University of North Carolina Asheville

Standard Operating Procedure

ORGANIC PEROXIDES AND PEROXIDE FORMING COMPOUNDS

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

Organic peroxides are a special class of compounds that have unusual stability problems, making them among the most hazardous substances normally handled in laboratories. In addition, certain laboratory chemicals can react with the oxygen in air to form peroxides. Some may continue to build peroxides to potentially dangerous levels, while others accumulate a relatively low equilibrium concentration of peroxides, which becomes dangerous only after being concentrated by evaporation or distillation. The peroxide becomes concentrated because it is less volatile than the parent chemical. Stabilizers or inhibitors are sometimes added to the liquid to extend its storage life, but distillation will remove the inhibitor.

Examples of organic peroxides and peroxide forming compounds include:

Organic Peroxides:

- **Benzoyl Peroxide**
- **Butyl Peroxydicarbonate**
- **Cyclohexanone Peroxide**
- **Methyl Ethyl Ketone Peroxide**
- **Methyl Isobutyl Ketone Peroxide**

Peroxide Formers:

Class 1: Unsaturated materials, especially those of low molecular weight, that may polymerize violently and hazardously due to peroxide initiation.	Class II: Chemicals which are a peroxide hazard upon concentration (distillation/evaporation)	Class III: Peroxides derived from the following compounds may explode without concentration
Acrylic acid	Acetal	Divinyl ether
Acrylonitrile	Cumene	Divinyl acetylene
Butadiene	Cyclohexene	Isopropyl ether
Chlorobutadiene	Cyclooctene	Vinylidene
Methyl methacrylate	Cyclopentene	Potassium metal
Styrene	Diacetylene	Potassium amide
Tetrafluoroethylene	Dicyclopentadiene	Sodium amide
Vinyl acetate	Diethylene glycol dimethyl ether	
Vinyl acetylene	Diethyl ether	
Vinyl chloride	Dioxane	
Vinyl pyridine	Ethylene glycol dimethyl ether	
Vinylidene chloride	Furan	
	Methyl acetylene	
	Methyl cyclopentane	
	Methyl-i-butyl ketone	
	Tetrahydrofuran	
	Tetrahydronaphthalene	
	Vinyl ethers	
Recommended maximun storage time: 12 months	Recommended maximum storage time: 12 months	Recommended maximum storage time: 3 months

Potential Hazards/Toxicity

As a class, organic peroxides are low powered explosives, however they are particularly hazardous because they are sensitive to heat, friction, impact, light, and other forms of accidental ignition, as well as to strong oxidizing and reducing agents. The unusual stability problems of this class of compounds make them a serious fire and explosion hazard. This class of compounds is also highly flammable.

In addition to the physical hazards, these compounds may also pose health hazards. They are irritating to eyes, skin and respiratory tract and their vapors may cause drowsiness and dizziness. Repeated skin exposures may cause dryness or cracking.

As the hazards may vary by compound, 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 UNC Asheville's use of the Quartzy chemical ordering System.

Personal Protective Equipment (PPE)
The University's Personal Protective Equipment Policy can be found here:
https://ehs.unca.edu/personal-protective-equipment

Eye Protection
Safety glasses must be worn whenever handling organic peroxides or peroxide forming compounds. If there is a potential for splashes, goggles and/or a face shield must be worn.

Hand Protection
Gloves must be worn when handling organic peroxides or peroxide forming compounds. Exam style nitrile gloves (minimum 4 mil thickness) should be adequate for handling these compounds in general laboratory settings. However, if skin contact is likely or large amounts are being used, then a utility grade glove should be worn over the exam style nitrile. To ensure that the appropriate utility grade glove is selected, use the glove selection guide below or contact EH&S.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf

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.

Engineering Controls

Fume Hood
Fume hoods, or other locally exhausted ventilation, must be used when handling organic peroxides or peroxide forming compounds.

Storage/Handling

- Avoid friction, grinding, and all forms of impact near peroxides, especially solid peroxides. Do not use glass containers with screw caps or glass stoppers. Polyethylene containers with screw tops may be used.
- Store peroxides at the lowest possible temperature consistent with their solubility or freezing point to minimize the rate of decomposition. Do not store them at or lower than the temperature at which the peroxide freezes or precipitates because peroxides in these forms are extremely sensitive to shock and heat.
- Store all peroxidizable compounds in tightly closed, air-impermeable, light-resistant containers, away from light, heat, direct sunlight, sources of ignition, oxidizers, and oxidizing agents. Storage under nitrogen may be advisable is some cases.
- Do not use metal spatulas to handle peroxides because metal contamination can lead to explosive decomposition. Magnetic stirring bars can unintentionally introduce iron, which can initiate an explosive reaction of peroxides. Teflon, ceramic or wooden spatulas and stirring blades may be used if it is known that the material is not shock sensitive.
- Do not allow these compounds to evaporate to near dryness unless absence of peroxides has been shown.
- Purchase peroxide formers with inhibitors added by the manufacturer when possible.
- For peroxide forming compounds, mark the receipt and opening date on the container and discard within the time frame listed in the table above.
- If a peroxide-forming chemical or container is of unknown age or history, if crystals or solid masses are visibly present on or in the container or lid, or if the chemical shows discoloration, string-like formations, or liquid stratification, do not open the container. Contact EH&S for assistance.

Waste Disposal

Organic peroxides or peroxide forming compounds must be collected as hazardous waste.

Emergency Procedures

Fire Extinguishers
ABC dry powder fire extinguishers are appropriate for fires involving these compounds.

Eyewash/Safety Showers
An ANSI approved eyewash station and safety shower that can provide quick drenching or flushing of the eyes must be immediately available within a 10 second 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 and call University Police for immediate medical attention.

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. Call University Police for immediate medical attention.

In case of eye contact
Go to nearest emergency eyewash. Yell for assistance and rinse for 15 minutes. Call University Police for immediate medical attention.

Spills

Small Spill (inside a fume hood)
If a small spill occurs inside a fume hood, lab personnel should be able to safety clean it up by following standard spill clean up procedures:

- Alert others in immediate area of spill.
- Increase ventilation in area of spill (open fume hood sashes)
- Wear appropriate PPE.
- Confine/absorb spill of liquids with spill clean up pads or absorbent
- Keep spills of solid peroxides wet with an appropriate inert solvent. Cover the spill with a wet mixture of sodium carbonate, vermiculite, and sand.
- Collect residue, place in container, label container, and dispose of as hazardous waste.
- Clean spill area with soap and water.

Large Spill/Any spill outside a fume hood

- Call University Police.
- Evacuate the spill area.
- Post someone or mak-off the hazardous area with warning signs to keep other people from entering.
- Stay nearby until emergency personnel arrive and provide them with information on the chemicals involved.

Authorized Research Group Signature/Date