Managing Particularly Hazardous Substances (PHS) In Your Laboratory

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INTRODUCTION

Before beginning laboratory research with a particular substance, the hazard properties of that substance should be known in order to determine appropriate personal protection and safe handling procedures. The Material Safety Data Sheet (MSDS) is a good source of hazard information for most substances.

Certain substances are considered to be "Particularly Hazardous Substances" (PHS) by the Occupational Safety and Health Administration (OSHA) due to their potential to cause severe adverse health effects. Particularly Hazardous Substances should be identified, evaluated, and managed in accordance with this guidance document to ensure that adequate protection is provided.

IDENTIFICATION OF A PARTICULARLY HAZARDOUS SUBSTANCE

The OSHA Laboratory Standard (29 CFR 1910.1450) defines a Particularly Hazardous Substance as a select carcinogen, reproductive toxin, or substance with a high degree of acute toxicity.

- Select carcinogens are those that are listed by OSHA, the International Agency for Research on Cancer (IARC), and the National Toxicology Program (NTP) as known or suspected human carcinogens. Complete lists of these compounds can be found at:

- Reproductive toxins are chemicals that may adversely affect male and female reproductive health and the developing fetus. One source of information about reproductive toxins is the Proposition 65 list developed by the State of California. This list is updated annually and available online ([http://www.oehha.org/prop65.html](http://www.oehha.org/prop65.html)).

- Chemicals having high acute toxicity are those that have oral, inhalation, or dermal LD50 and LC50 values below specified thresholds listed in the OSHA Lab Standard. These values are as follows:
  - Oral LD50 (albino rats) < 50 mg/kg
  - Dermal LD50 (albino rabbits) < 200 mg/kg
  - Inhalation LC50 (albino rats) < 200 ppm in air
  - Probable Equivalent Lethal Oral Dose in Humans (70 kg) < 3.5 g (@ 1/10 oz. or 1/2 teaspoon)

Select Toxins

As a result of requirements of the U.S. Department of Health and Human Services (DHHS) and the U.S. Department of Agriculture (USDA), a select group of biologically-derived toxins have been identified that are considered particularly hazardous because of their acute toxicity. Extreme care should be taken when working with any of these materials. Specific regulations apply when any investigator or laboratory possesses amounts above the regulatory threshold level. These agents and threshold quantity levels are provided in the tables below.*
<table>
<thead>
<tr>
<th>DHHS Toxins</th>
<th>Regulatory Threshold Quantity Requiring CDC Certificate of Registration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrin</td>
<td>100 mg</td>
</tr>
<tr>
<td>Contotoxins</td>
<td>100 mg</td>
</tr>
<tr>
<td>Diacetoxyscirpenol</td>
<td>1000 mg</td>
</tr>
<tr>
<td>Ricin</td>
<td>100 mg</td>
</tr>
<tr>
<td>Saxitoxin</td>
<td>100 mg</td>
</tr>
<tr>
<td>Tetrodotoxin</td>
<td>100 mg</td>
</tr>
<tr>
<td>Shiga-like ribosome inactivating proteins</td>
<td>100 mg</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Overlap Toxins (DHHS and USDA)</th>
<th>Regulatory Threshold Quantity Requiring CDC or USDA Certificate of Registration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botulinum neurotoxins</td>
<td>0.5 mg</td>
</tr>
<tr>
<td>Clostridium perfringens epsilon toxin</td>
<td>100 mg</td>
</tr>
<tr>
<td>Shigatoxin</td>
<td>100 mg</td>
</tr>
<tr>
<td>Staphylococcal enterotoxins</td>
<td>5 mg</td>
</tr>
<tr>
<td>T-2 toxin</td>
<td>1000 mg</td>
</tr>
</tbody>
</table>

*For more information on Biotoxins - Please check the following link on the VEHS website at [http://www.safety.vanderbilt.edu/resources/biosafety_guidelines.htm](http://www.safety.vanderbilt.edu/resources/biosafety_guidelines.htm).

PROCEDURES TO FOLLOW WITH PHS:

- Maintain a current inventory of PHS in your laboratory - Have this available for all lab employees and kept up to date. Chemtracker is available for use at Vanderbilt University to assist with maintaining inventories. Staff and students should be trained on the hazards of the PHS in the laboratory.

- The smallest possible chemical container or gas cylinder should be used for the experiment. A well-managed research plan will reduce the potential for exposure to PHS by limiting the quantity of material to the minimum required.

- Establish Designated Work Areas for Use of PHS - Determining a designated work area depends on the circumstances of use of the PHS. A designated area may be a specific area of the lab, or a device such as a hood or glove box. There may be dedicated equipment for use with PHS.

- Make PHS clearly visible to laboratory workers. Highly visible colored containers or labels can be used to mark PHS. Designated areas or equipment can be marked with signs reading "DESIGNATED AREA FOR USE OF PARTICULARLY HAZARDOUS SUBSTANCES - AUTHORIZED PERSONNEL ONLY".

- Avoid inhalation of PHS. Take action to prevent skin contact. Use appropriate personal protective equipment such as chemical resistant gloves, safety glasses, and protective clothing as necessary. Respiratory protection may be necessary where materials are handled outside chemical fume hoods or glove boxes and exposure limits may be exceeded. Contact VEHS regarding any use of respiratory protection.

- Thoroughly decontaminate and clean designated areas at regular intervals. This may be as simple as a wiping a counter with a wet paper towel or periodic use of a neutralizing agent. Proper decontamination procedures are determined by the type of chemical, the amount of use, the location of use and other factors.

- Be prepared for accidents. Secondary containment for chemical containers is recommended. Keep spill control materials on hand and establish a plan for responding to spills including a determination when to call for outside help, an evacuation plan, and any special treatment materials needed (such as calcium gluconate gel).

- Highly toxic gas cylinders must be enclosed in gas cabinets with the following features:
  - Self-closing limited access ports or fire-rated windows
- Self-closing doors
- Negative pressurization inside the cabinet relative to the surrounding area
- Face velocities on access ports greater than 200 feet per minute
- At least 12-gauge steel construction
- Treatment systems connected to the exhaust

- A continuous gas monitoring system must be available for highly toxic gases. Sensing ports should be located in the gas cabinets, in the equipment (where the delivery gas line terminates) and in the lab operator area.

Commonly Used Particularly Hazardous Substances (Chemicals) at Vanderbilt University (list not inclusive):

- acetaldehyde
- acrolein
- acrylamide
- acrylonitrile
- ammonia (anhydrous)
- ammonium hydroxide
- aniline
- arsenic
- arsenic pentoxide
- arsenous oxide
- benzene
- benzenearsonic acid
- beryllium
- boron tribromide
- bromine
- brucine
- butyl lithium
- cadmium
- cadmium bromide
- cadmium chloride
- cadmium oxide
- carbon disulfide
- carbon tetrachloride
- chloroacetic acid
- chloroform
- chloromethyl ether
- chloromethyl ether
- chlorotrimethylsilane
- chromium hexacarbonyl
- chromium trichloride
- (& other Cr VI salts)
- cobalt carbonyl
- cyanogen bromide
- diazomethane
- dichloromethane
- diethylammonium
- dimethyl mercury
- dimethyl sulfate
- dimethylaniline
- dioxane
- ethylene diamine
- ethylene dibromide
- ethylene oxide
- fluoroacetyl chloride
- formaldehyde
- formamide
- formic acid
- hexamethylphosphoramide
- hydrazine hydrate
- hydrochloric acid
- hydrogen peroxide
- iodine
- lead and its inorganic compounds
- manganese chloride
- mercuric chloride
- mercuric oxide
- methyl iodide
- methyl mercury
- methyl vinyl ketone
- nickel carbonyl
- nickel chloride
- nickel nitrate
- nitrogen dioxide
- nitrobenzene
- nitrogen dioxide
- osmium tetroxide
- palladium on carbon
- paraformaldehyde
- peracetic acid
- phenol
- phosphorus
- phosphorus pentoxide
- picric acid
- potassium hydroxide
- potassium cyanide
- propargyl bromide
- silane
- sodium azide (Na (N3))
- sodium cyanide (Na (CN))
- sodium hydroxide
- sulfur dioxide
- sulfur trioxide
- tert butyl hydroperoxide
- tetrafluoroboric acid
- tetramethyl ethylenediamine
- thallium compounds
- toluene
- toluene diisocyanate (mixture of isomers)
- toluene diisocyanate
- trichloroethylene
- triethylamine
- trifluoroacetic acid
- trimethyltin chloride

Common Used Particularly Hazardous Substances (Gases) at Vanderbilt University (list not inclusive):

- arsine (gas)
- boron trifluoride (gas)
- carbon monoxide (gas)
- chlorine (gas)
- diborane (gas)
- dichlorosilane (gas)
- fluorine (gas)
- hydrogen chloride (gas)
- hydrogen cyanide (gas)
- hydrogen fluoride (gas)
- hydrogen selenide (gas)
- hydrogen sulfide (gas)
- nitrogen dioxide (gas)
- nitric oxide (gas)
- ozone (gas)
- phosgene (gas)
- phosphine (gas)