MSDS

If space does not allow Storage Groups to be kept in separate cabinets the following scheme can be used with extra care taken to provide stable, uncrowded, and carefully monitored condition



Storage Group X must be segregated from all other chemicals.

Storage Group B is not compatible with any other storage group.

hazardous waste produced in their science laboratories and may have legal responsibilities from governmental agencies.

II. Does your school contain hazardous waste?

The first thing to do is to determine if and where hazardous waste is being generated. Usually chemistry laboratories are prime candidates by the nature of the discipline, though other labs may also be producing waste. More recently, middle school life science and high school biology laboratories have the potential to produce biological or medical waste as the result of biology, biotechnology and microbiology course work. Other areas for hazardous waste production may include art rooms, technology education/Engineering Labs, STEM labs and maintenance shops/custodial closets.

The second thing to determine is whether the waste being produced is hazardous or nonhazardous. This determination will dictate how to handle the waste. All waste chemical solids, liquids, or containerized gases should be treated as hazardous waste unless they have been confirmed to be a non-hazardous waste. Remember that a laboratory chemical is "waste" when you no longer plan to use it. Also remember that spilled chemicals and materials used to clean them up are hazardous waste. In addition to stock chemicals, items containing chemicals are also to be considered; e.g., paints, solvents, glues, disinfectants, etc. A generator can make the determination based on information supplied by the manufacturer, having the waste tested or having the chemical listed in the *Resource, Conservation and Recovery Act* (RCRA). (Part 261—Identification and listing of hazardous waste - https://www.law.cornell.edu/cfr/text/40/part-261 The final thing to determine is how to manage the waste appropriately. Depending on the type of waste will dictate if it is subjected to regulatory statute.

Iii. Options for dealing with waste disposal!

There are appropriate methods in how to deal with the disposal of middle and high school science department waste. Examples of these management methods are:

A. Recycling procedures;

B. Discharge to municipal water treatment facilities (sewage systems). Local regulations will dictate what is allowed for disposal in this method. For example, strong acids might be diluted to a pH of around 3-7 before pouring down the drain at a relatively slow rate.

C. Discharge into the atmosphere;

D. Disposal into local refuse or solid waste collection;

E. Disposal via state recognized waste contractor.

Again – which waste disposal process will be used is dictated by what the hazards are in the waste. One disposal process does not fit all hazardous chemicals!

IV. What kind of waste generator are you?

U.S. Federal government agencies and to some degree, state and local governments, regulate hazardous waste. A little history of waste regulation in the US is provided as an example. As noted, before, in 1976, the U.S. Congress enacted the *Resource, Conservation and Recovery Act (RCRA)* to address a growing waste problem. RCRA directed the U.S. Environmental Protection Agency (EPA) to protect the general public and environment from improper hazardous waste management practices. The RCRA provided a framework for controlling the generation, transport, and disposal of solid and hazardous waste "from cradle to grave." School science laboratories are not totally exempt from federal and state waste regulation! In 1984, the Hazardous and Solid Waste Amendments (HSWA) to RCRA became law.

Congress defined hazardous waste generators by three categories: conditionally exempt small quantity generators (CESQG), small quantity

generators (SQG), and large quantity generators (LQG).

CESQG: If a site generates 220 pounds (100 kg) or less of hazardous waste per month, it is considered a CESQG.

SQG: If a site generates more than 220 pounds (100 kg) but less than 2200 pounds (1000 kg) of hazardous waste per month, it is considered an SQG for that year.

LQG: If a site generates 2200 pounds (1000 kg) or more of hazardous waste in per month of the calendar year, it is considered an LQG for that year.

Note that the status could change from one month to another and be subject to the management requirements for that new classification.

To determine the appropriate classification, all quantities of hazardous waste must be inventoried that are generated and collected at the work site prior to treatment or disposal on a monthly basis. Also waste packaged and transported offsite per month. Generators are not only defined by the amount they generate, but also the amount they store.

Not all waste must be counted. For example, waste directly discharged to a water treatment plant without being stored or accumulated first. This discharge however is subject to Clean Water Act provisions and other local regulations. Hazardous waste that are to be recycled do not need to be considered, but must be managed as hazardous waste until they are recycled.

It must also be noted that most states have additional hazardous waste regulations that must be followed. It is only prudent to check with state environmental office for additional requirements.

V. CESQG still has disposal requirements!

CESQC or Conditionally Exempt Small Quantity Generators are exempt from all RCRA notification, reporting, and manifesting requirements. However, they are required to send their wastes to permitted or interim status treatment, storage, or disposal facilities, or to legitimate recycling or to legitimate recycling or reclamation facilities.

All but the largest urban or county school districts are classified as CESQGs. The federal hazardous waste laws however do require CESQGs to:

a. Identify (check Safety Data Sheets - #15. Regulatory information) and inventory all hazardous waste it produces;
b. Forward waste to a permitted, licensed, or registered hazardous waste facility or landfill or other locations approved by state regulations (40 CFR 261.5(f)(3)).;
c. If the hazardous waste is treated or disposed of on site, the facility must be able to use, reuse or legitimately recycle the waste.
d. Never store more than 1000 kg of hazardous waste on property.

Again, specific regulations on waste management and disposal are relative to national and/or local governments. These should be secured and reviewed prior to developing policies and procedures at a local school. A helpful guide is the *"Managing Hazardous Waste: A Guide for Small Businesses"* by the EPA can be found at: https://www.epa.gov/sites/production/files/2019-10/documents/10008_managingyourhazwaste_508pdf_october_16_2019.pdf

Vi. How can hazardous waste be dealt with?

The cost of addressing laboratory waste has been increasing exponentially. However, planning and setting waste reduction goals can significantly reduce the cost of dealing with waste over the long term. In addition to helping the environment, waste management programs

help to reduce or eliminate potential liabilities. The following items represent the basic components of a program to reduce laboratory waste production in middle and high school laboratories:

A. Develop Chemical Practices:

Practices need to be established from what and how much to purchase to inventorying and disposal programs. Use coordinated planning in procurement procedures. For example, many schools purchase numerous bottles of the same chemicals or buy in too large volumes. Also, try substituting less-hazardous chemicals for experiments. As an example, in lieu of para-Dichlorobenzene for freezing point depression labs, use lauric acid and benzoic acid as substitutes.

B. Develop Laboratory Practices:

Microchemistry has been an adopted practice in many school chemistry labs and for a good reason. Scaled down volumes of chemicals in lab experiments reduce cost of chemical use from cradle to grave, especially in challenging budget times, take up less storage space and have less chance of decomposition. Pre-massing chemicals for use by students is another strategy. Have waste storage planned in advance of its production. Try to recycle spent solvents. Plan to dispose of hazardous waste via appropriate methods.

CESQG's are allowed to perform waste minimization procedures, such as neutralizations,

redox reactions and precipitations. Middle and high school science laboratories can use methods to convert waste to innocuous, non-hazardous forms or minimization of waste volume. Disposal procedures can be used on inorganic acids, organic acids, inorganic bases and anhydrides, halogenated hydrocarbons, non-halogenated hydrocarbons, peroxides, oxidizing agent, chromates, dichromates and permanganates, reducing agents, sulfides, inorganic, carbides, halogens, heavy metal salts (soluble) and mercury and mercury compounds. Procedures exist for each of these categories but should only be done with small quantities under a fume hood. Chemical splash goggles, gloves and apron.

VII. In the end!

In Connecticut, the State of Connecticut Department of Environmental Protection Bureau of Materials Management and Compliance Assurance Waste Engineering & Enforcement Division regulates hazardous waste management. They have developed an informational resource titled: *Environmental Program Fact Sheet Hazardous Waste Management in Academic Laboratories.* It can be found at: https://portal.ct.gov/-/media/DEEP/waste_management_and_disposal/hazardous_waste/HW_Management_in_Academic_Laboratories.pdf It is the legal responsibility of school administrators to follow the hazardous waste disposal regulations noted in this fact sheet. Science teachers generating the hazardous waste also have the responsibility to inform their employer of these requirements.

The bottom-line is that laboratory waste disposal must be addressed, even in middle and high school laboratories. If not, it will only grow out of control! Pay now or pay more later.!

LIVE LONG AND PROSPER SAFELY!

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