Hazardous Materials Disposal Guide

Policies and Procedures Reference

Questions and comments related to this guide can be directed to:

Laboratory Safety Coordinator
Environmental Health and Safety
100 College Drive
North Bay, Ontario P1B 8L7
e-mail: davev@nipissingu.ca
Phone: (705) 474-3450 ext. 4180

Emergency Contact Information

In case of emergency:	911
Security Services Cell (available 24 hours):	(705) 498-7244 or (705) 471-2488
Laboratory Safety Coordinator/Biosafety Officer:	(705) 474-3450 ext. 4180

Emergency Procedures

Chemical Spill

On Body

- Rinse affected area immediately for 15 minutes using emergency shower, if required.
- Care must be taken to avoid contamination with face and eye(s).

In Eye(s)

- Immediately flush eye(s) using emergency eyewash station for a minimum of 15 minutes.

In Laboratory

- Assess the scene. If the situation is beyond your capabilities, contact your supervisor, Laboratory Safety Coordinator or Security Services.
- If safe to do so, turn off any ignition sources if flammable material is present.
- Use spill kits to assist in spill containment.
- Dispose of waste material with other hazardous waste.

Report the injury/incident to your supervisor as soon as possible.

Contents

Acknowledgements

Portions of this manual are based on the University of Windsor, the University of Toronto and the University of Guelph's hazardous materials disposal guidelines. Their assistance in shaping Nipissing University's hazardous waste disposal guide is greatly appreciated.

Overview

Hazardous wastes can range in nature from laboratory chemicals, broken glass, used motor oil, paints and thinners, biomedical wastes, biohazardous waste, unused cleaning products, batteries, etc. All of these wastes require special handling and disposal considerations in order to protect human health and the environment.
The purpose of this guide is to ensure that all waste that is collected is packaged, handled and disposed of in an environmentally friendly manner that will minimize the impact on human health and safety, within the scope of all applicable laws and regulations. Please remember that the best reference for the safe handling, storage and disposal of many hazardous waste products is the product's safety data sheet (SDS). SDS's can be found for most products, including those products obtained from a retail outlet. SDS's can be accessed via the intranet at http://SDS.nipissingu.ca or in some cases, an SDS binder located adjacent to the chemical storage area.

Introduction

Nipissing University generates a wide variety of hazardous waste from a diverse set of operations ranging from academic programs such as Biology, Chemistry, Neuroscience and Fine Arts to University operations such as Print Plus and Building Maintenance Services. Nearly all facets of the university community generate hazardous waste.
Some of the types of hazardous waste that may be generated are:

- Toxic, reactive, explosive and ignitable laboratory waste;
- Waste solvents from printing and painting operations;
- Corrosive wastes from cleaning operations;
- and, Other miscellaneous wastes from across the campus.

To deal with this waste, Ontario has developed a comprehensive legislative and regulatory framework to ensure that hazardous waste is handled in an environmentally safe manner. The Environmental Protection Act (EPA) and its accompanying regulations ensure the systematic control of collection, storage, transportation, treatment, recovery and disposal of hazardous waste. It is incumbent on all individuals and departments that produce hazardous waste to ensure that the Act and its regulations are followed.

Responsibilities

The management of hazardous chemical waste at Nipissing University consists of the coordination and collection of the waste generated in laboratories and other campus facilities. To effectively manage this program, it is necessary to use the services and technical expertise of the Laboratory Safety Coordinator, the Human Resources Generalist - Health, Safety and Wellness, faculty, and staff members. This part briefly describes the function and responsibility of each group and its relation to hazardous chemical and biological waste management.

Laboratory Safety Coordinator

The Laboratory Safety Coordinator, is responsible for surveillance of all laboratory activities involving the use of chemical agents and all additional chemical problem areas within the confines of the University. Specific duties include:

1. Implementation of policies established by the University.
2. Design and implementation of disposal procedures for chemical waste materials.
3. Preparation, submission, and maintenance of records, reports, and manifests as required by government regulations.
4. Preparation of applications for provincial and federal permits to properly generate and dispose of hazardous chemical waste.
5. Assuring that University policies and guidelines regarding the proper disposal of hazardous chemical waste are followed.

Responsibilities of the End-user

The success of the hazardous waste management program depends on the conscientious efforts of all persons who use hazardous materials. When hazardous materials are mismanaged they have the potential to pollute the environment and threaten human health. Under the Consolidated Transportation of Dangerous Goods Regulations (SOR/2017-253), the responsibility for classification of the hazardous waste is the person who formulates, blends or otherwise prepares the mixtures or solutions. Anyone handling hazardous waste must follow the instructions outlined in this guide. They are expected to:

- Package, label and store hazardous waste and unwanted chemical products according to the procedures outlined below;
- Identify, classify and label all chemical wastes properly so that unknowns are not generated;
- When in doubt, seek the advice of their supervisor, Laboratory Safety Coordinator for procedures on how to handle, classify and/or dispose of any chemical product; and,

- Make every effort to reduce the amount of hazardous waste generated.

Labs that cease operations or change hands

When laboratories change hands or when a faculty member or researcher leaves the University, there are often unknown and unwanted chemicals left behind. The ensuing cleanup and disposal of chemicals is time-consuming and costly. Before a faculty member or research investigator leaves the University, either the departing individual or the department must take responsibility for the removal of chemical wastes. The departing individual should notify their Department Head and the Laboratory Safety Coordinator before he/she ceases laboratory operations. In the event that an individual 'abandons' a laboratory, the Department Head or designee shall take this responsibility. All waste chemicals shall be identified, labeled, and stored properly prior to the pre-arranged pickup date.

Managing waste and unwanted chemicals

There are three routes of disposal for waste chemicals:

1. Disposal by an outside waste management firm or entity;
2. Disposal of non-hazardous materials into the normal trash or sanitary sewer system; and,
3. Chemical treatment, such as neutralization, followed by disposal into the sanitary sewer system. **Note: Any treatment method other than neutralization must be incorporated into an experimental procedure to be considered legal.**

Hazardous waste minimization

It is important to minimize the generation of waste in order to reduce unnecessary expenditure of University funds (and ultimately your department's funds) on waste disposal and material procurement. This can be accomplished by following the guidelines below:

1. Chemical inventory

The most important step towards waste minimization is to maintain a running inventory of chemicals present in the laboratory. An inventory will prevent you from ordering more of what you already have. It also helps you to ensure that the chemicals are stored properly and can be an invaluable tool in emergency situations.

2. Order only what you need

Don't buy a kilogram of material when you plan to use only a few grams. The economy of size may be offset by the cost of disposing of your excess. Before ordering chemicals, check your current stock and check the SDS database to see what is available in other laboratories – you may be able to borrow small amounts from other laboratories.

3. Substitute non-hazardous or less hazardous materials

There are many non-hazardous substitutes for commonly used chemicals. Other alternatives may be much less toxic. These substitutions can be done with satisfactory results in most cases.

4. Do not mix hazardous and non-hazardous waste

Non-hazardous waste when mixed with hazardous waste will become hazardous. Do not mix small quantities of hazardous waste with non-hazardous waste because it will increase the volume of hazardous waste produced. Likewise, high concentration waste should not be mixed with low concentration waste.

Waste packaging and labeling

General waste packaging instructions

- All waste must be packaged in containers that are compatible with the material being packaged. The outsides of the containers must be free of contamination, securely closed and capable of containing the waste inside.
- The container size should fit the amount of waste inside as nearly as possible to reduce disposal costs (cost is associated with the container size not the amount contained). Liquid waste containers should never be filled to more than 75% capacity to allow for expansion of the liquids and headspace vapours.
- Prior to placing any waste into the waste container a hazardous waste label must be completely filled out, signed and affixed to the outside of the container (see Appendix 2 for an example).

Characterization of hazardous waste

Hazardous waste is surplus material that is no longer of either commercial or research value and poses substantial or potential threats to public health, the environment or property. It can

also be a laboratory generated hazardous by-product of an experimental procedure. RRO Regulation 347 and the Consolidated Transportation of Dangerous Goods Regulations requires that all waste must be fully characterized and that the characterization must be documented before it can be offered to a hazardous waste disposal company. The container must be labelled with a fully filled out hazardous waste label containing the hazard characterization (see Appendix 3). Hazardous waste generally exhibits one or more of the following characteristics: (1) ignitibility; (2) reactivity; (3) oxidizing ability; (4) corrosivity; (5) toxicity.

1. **Ignitibility** refers to characteristic of a waste that is capable of causing or intensifying a fire during routine handling. There are three designations of ignitable materials, which may be solid, liquid or gas.
    - **Flammable** materials will burn or catch on fire easily below 37.8 °C (100 °F);
    - **Combustible** materials which must be heated before they catch on fire at temperatures between 37.8 °C (100 °F) and 93.3 °C (200 °F).
    - **Reactive flammable** materials are those which may suddenly start burning when it touches air or water, or may react with air or water to make a flammable gas (e.g. sodium metal, lithium metal, etc.). Can include oxidizing substances and organic peroxides.
2. **Reactivity** refers to ability of a waste to undergo extremely hazardous uncontrolled reactions. Dangerously reactive waste can cause explosions, fires or extreme heating, with potential for significant personal injury and property damage (e.g. peroxide forming compounds, sodium metal, etc.). It also refers to those cyanide or sulphide-bearing wastes that if exposed to pH conditions between 2.0 and 12.5 can generate toxic gases or a compound that when exposed to water emits toxic gases.
3. **Oxidizing** ability refers to the ability of a chemical to spontaneously evolve oxygen. When in contact with wooden cabinets and other cellulose materials oxidizers may spontaneously ignite the material. They may also yield oxygen to the fire, greatly increasing the fire's effect (e.g. hydrogen peroxide, sodium nitrate, nitric acid, etc.) .
4. **Corrosivity** refers to the ability of any solid, liquid, or gaseous substance to burn, irritate, or destructively attack organic tissue. Chemicals with a pH value less than 2.0 (acidic) or greater than 12.5 (basic) are considered to be corrosive substances.
5. **Toxicity** refers to the degree that a chemical can cause damage to living tissue, impairment of the central nervous system, severe illness, or death when ingested,

injected, inhaled, or absorbed through skin (e.g. methyl viologen, mercury, benzene, etc.).

Classification of Hazardous Waste

Hazardous waste usually comes in two forms: solid and liquid. **If a waste container contains both a solid and any amount of free liquid (liquid not bound by an absorbent), it is a "liquid."**

All hazardous waste must be segregated into one of a number of waste categories based on its chemical and physical properties (see Figures 1 and 2). For pure or surplus chemicals, the chemical's SDS should be consulted before deciding how best to categorize the chemical waste being generated. For mixtures of chemicals destined for waste, the waste category must be determined.

Please keep in mind that there are some materials that require special handling before, during and after disposal. These include organic peroxides, PCBs (polychlorinated biphenyls) and explosives. Before disposing of these materials, consult with the Laboratory Safety Coordinator. The following broad groupings are based on chemical properties.

Organic Waste – Phenol

Any waste that contains phenol or phenol mixtures, including phenol-acid mixtures and phenol-chloroform mixtures.

Organic Waste - Halogenated

A halogenated organic is one that contains one or more of the Group 17 elements (F, Cl, Br, I, At). Halogenated organic waste is any halogenated solvent mixed with less than 20% water or an organic compound that has been dissolved in halogenated solvents. **The solvent must be acid and peroxide free.**

<u>Incompatible with</u>: Acids, bases, oxidizers and peroxides. Refer to the SDS in all cases.

Examples of halogenated organic solvents are (please note that this list is not exhaustive):

1,1,1,2-Tetrachloroethane	Bromoform	Glycerol trichlorohydrin
1,1,1-Trichloroethane	Bromomethane	Hexachlorobutadiene
1,1,2,2-Tetrachloroethane	Carbon tetrachloride	Hexachlorocyclopentadiene
1,1,2-Trichloroethane	Chlorodibromomethane	Hexachloroethane
1,1-Dichloroethane	Chloroethane	Methylene Chloride
1,1-Dichloroethylene	Chloroform	Neoprene
1,2,2-Trichloroethane (Freon 113)	Chloromethane	Pentachloroethane

1,2-Dichloroethane	Chloropropane	Perchloroethylene
1,2-Dichloropropane	Cis-1,2-dichloroethylene	Propylene dichloride
1,2-Trans-dichloroethylene	Cis-1,3-dichloropropene	Trichlorotrifluoroethane
1,3-cis-dichloro-1-propene	Dibromochloropropane	Monochlorobenzene
1,3-trans-dichloropropene	Dibromomethane	Tetrachloroethylene (Perchloroethylene) (PCE)
1-chloro-2-propene	Dichlorobromomethane	Trichloroethylene (TCE)
2-butylene dichloride	Dichloromethane	Vinyl chloride
Acetylene tetrachloride	Ethylene dibromide	Vinyl trichloride
Bromodichloromethane	Fluorotrichloromethane (Freon 11)	Vinylidene chloride

Organic Waste – Corrosive

Organic Acids

Most organic acids are termed 'weak' acids and some are flammable as well as being corrosive.

Incompatible with: Flammable liquids, flammable solids, oxidizing inorganic acids bases, oxidizers. Refer to the SDS in all cases.

The following organic acids and their wastes should be kept in a flammable storage cabinet.

Acetic acid	Propionic acid
Glacial acetic acid	Trichloroacetic acid (TCA)
Butyric acid	Trifluoroacetic acid (TFA)
Formic acid	Isobutyric acid
Mercaptopropionic acid	

For any organic acid not listed above, refer to the SDS for hazardous waste handling instructions.

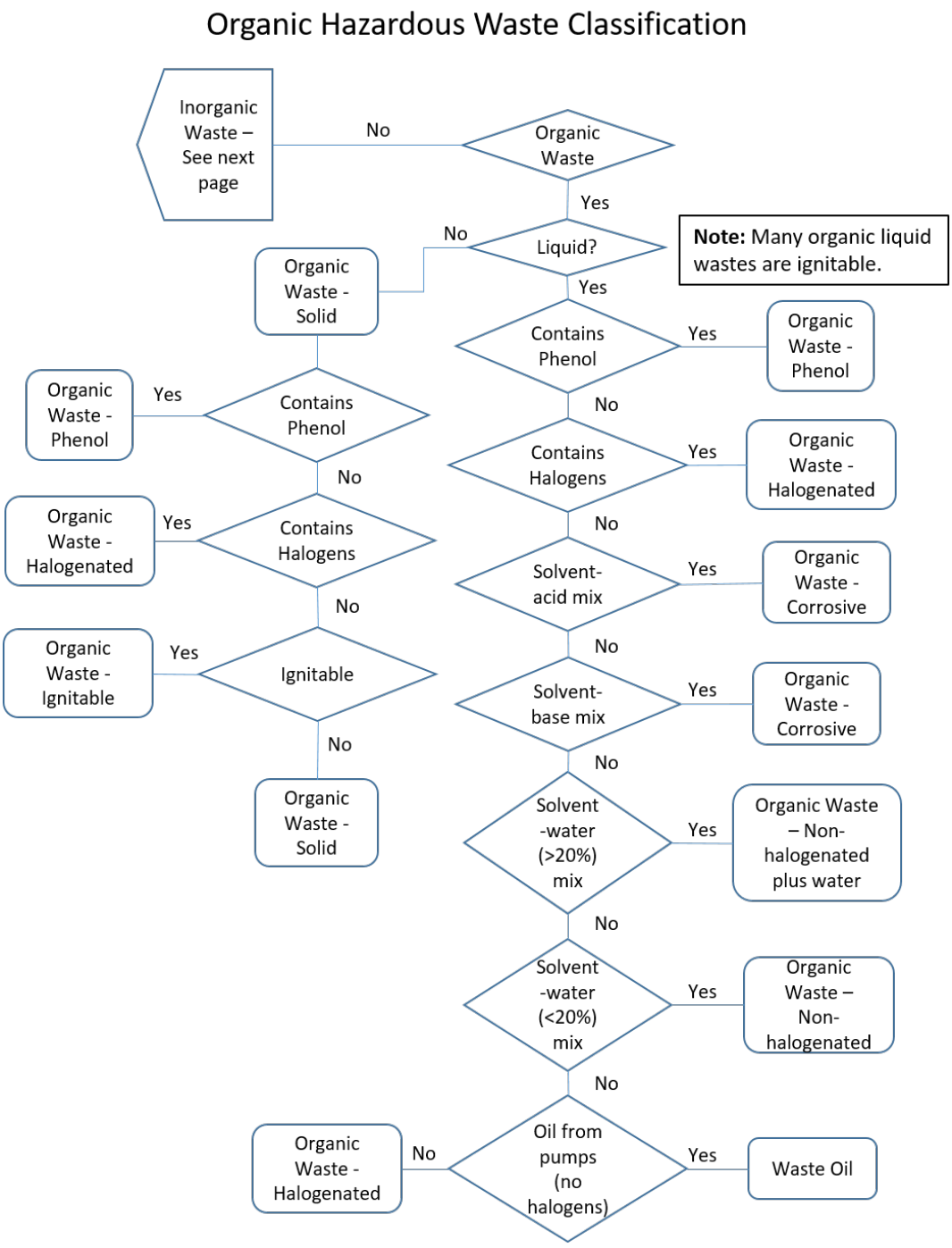


Figure 1. Organic waste stream classification flow chart. See text below for detailed explanations of each waste classification.

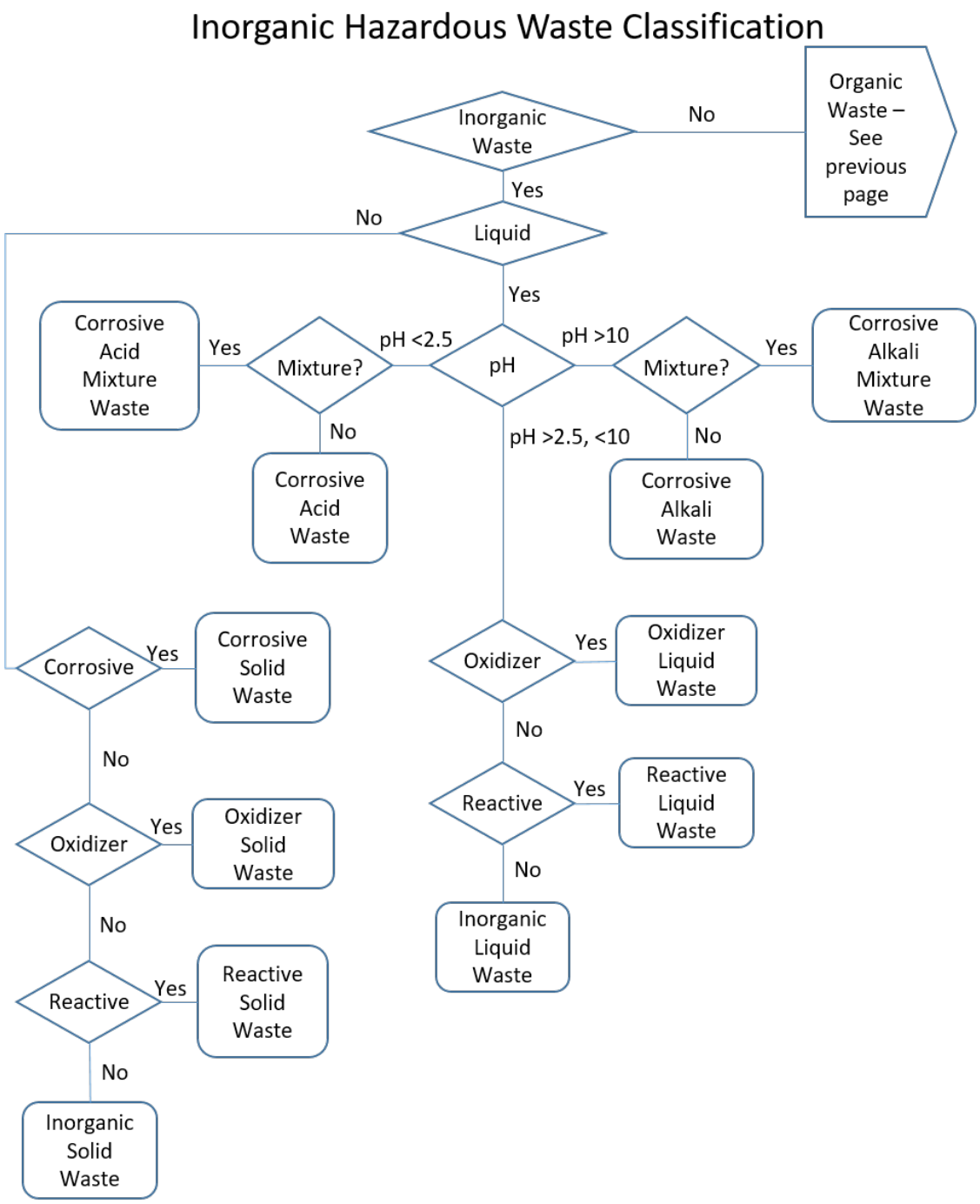


Figure 2. Inorganic waste stream classification flow-chart. See text below for detailed explanation of each waste classifications.

Organic Bases

An organic base is an organic compound that acts as a base and can usually accept a proton. All organic bases are considered to be weak bases.

Incompatible with: Flammable liquids, flammable solids, inorganic bases, oxidizers. Refer to the SDS in all cases.

Some examples include:

- Benzimidazole
- Histidine
- Hydroxides of some organic cations
- imidazole
- Methyl amine
- Pyridine
- Phospazene bases

Organic Waste – Non-halogenated plus water

Non-halogenated organic solvent waste is any non-halogenated organic solvent-water mixtures or non-halogenated solvents with greater than 20% water.

Some examples include:

- Acetonitrile/water HPLC waste
- 70% ethanol/water mixture

Organic Waste – Non-halogenated

Non-halogenated organic solvent waste is any non-halogenated organic solvent mixed with less than 20% water or an organic compound that has been dissolved in non-halogenated organic solvents. They should be stored in flammable cabinets prior to disposal.

Incompatible with: Acids, bases and oxidizers. Refer to the SDS in all cases.

Examples of non-halogenated organic solvents are as follows (please note that this list is not exhaustive):

- Acetone
- Acetonitrile
- Benzene
- Ethanol
- Ethyl Acetate
- Heptane
- Hexane
- Pentane
- Petroleum Ether
- Toluene
- Xylene

Waste Oil

Any petroleum based or synthetic oil that is contaminated and thereby unsuitable for its original purpose. Examples of waste oil are: used vacuum pump oil, crankcase oil, hydraulic oil, mineral oils. **Does not include** oils that are contaminated with halogenated materials or halogenated oils such as cutting oils. It is advisable to utilize the same type of container that the oil originally came in (HDPE plastic container).

Corrosive Acid Waste (pH <2) (do not mix)

Inorganic Acidic Waste

Inorganic acids (or mineral acids) are derived from one or more inorganic compounds and tend to be very soluble in water. Inorganic acids range in strength from very strong to very weak. These acid wastes should not be combined, but should be stored in separate glass bottles in the acid storage cabinet.

Incompatible with: Flammable liquids, flammable solids, inorganic bases, oxidizers. Refer to the SDS in all cases.

Some common acids are listed below (in alphabetical order):

Acid	Strength
Chlorosulfuric acid (HSO_3Cl) *	Strong
Hydrobromic Acid (HBr)	Strong
Hydrochloric Acid (HCl)	Strong
Hydroiodic Acid (HI)	Strong
Nitric Acid (HNO_3) **	Strong
Perchloric Acid ($HClO_4$) **	Strong
Sulfuric Acid (H_2SO_4)**	Strong
Boric Acid	Medium – weak
Carbonic acid	Medium – weak
Hydrofluoric acid ***	Medium – weak
Phosphoric acid	Medium – weak

* Chlorosulfuric acid reacts violently with water to produce hydrochloric acid and sulfuric acid.

** Nitric acid, Strong Sulfuric acid and Perchloric acid are strong oxidizers in addition to being strong acids. They must be segregated from other mineral acids and handled like strong oxidizers.

*** Hydrofluoric acid, while being a weak acid, has other properties that make it dangerous to handle without proper training and safety precautions. Please consult the NU Laboratory Safety Manual for instructions on handling hydrofluoric acid.

Aqueous Inorganic Acid Salt Waste

Aqueous inorganic acid salts are salts that have been formed from the partial neutralization of diprotic or polyprotic acids. Some of these salts, when dissolved in water exhibit acidic properties.

Incompatible with: Flammable liquids, flammable solids, bases, oxidizers. Refer to the SDS in all cases.

Examples include:

- Ferric chloride
- Sodium bicarbonate
- Sodium bisulfate
- Sodium hydrosulfide
- Sodium sulphate

Corrosive Alkaline Waste (pH >12.5) (do not mix)

Inorganic Bases

Most inorganic bases are solid at room temperature and when dissolved in water have a bitter taste, feel soapy, will turn red litmus blue, and can conduct an electric current. The most common inorganic bases are hydroxides. Other inorganic bases include ammonia and many metal oxides. These compounds, either dry or aqueous should not be mixed, but should be kept separate.

Incompatible with: Flammable liquids, flammable solids, oxidizers. Refer to the SDS in all cases.

Some of the more common inorganic bases are listed below (in alphabetical order):

- Aluminum hydroxide
- Ammonium hydroxide (ammonia water)
- Calcium carbonate
- Calcium hydroxide
- Calcium oxide
- Magnesium carbonate
- Magnesium hydroxide
- Potassium hydroxide
- Potassium carbonate
- Sodium bicarbonate
- Sodium carbonate
- Sodium hydroxide

Reactive Solid Waste - alkali metals and other air and water reactives

This group of chemicals contains all the other reactive/explosive chemicals including water reactive, sulfides, and cyanide compounds. Cyanides and sulfides should be kept away from acids.

Incompatible with: Flammable liquids, flammable solids, bases, oxidizers. Refer to the SDS in all cases.

These chemicals include:

- Acetyl chloride
- Anhydrous aluminum chloride
- Arsenic
- Benzyl peroxide
- Bromine
- Calcium metal
- Chlorosulfonic acid
- Cyanide compounds
- Lithium metal
- Metal hydrides
- Nitric acid above 40%
- Phosphorus (all forms)
- Phosphorus pentoxide
- Potassium metal
- Selenium
- Silanes
- Sodium metal
- Sulfide compounds
- Tellurium
- Thionyl chloride

Reactive Liquid Waste - Peroxide forming chemicals

Sensitive to light and heat, this class of compounds reacts with air and light to form unstable peroxides. Before opening containers of peroxide forming solvents, check for crystal formation that may indicate the presence of peroxides. Do not open any container that has crystals around the cap or has a fitted glass top or metal cap as it may cause sparks. Peroxides are shock and heat sensitive.

Once opened, stocks of these peroxides forming chemicals should be used within the specified time frame. It is essential to label all peroxide forming chemicals with the date received, date opened and expiration date (Figure 1).

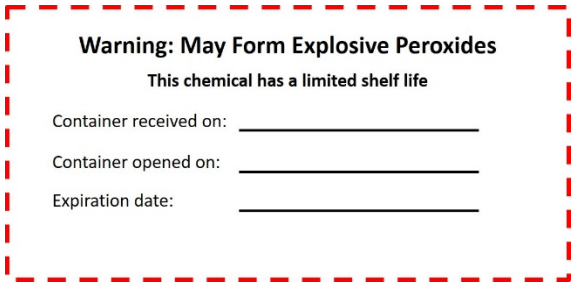


Figure 3. Peroxide warning label to be affixed to all peroxide forming chemicals.

After six months they must be tested for peroxide formation. These tests are easily done with inexpensive test strips. Never distill peroxide-forming solvents unless first tested and found to be free of peroxides. Peroxides concentrated in the pot residue still pose a serious explosion hazard and must be handled carefully.

Solvents which may form peroxides after 6 months (or 3 months after opening) include:	Solvents which may form peroxides after 12 months (or 6 months after opening) include:	Solvents which may form peroxides after 24 months include:
Cyclohexanes	Acrylonitrile	Acetal
Cyclooctene	Butadiene	Acrylic acid
Diethyl ether	Chlorotrifluoroethylene	Chloroprene
Dioxanes	Tetrafluorethylene	Diethylene glycol dimethyl ether (Diglyme)
Isopropyl ether	Vinyl chloride	Decahydronaphthalene (Decalin)
Sodium amide	Vinyl ethers	Dicyclopentadiene (Tetralin)
Tetrahydrofuran (THF)	Vinylidene chloride	Dimethyl ether
		Diacetylene
		Methyl acetylene

		Methyl methacrylate
		Styrene diacetylene
		Tetrahydronaphthalene
		Vinyl pyridine

(Note: "petroleum ether" is often erroneously treated as if it were in the ether chemical class. Petroleum ether is a mixture of light hydrocarbons and, although highly flammable is not a peroxide-forming material.)

Oxidizer Solid and Liquid Waste - Strong Oxidizing/Reducing Agents

This class of chemicals causes severe reactions when mixed with incompatible materials including violent polymerization with generation of heat, production of unstable or pyrophoric compounds, and production of flammable gases. Fire may also result.

Incompatible with: Flammable liquids, flammable solids, bases, oxidizers. Refer to the SDS in all cases.

These chemicals include:

Oxidizing agents	Reducing agents
Chromic acid (fresh)	n-butyl lithium
Metallic chlorates	Metallic sulfides
Metallic nitrates	Calcium hydride
Metallic perchlorates	Sodium hydride
Perchloric acid	Stannous chloride
Peroxides	

Inorganic Solid and Liquid Waste - Heavy metal solutions and salts

All heavy metals compounds and solutions containing them must be kept separate from other materials to facilitate disposal.

Incompatible with: Flammable liquids, flammable solids, bases, oxidizers. Refer to the SDS in all cases.

Examples of heavy metals are:

Arsenic	Barium
Cadmium	Chromium
Lead	Mercury
Selenium	Silver

Unstable chemicals

Inorganic Acid Mixtures – Danger

In some applications acids are mixed to form a stronger or more reactive form of acid. These mixtures should be treated with care and the hazards associated with the production and use of these acid mixtures should be thoroughly investigated prior to their production. Two of the more common forms of acid mixtures are Aqua Regia and Piranha Solution.
In all cases, only prepare the amount needed for immediate use. Label container as per WHMIS procedures. **Never store** mixtures of highly corrosive acids and *never put it in a sealed container*, since pressure from evolving gases accumulates and can possibly cause an explosion. Never take these acids out of the fume hood in which they are prepared and do not store them there either. Use them immediately after preparation and destroy any excess in the fume hood in which they were prepared.
Mixing either of these solutions with organic compounds or solvents can cause a violent reaction and possibly an explosion. This includes acetone, photoresist, isopropyl alcohol, and nylon.

Aqua Regia

Aqua Regia is a mixture of concentrated hydrochloric acid and concentrated nitric acid that has been used for centuries for dissolving noble metals (gold, silver and platinum). Aqua Regia is a highly corrosive solution that is also a powerful oxidizing agent that is inherently unstable (given the fact that the activity of Aqua Regia decreases slowly and gives off brown fumes of nitrogen peroxide. **Aqua Regia should be freshly prepared, never stored in a closed vessel. Render it safe by dilution and neutralization.**
Aqua regia can be destroyed safely by cautiously adding it to water to dilute, and then neutralize the diluted solution with sodium bicarbonate (baking soda). The resulting contents can be disposed as chemical laboratory waste. A box or two of ordinary sodium bicarbonate (baking soda) or other commercial spill kits should be nearby to effectively neutralize acid spills.

Piranha Solution

Piranha solution is a 3:1 mixture of concentrated sulfuric acid and hydrogen peroxide. Piranha solution is very energetic and potentially explosive and is very likely to become hot when it is made, more than 100 degrees C, producing an exothermic reaction with gas release. There are many factors that will cause the reaction to accelerate out of control, causing an explosion and fire. The following procedures and precautions must be observed when using Piranha solution.

1. Do not move Piranha waste from the chemical fume hood where it was generated.

2. Prior to collection and storage of the Piranha solution, it must be left in an open container inside a chemical fume hood in order to cool down and allow the gases from the solution to dissipate for at least 24 hours.
3. The cooled Piranha solution may be transferred into the Piranha waste bottle. When transferring, make sure no heat is produced or reactions are occurring.
4. Following the transfer, the Piranha waste bottle contents must be swirled to achieve agitation.
    - Following each addition, the contents of the Piranha waste bottle must be swirled to achieve agitation. Stirring with glass rods or stir bars is not recommended since scoring of the container may occur and stir bar coatings may be damaged or removed by Piranha solutions.
    - Following the LAST ADDITION – as with all other additions – the contents of the Piranha waste bottle must be swirled.
    - After a minimum of 48 hours, the contents should again be swirled and the action documented.
    - A Piranha waste bottle may be considered CLEARED FOR SUBMISSION after the second consecutive agitation with no reaction observed. These consecutive agitations must be separated by a minimum of 48 hours.

5. Do not place caps on Piranha waste bottles. Caps will be put on by the chemical waste company technician at pickup.
6. Do not fill Piranha waste bottles above 75% of capacity.
7. Maintain a log of all additions to Piranha waste bottles including the user name, date, time, amount, concentration (3:1, 5:1, etc.), and verification of swirling.
8. Do not keep Piranha waste on hand for extended periods of time. The LAST ADDITION to a Piranha waste bottle should be no later than 3 months after the first.

Designated Substances

There are eleven substances that are covered under O. Reg. 490/09 Designated Substances. These substances include acrylonitrile, arsenic, asbestos, benzene, coke oven emissions (not applicable to Nipissing University), ethylene oxide, isocyanates, lead, mercury, silica, and vinyl chloride. Because of the regulations associated with these substances, there must be a full risk assessment done on the likelihood of personnel exposure prior to the use of these substances. The risk assessment must take into account the storage, use and waste disposal of these substances.

Acrylonitrile

Acrylonitrile (2-propenenitrile – CAS# 107-13-1) is a colorless (sometimes yellowish due to contaminants), volatile, highly flammable, toxic liquid with a slightly pungent odour similar to garlic or onion. Acrylonitrile waste must be stored in tightly-closed containers in a cool, well-ventilated area and precautions taken to avoid any explosion hazard. Non-sparking tools must be used to open and close metal acrylonitrile containers. These containers must be effectively grounded and bonded prior to pouring. Acrylonitrile and/or any waste products incorporating acrylonitrile must be kept segregated and not combined with other solvents or compounds.

Arsenic

Arsenic (CAS# 7440-38-2) is a poisonous metalloid commonly found as arsenide and arsenate compounds. It is an odourless, silver-grey, brittle, crystalline solid. Organic arsenic compounds should be stored in a cool, dry, well-ventilated area in tightly sealed containers that are labeled in accordance with WHMIS. Containers of organic arsenic compounds should be protected from physical damage and should be stored separately from oxidizers such as perchlorates, peroxides, permanganates, chlorates, or nitrates, and strong acids such as hydrochloric, sulfuric, or nitric. Specific organic arsenic compounds may have other storage requirements which should be evaluated prior to storage.

Benzene

Benzene (benzol or 1,3,5-cyclohexatriene – CAS# 71-43-2) is a clear colourless liquid with a characteristic, aromatic hydrocarbon odour. It is a known carcinogen and is typically used as an industrial solvent and a precursor in the production of drugs, plastics, rubber and dyes. Benzene waste must be stored in tightly-closed containers in a cool, well-ventilated area and precautions taken to avoid any explosion hazard. Non-sparking tools must be used to open and close metal acrylonitrile containers. These containers must be effectively grounded and bonded prior to pouring. Benzene can be combined with other non-halogenated organics; however, the hazardous waste label must indicate the presence of benzene as a constituent.

Ethylene Oxide

Ethylene oxide (epoxyethane, dimethylene oxide, or oxirane – CAS# 75-21-8) is a colourless highly flammable, extremely toxic gas or refrigerated liquid with a sweet, ether-like odour and is typically used as an intermediate in the production of ethylene glycol and other chemicals. Please note that the odour threshold for ethylene oxide is at toxic concentrations (250 – 800 ppm; STEL is 1 ppm). Ethylene oxide is typically supplied in pressurized gas cylinders. Keep empty cylinders under slightly positive pressure. Do not use cylinders as rollers or for any

other purpose than to contain the gas as supplied. Move cylinders by hand truck or cart designed for that purpose. Do not drop cylinders or permit them to bang against each other. For a complete synopsis of the hazards and precautions in the use of ethylene oxide, please see http://www.ccohs.ca/oshanswers/chemicals/chem_profiles/ethylene_oxide/working_eth.html.

Isocyanates

Isocyanates are a group of very reactive organic compounds which contain a functional isocyanate group (-N=C=O). They react with water and other industrial compounds, and even with themselves, unless carefully controlled. Most isocyanates are liquid at room temperature, and can evaporate and become airborne as vapours. Both isocyanate vapour and mist will burn in the presence of a flame, spark or other ignition source. When heated or burned, isocyanates can break down and release toxic gases such as carbon monoxide, hydrogen cyanide and nitrogen oxides. Avoid mixing isocyanates with water, oxidizing agents, alcohols, acids, bases and amines.

Lead

Lead (CAS# 7439-92-1) is a bluish-white, silvery, grey, heavy, ductile, soft metal that tarnishes on exposure to air. When heated in air, lead and lead compounds form highly toxic lead oxide fumes. Lead is a potent neurotoxin that can accumulate in soft tissues and bones. Lead wastes must be kept separate from other waste and placed in a covered and labeled container. Lead waste should not be mixed with strong acids and/or hydrogen peroxide.

Mercury

Mercury (CAS# 7439-97-6) is a silvery transition metal that is liquid at or near room temperature and pressure. It is a potent neurotoxin that can accumulate in soft tissues and bones. Mercury is widely used in thermometers, barometers, and other scientific equipment. At room temperature, metallic mercury is stable; however when it is heated it can form very toxic mercury vapour and/or mercury oxide. Mercury is easily absorbed into the skin. Mercury and all its compounds are considered to be very toxic. Keep containers tightly closed when not in use. Assume that empty containers contain residues which are hazardous. Do not re-use containers that have contained mercury or mercury compounds; dispose of as hazardous waste.

Silica

Silicon dioxide is the oxide of silicone and is the principle component in most types of glass and concretes. Silica should not be confused with silica sand or silica gel (although anyone working with these substances should wear an approved dust mask as the dust can be harmful). The inhalation of significant quantities of silica dust can cause a number of health problems

including silicosis and cancer. Waste material should be kept in tightly closed, labelled containers.

Vinyl Chloride

Vinyl chloride (CAS# 75-01-4), at ambient pressure and temperature is a highly toxic, flammable and carcinogenic gas with an odour that has been described as pleasant, sweet, ethereal or sickly sweet. The risk from explosions is great when this gas is released into an enclosed space such as a laboratory. Vinyl chloride is typically supplied in pressurized gas cylinders. Keep empty cylinders under slightly positive pressure. Do not use cylinders as rollers or for any other purpose than to contain the gas as supplied. Move cylinders by hand truck or cart designed for that purpose. Do not drop cylinders or permit them to bang against each other.

Controlled Substances

The Office of Controlled Substances, Health Canada is responsible for the development of legislation, regulations, policies and procedures related to the control of illicit drugs and other substances including cannabis, steroids, cocaine, heroin and barbiturates. Because of regulation, these substances require specialized treatment and documentation prior to disposal. All individuals who have been issued an exemption permit to use these substances must contact the Laboratory Safety Coordinator to make disposal arrangements.

Other toxic materials

Chemical waste from experimental procedures

Hazardous laboratory chemical waste from experimental procedures must be properly classified according to the Consolidated Transportation of Dangerous Goods Regulations (R.R.O. 1990 Reg. 347 and SOR/2017-253).

Chemically contaminated items

Chemically contaminated items, if they cannot be decontaminated safely or in an environmentally friendly manner, must be disposed of as hazardous waste and must not enter the non-hazardous waste stream. The requirements for packaging and labelling are the same as with the chemical(s) they are contaminated with. These items include disposable lab ware such as gloves, bench top coverings, pipettes, test tubes, spill clean-up waste, etc.

Silica gel

Silica gel by itself is not considered hazardous waste, but once it has been exposed to a solvent extraction system or solvent separation system, it must be disposed of as hazardous waste and

must not enter the non-hazardous waste stream. The requirements for packaging and labelling are the same as with the chemical(s) they are contaminated with.

Sharps, biomedical and biohazardous waste

Biohazardous waste can take the form of contaminated air escaping to the outside of an enclosure, liquid waste or solid waste, such as contaminated glassware, contaminated clothing and gloves. In order to reduce the likelihood of environmental contamination by biohazardous waste it is crucial that all biohazardous waste be treated prior to release or disposal. In Ontario, biohazardous waste is regulated under the Part V of the Environmental Protection Act, Regulation 347 and Guideline C-4: The Management of Biomedical Waste in Ontario 2009.

Biohazardous waste, including full sharps containers must be stored in a secure area, not accessible to the public and not adjacent to supply storage or areas used for food preparation and consumption. Where required, a refrigerator designated only for biohazardous waste, should be available for waste. All waste storage areas, cabinets and refrigerators must be labelled with the universal biohazard symbol.

Sharps

There are many categories of sharps that are generated on campus, such as needles, razors, used slides, broken or sharp glassware. Most sharps are not considered hazardous unless exposed to hazardous chemicals or biohazardous substances. However all sharps must be placed in puncture-resistant commercially available cardboard or plastic sharps containers. It is important to segregate non-contaminated sharps from contaminated sharps as outlined below.

- Chemically contaminated sharps: Metal or glass sharps that are grossly contaminated with hazardous chemicals should be collected in a desk-top style puncture-proof cardboard or plastic sharps container and labelled with a yellow hazardous waste disposal tag (Appendix 3 - tag contents should read chemically contaminated sharps). This container should be disposed of as hazardous chemical waste.
- Biohazardous sharps: Metal or small glass sharps (slides and coverslips, Pasteur pipets, etc.), whether contaminated or not, should be placed in a red, biohazardous sharps container. This container should be disposed of as biohazardous waste
- Uncontaminated large glass sharps: Glass sharps resulting from broken glassware (beakers, flasks, etc.) should be placed in a large floor style cardboard sharps container. The container should be labelled as non-contaminated waste and disposed of in the municipal landfill.

Animal Carcases (tissues and associated non-sharps solid waste)

Animal carcases and tissues that have been treated with formalin or some other type of chemical fixative are handled as chemical waste. For large preserved specimens, they should

be placed in a biohazardous bag followed by placement in a black garbage bag (i.e. double bagged) and tagged with a yellow hazardous waste tag (Appendix 3) indicating the contents. For small preserved specimens, place them in the original plastic bucket (if they came in a bucket) and label the bucket with a yellow hazardous waste tag (Appendix 3). Do not dump the formalin or chemical preservative down the sink. For small preserved specimens that didn't come in a bucket, handle them the same as large preserved specimens.

Liquid Biohazardous Waste

Liquid biohazardous waste, such as unwanted bacterial cultures can be dealt with either by autoclaving or by pouring commercial bleach into the culture to a concentration of 5% (v/v), swirling the culture to mix and then letting the mixture sit for 20 minutes to ensure all micro-organisms are killed. The bleach culture mix can then be poured down the drain.

Solid Biohazardous Waste

All solid waste including nutrient plates, plastic ware, paper, clothing, or any other solid item that has come in contact with biohazardous material, must be placed into bags clearly marked with the biological hazard symbol. The waste will then be processed by autoclave treatment and then discarded in the regular garbage (see the Nipissing University Biosafety Policies and Procedures Manual for more information).

> Under no circumstances should materials that have come in contact with a disinfectant agent containing chlorine (bleach, chlorine dioxide, etc.), formaldehyde or gluteraldehyde to be processed in an autoclave. These substances will cause corrosion and pitting of the pressure chamber.

Unknown Chemicals

Unknown chemicals pose a serious legal and safety problem for Nipissing University. Without an accurate description of the chemical, it is difficult to handle and dispose of the chemical safely, which means the disposal company may not accept the chemical waste without an analysis of the chemical in question. Such analysis could cost your department up to $1000.00 per sample.

Often it is possible to deduce the contents of an unknown chemical container by locating the original generator or talking to fellow researchers who are familiar with the kinds of chemicals used in a particular research project or laboratory. It is up to the laboratory supervisor to ensure that students and employees are labelling all waste containers properly. This can be

done by periodically checking that waste containers are labelled properly as they are being filled.

Non-hazardous liquid or solid chemical waste

Non-hazardous liquid, for the most part, can be poured down the drain (see Appendix 2, Sanitary Sewer Disposal). Non-hazardous solid waste can usually be put into the garbage and taken to the municipal landfill. Please see Appendix 2, Regular Garbage Disposal, for a list of chemicals that fall into this category.

Donated Chemical Policy

The University does not accept donated chemicals without prior approval from Laboratory Safety Coordinator. Very often the chemicals are near their expiration date or are in quantities that will not be used. In addition the purity cannot be verified due to containers having been opened. The University ends up paying for the disposal of those chemicals which are deemed unacceptable. Disposal costs are expensive and the University spends much more than the original cost savings. The University is then the new generator of the waste and is responsible for it forever.

Hazardous Waste Storage

Hazardous waste must be stored based on the characteristics of the material that makes up the waste. In other words, the waste must be stored based on its compatibility grouping (i.e. acid, base, oxidizer, ignitibility, etc.). See above for more information on compatibility groups.

Disposal Procedures and Pick-ups

Hazardous Chemical Waste

Hazardous chemical waste must not be held on campus for more than 90 days from the time that it is generated (R.R.O 1990, Reg. 347) At quarterly intervals, the Laboratory Safety Coordinator will schedule a waste pick-up and forward a blank waste pick-up template to the technologists in charge of the waste. The waste must be categorized (see above) and added to the waste pick-up form and returned by email to the Laboratory Safety Coordinator, who will then collate and forward the list to the waste disposal company. Once a date is set for the pick-up, a notice will be sent to all parties. Waste pick-up is handled by the Laboratory Safety Coordinator and the waste disposal company.

Biohazardous Waste

Biohazardous waste is scheduled for pick-up three times per year by Stericycle. The pick-up will be coordinated by the Laboratory Safety Coordinator to ensure that the materials for pick-up are delivered to a secure area in the loading dock the day prior to the pick-up.

Chemical Spill Response procedures

Before attempting to deal with any chemical spill, regardless of the category of spill, you must have had hazardous material spills training. If you did not have this training you should not attempt to handle a spill, but should contact the designated person(s) from the emergency call list in Appendix 1. In all cases where someone has been injured or contaminated the first priority must be to the injured person. Remove contaminated clothing and obtain medical attention as soon as possible.

There are two types of chemical spills that may be encountered, those that are minor and those that are major (Table 1).

Table 1. Chemical spill criteria used in determining the type of response and treatment materials required to remediate a chemical spill at Nipissing University.

Category	Size	Response	Method of Treatment	Treatment Materials
Minor	Less than 1L (amount that spill kit can handle) and not an immediate threat to an individual's wellbeing[1]	Level I	Chemical treatment or absorption	Chemical spill kit
Major	More than 1L or immediate threat to an individual's wellbeing[1]	Level II	Possible outside assistance	

In addition to these broad categories of spills, the following chemicals when spilled in any quantity are considered a major spill due to their hazardous nature:

- Any acid concentrated enough to emit fumes or gases;
- Any base concentrated enough to emit fumes or gases;
- Any chemical that readily emits vapors or gases at normal temperature and pressure that are extremely toxic by inhalation;
- Any chemical that is sensitive to air, water, shock, friction and/or temperature;
- Any chemical that is readily absorbed through the skin and is extremely toxic at small concentrations;
- Any mercury compound or liquid mercury (see Table 2 for exceptions).

[1] This information can be determined in advance from the SDS. It will list potential health effects due to exposure, as well as the type of PPE required in case of an accidental release. If you are not equipped to handle an accidental release, based on information contained within the SDS, then it is considered a major spill, no matter how small the spill. Also, if the spilled material has entered a drain or escaped to the environment, it is considered a major spill, no matter how small the spill.

Table 2. Chemical spill criteria used in determining the type of response and treatment materials required to remediate a mercury spill at Nipissing University.

Category	Size	Response	Method of Treatment	Treatment Materials
Minor	Broken fluorescent light bulb	Level I	Physical pick-up	None
Major	Less than 28 mL	Level II	Chemical treatment or absorption	Chemical spill kit
Major	More than 28 mL or immediate threat to an individual's wellbeing[2]	Level II	Outside assistance	

Minor spills (Level 1 Response)

If you believe that it is safe to clean-up a spilled chemical, follow these steps:

1. Immediately alert area occupants that a spill has occurred and evacuate the area, if necessary.
2. Isolate the area so that no one accidently enters the contaminated area by: closing doors; posting other individuals at doors and/or hallways to warn others; installation of barrier tape; or any other reasonable method.
3. Increase the ventilation within the spill area. If needed turn on chemical fume hoods and/or open exterior windows.
4. Review the spill clean-up procedures recommended on the SDS.
5. Locate the nearest Chemical Spill Kit and evaluate the contents.
6. Don appropriate PPE such as safety goggles/face shield, gloves, lab coat, or apron. Consider the need for appropriate respiratory protection, if required.

   The use of a respirator or self-contained breathing apparatus requires specialized training and medical surveillance. Never enter a contaminated atmosphere without protection or use a respirator without training. If no trained personnel are available contact Security at (705) 498-7244 (24 hr. cell#). If respiratory protection is used, ensure there is another person outside the spill area in communication, in case of emergency.

7. Protect floor drains or other means of environmental release. Spill socks and absorbents may be placed around drains as needed.
8. Confine the spill to a small area using absorbents.
9. Spill control materials should be distributed over the entire spill area, working from the outside, circling to the inside. This reduces the chance of splash or spread of the chemical.

[2] This information can be determined in advance from the SDS. It will list potential health effects due to exposure, as well as the type of PPE required in case of an accidental release. If you are not equipped to handle an accidental release, based on information contained within the SDS, then it is considered a major spill, no matter how small the spill. Also, if the spilled material has entered a drain or escaped to the environment, it is considered a major spill, no matter how small the spill.

10. When spilled materials have been absorbed, collect the residue using a brush and scoop. Be sure to wear appropriate respiratory protection. Place materials in a disposal container, such as polyethylene bags, pails or gallon drums with polyethylene liners for larger quantities.
11. Place all contaminated PPE (gloves, lab coat, etc.) into a plastic bag for disposal.
12. Complete the hazardous waste tag (Appendix 3) and affix to the waste container(s), identifying the material as "*Spill Debris*".

    Spilled chemical reagents and contaminated PPE must be disposed of as hazardous waste.

13. Decontaminate reusable clean-up supplies and the spill area using mild detergent and water and return them to the spill kit. Determine what spill response materials have been used during the spill clean-up and arrange to have them replaced.
14. Inform your supervisor and arrange for the submission of a fully completed "Injury/Incident Report"[3] to the Human Resources Generalist - Health, Safety and Wellness as soon as possible.

Major spills (Level II Response)

- Employees should only attempt to clean up large or major spills if they have received Hazardous Materials Handling training, and when appropriate spill clean-up materials and appropriate PPE are readily available and are properly utilized.
- Otherwise, in the event of a major spill for which personnel are not properly prepared, particularly if any person has been significantly exposed, contaminated, injured to such an extent that medical or other outside assistance is needed, follow the following steps:
    1. Evacuate the affected areas and secure these areas (i.e. close the doors).
    2. Ensure injured or contaminated people get immediate exposure and medical treatment (call 911 in case of injury).
    3. Alert campus security by calling (705) 498-7244 or (705) 471-2488 (cell) from a safe distance from the contaminated site.
    4. Remain close to the phone, if requested to do so, until contacted by emergency responders.
    5. Stand-by to provide more information about the spill, including chemical name, quantity, hazards and any other relevant information. Have a copy of the SDS on hand if available. Assist emergency personnel upon arrival.
    6. For any chemical spill that occurs outside the building, with potential for adversely affecting the environment, contact campus security.

[3] Injury/Incident Report available on the Nipissing University web-site at the following address: https://www.nipissingu.ca/injury-incident-reporting-and-investigation

Appendix 1

Spill Response Team

Minor Spill				
Name	Position	Area of Responsibility	Work Extension	Cell Phone
Sarah Minnery	Biology Technologist	H-Wing	4133	N/A
Ashley Marcellus	CAF Technologist	R-Wing	4705	N/A
Amy Stillar	Laboratory Technologist	R-Wing	4486	N/A
Leah Symington	FAVA Technician	Monastery	4652	N/A
Kevin Vibe	Shipper and Receiver	F-Wing	4544	N/A
Shawn Bester	Shipper and Receiver	F-Wing	4533	N/A
Dave Vadnais	Laboratory Safety Coordinator	Campus Wide	4180	N/A
Security Services	Security	Campus Wide	5555	(705) 498-7244 or (705) 471-2488
Major Spill (to be called under all circumstances)*				
Name	Position	Work Extension	Cell Phone	
Security Services	Security	5555	(705) 498-7244 or (705) 471-2488	

*Call 911 first if there is any doubt about danger to human life.

Appendix 2

Sanitary Sewer Disposal

The following chemicals are safe to dispose of down the drain with plenty of water:

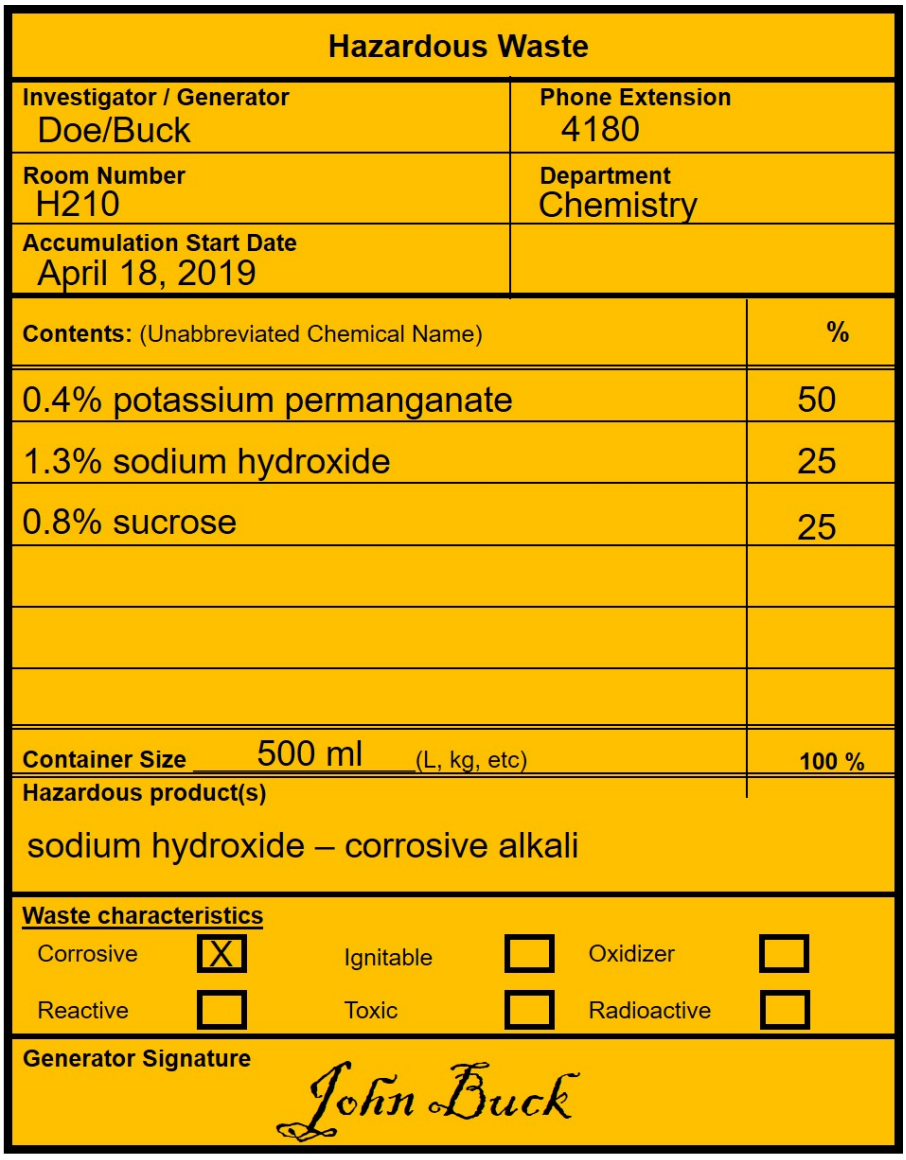
- Solutions of the following:
  - Sodium chloride
  - Sucrose
  - Dextrose (glucose)
  - Fructose
- Yeast peptone dextrose broth
  - If used to culture bacteria, it should have bleach added to 10% v/v or should be autoclaved prior to disposal.
- Any other bacterial minimal nutrient media
  - If used to culture bacteria, it should have bleach added to 10% v/v or should be autoclaved prior to disposal.

Regular Garbage Disposal

The following chemicals are safe to dispose of in the regular garbage:

- Agar
- Agarose
- Bacto peptone
- Beef extract
- Dextrose
- Fructose
- Glucose
- Lactose
- Mannitol
- Maltose
- Placebo drug (sugar pills)
- Pumice stone powder
- Ribose
- Raffinose
- Sea sand
- Sodium chloride
- Starch, hydrolysed
- Sucrose (saccharose)
- Yeast peptone dextrose broth

Appendix 3 – Hazardous Waste Label Example



Hazardous Waste

Investigator / Generator Doe/Buck	**Phone Extension** 4180
Room Number H210	**Department** Chemistry
Accumulation Start Date April 18, 2019	

Contents: (Unabbreviated Chemical Name)	**%**
0.4% potassium permanganate	50
1.3% sodium hydroxide	25
0.8% sucrose	25

Container Size 500 ml (L, kg, etc) **100 %**

Hazardous product(s)

sodium hydroxide – corrosive alkali

Waste characteristics

Corrosive	X	Ignitable	☐	Oxidizer	☐
Reactive	☐	Toxic	☐	Radioactive	☐

Generator Signature John Buck

Figure 4. Completed hazardous waste label for a reaction that consisted of three starting chemicals. While the starting chemicals have the following characteristics – oxidizer and corrosive, the final products, with the exception of sodium hydroxide are not hazardous. Therefore in the waste characteristics box, only Corrosive has been checked off. Because this is a legal document certifying that the contents and products are in fact as listed, the Generator Signature box must be signed.

Document Revision History

Date	Author	Revision
18 January 2012	D Vadnais	New Document
16 July 2018	D Vadnais	Minor revisions to reflect WHMS 2015 regulations
22 Mar 2019	D Vadnais	Updated to indicate changes in administrative structure.
24 Apr 2019	D Vadnais	Minor revisions throughout document.
12 Jun 2019	D Vadnais	Revised characterization and classification of hazardous waste sections due to updates in Regulation 347 and TDG. Updated Appendix 3 to reflect changes to the Hazardous Waste Label.