Standard Operating Procedure

STRONG OXIDIZERS

This standard operating procedure (SOP) is intended to provide general guidance on how to safely work with compounds which are strong oxidizers. This SOP is generic in nature and only addresses safety issues specific to these materials. In some instances, several general use SOPs may be applicable for a specific chemical.

Oxidizing chemicals are materials that promote/support combustion or spontaneously evolve oxygen at room temperature or with slight heating. This class of chemicals includes peroxides, chlorates, perchlorates, nitrates, and permanganates. Strong oxidizers are capable of forming explosive mixtures when mixed with combustible, organic or easily oxidized materials.

The NFPA defines four categories of strong oxidizers, divided by the severity of risk when mixed with other compounds:

- Class 1. An oxidizer that does not moderately increase the burn rate of another material.
- Class 2. An oxidizer that will moderately increase the burn rate.
- Class 3. An oxidizer that will cause a severe increase in burn rate.
- Class 4. An oxidizer that has the potential to lead to an explosive oxidation when combined with other materials.

Examples of strong oxidizers include:

- Ammonium perchlorate (Class 4)
- Ammonium permanganate (Class 4)
- Chromic acid (Class 2)
- Hydrogen peroxide (>27.5-52% Class 2, >52-91% Class 3)
- Mangesium peroxide (Class 1)
- Nitric Acid (≤40% Class 1, >40-86% Class 2)
- Perchloric acid (>50-60% Class 2, >60-72% Class 3, >72% Class 4)
- Potassium bromate (Class 3)
- Potassium chlorate (Class 3)
- Potassium peroxide (Class 2)
- Sodium chlorate (Class 3)
- Sodium chlorite (>40% Class 3)
- Sodium perchlorate (Class 2)

Potential Hazards/Toxicity

Physical Hazards

Strong oxidizing agents can present fire and explosive hazards. This hazard is highest when there is a possibility of an oxidizing agent coming in contact with a reducing agent, a fuel, or some other combustible.
Solid oxidizers in solution may be too dilute to react with combustible materials to produce a fire. However, if a combustible material (e.g., a paper towel, lab coat, lab matting) is contaminated with a solution containing an oxidizer, as the solution dries, the oxidizer is concentrated. This can cause the combustible material to spontaneously ignite and burn intensely.

Toxicity of Oxidizing Compounds
The combustion products of oxidizer-fed fires are generally much more toxic than the combustion products of the combustible material itself in air. For example, methane (i.e., natural gas) burned in air will produce carbon dioxide and water. Burned in a chlorine atmosphere, the combustion products are hydrogen chloride gas and carbon tetrachloride vapor. Inhaled, hydrogen chloride gas will go into solution as hydrochloric acid and corrode lung tissue and other mucous membranes. This can result in chemical pulmonary edema with symptoms not becoming evident for several hours. Other oxidizers have similar hazards.

Since the purpose of oxidizers is to oxidize, tissues such as lung, skin and eyes are at risk. The hazards to tissues from oxidizers will vary depending on the oxidizer and its concentration. Skin exposure can result in dangerous burns, but dermatitis (i.e., drying of the skin) is more common. Eyes are much more sensitive to exposure.

Users must familiarize themselves with the specific hazards of the compounds they are working with, which can be found on the chemical's Safety Data Sheet (SDS). SDSs are available through the Safety Data Sheet link on Yale's EHS webpage (ehs.yale.edu).

Personal Protective Equipment (PPE)

The University's Personal Protective Equipment Policy can be found on the EHS website (ehs.yale.edu)

Eye Protection
Safety glasses must be worn whenever handling oxidizing chemicals. When there is the potential for splashes, goggles must be worn.

Hand Protection
Gloves must be worn when handling oxidizing chemicals. Exam style nitrile gloves (minimum 4mil thickness) should be adequate for handling small quantities of these compounds in general laboratory settings. However, if skin contact is likely or large amounts are being used, then a utility grade neoprene or nitrile glove should be worn over the exam style nitrile.

Skin and Body Protection
Long pants or clothing that covers the body to the ankles and closed-toe solid top shoes must be worn when handling these compounds. Lab coats must be worn. Additional protective clothing (i.e., face shield, apron, oversleeves) is appropriate where chemical contact with the skin is likely.

Engineering Controls

Fume Hood
Fume hoods, or other locally exhausted ventilation, must be used when handling these substances. This includes during transfers or manipulations of small amounts which may generate aerosols and during the weighing of solids if they are toxic.

Storage/Handling

- Store oxidizers away from organic, flammable, dehydrating, or reducing agents.

- Do not store oxidizers in wooden cabinets or on wooden shelves.
- Do not store liquids above eye level (~5 feet).
- Provide secondary containment for strong oxidizing acids such as perchloric and chromic acid.
- Do not use corks or rubber stoppers.

Waste Disposal

Oxidizers must be collected as hazardous waste. Items which have come into contact with these compounds, such as weigh boats, pipettes, and gloves, but which only have trace amounts on them, can be disposed of in the normal trash.

Emergency Procedures

Fire Extinguishers
Fires involving oxidizers are difficult to extinguish. An ABC dry chemical extinguishers can be used in a very small fire, however it may not be effective in a larger fire.

Eyewash/Safety Showers
An ANSI approved eyewash station that can provide quick drenching or flushing of the eyes must be immediately available within 10 seconds travel time for emergency use. An ANSI approved safety drench shower must also be available within 10 seconds travel time from where these compounds are used. Ensure the locations of the eyewashes and safety showers, and how to activate them, are known prior to an emergency.

First Aid Procedures

If inhaled
Remove to fresh air. Follow up with Acute Care or Employee Health as appropriate (203-432-0123).

In case of skin contact
Go to the nearest emergency shower if contaminated. Yell for assistance and rinse for 15 minutes, removing all articles of clothing to ensure contaminate is completely removed. Follow up at Acute Care/Employee Health as appropriate (203-432-0123).

In case of eye contact
Go to the nearest emergency eyewash. Yell for assistance and rinse for 15 minutes. Follow up at Acute Care/Employee Health (203-432-0123).

Spills

Small Spill
If a small spill occurs inside a fume hood or near other local exhaust ventilation, lab personnel should be able to safely clean it up by following these spill clean up procedures:

Spill control materials for oxidizers are designed to be inert and will not react with the reagent (i.e, vermiculite)0000. Never use paper towels or other combustible materials. The waste materials generated during spill cleanup may pose a fire risk and should not remain in the laboratory overnight unless they are stored in an appropriate container.

- Alert people in immediate area of spill
- Increase ventilation in area of spill (open fume hood sashes)

- Wear personal protective equipment, including utility grade nitrile or neoprene gloves
- Confine spill to small area with appropriate inert adsorbent material (i.e., speedy dry) or neutralizing agent if chemical is a corrosive
- Collect residue, place in container, label container, and dispose of as hazardous waste
- Clean spill area with soap and water

Larger Spill

- Call EHS for emergency assistance (203-785-3555)
- Evacuate the spill area
- Post someone or mark-off the hazardous area with tape and warning signs to keep other people from entering
- Stay nearby until emergency personnel arrive and provide them with information on the chemicals involved