

## Peroxide-Forming Compounds- Safe Work Practices

Peroxide-forming compounds are among the most hazardous substances commonly handled in laboratories. Several commonly used solvents (e.g. diethyl ether, tetrahydrofuran, dioxane, etc.) can form explosive peroxides through a relatively slow oxidation process in the presence of air and light. Since most peroxide-forming chemicals are packaged in atmospheres containing air, even unopened bottles can produce peroxides. Refrigeration does not eliminate peroxide formation and stabilizers only slow down formation.

Peroxide formation becomes evident when crystalline solids are observed in the liquid itself or around the bottle's cap. Some peroxide-forming chemicals produce solutions that appear cloudy. Once peroxides have formed, they can detonate when combined with other compounds or when disturbed by unusual heat, mechanical shock, impact or friction. Visual inspection is the safest way to determine peroxide formation. If you suspect the presence of peroxides, contact Environmental Health & Safety at 860-486-3613.

### Prevention of Hazards

- Identify chemicals that form peroxides.
- Review the **safety data sheet (SDS)** associated with each peroxide-forming chemical.
- Substitute less hazardous chemicals. If substitution is not possible, use the minimum quantities required.
- Solvents containing low levels of free radical scavengers such as BHT should be used whenever the presence of the stabilizing species does not interfere with the intended application.
- Order only the quantities needed. Many common peroxide-forming chemicals (e.g. diethyl ether, tetrahydrofuran, etc.) used in labs should be discarded after 12 months.
- Store in tightly sealed containers when not in use. Protect peroxide-forming chemicals from air, heat and light.
- Store peroxides at the lowest possible temperature consistent with their solubility and freezing point.

- Do not store liquid or solutions of peroxides at a temperature below that at which the peroxide freezes or precipitates. Peroxides in this form are extremely shock and heat-sensitive.
- Store away from incompatible materials such as strong oxidizing and reducing agents.
- If materials must be refrigerated, store in an explosion-proof refrigerator.
- Discard bottles that have exceeded the manufacturer's expiration date.

### **Safe Work Practices**

- Visually check for crystalline solids before each use.
- Wear personal protective equipment as indicated by safety data sheets or the lab's workplace hazard assessment form.
- Label each bottle with the date received and the date the bottle was first opened.
- Conduct procedures inside a chemical fume hood or from behind a protective shield.
- Reduce the sensitivity of peroxides to heat and shock by dilution with inert solvents (e.g. water or aliphatic hydrocarbons).
- Avoid using solutions of peroxides in volatile solvents. Solvent evaporation should be controlled to avoid dangerous concentration of the peroxide.
- Do not use glass containers with screw-cap lids or glass stoppers. Use polyethylene containers, screw caps or stoppers.
- Do not allow peroxides to contact iron or compounds of iron, cobalt, or copper, metal oxide salts, acids or bases, or acetone.
- Do not use metal spatulas or magnetic stirring bars that could leach iron to handle peroxides. Teflon, ceramic or wooden spatulas and stirring blades are usually a safer option.
- Do not allow open flames, other sources of heat or sparks, friction, grinding or forms of impact near peroxides.
- Never distill peroxide-forming solvents unless they are known to be free of peroxides. Peroxides concentrated in the residue can pose a serious explosion hazard.

- Do not return unused peroxides to the container.

## Common Peroxide-Forming Agents

The following tables list common peroxide-forming chemicals present in laboratories. **These lists are not comprehensive.** Safety data sheets (SDSs) should indicate whether chemicals being utilized in the laboratory form explosive peroxides.

**Class A: Chemicals that form explosive levels of peroxides without concentration.** Severe peroxide hazard occurs after prolonged storage, especially after exposure to air. Test for peroxide formation prior to use or discard after 3 months.

Butadiene	Isopropyl ether	Sodium amide
Chlorobutadiene (chloroprene)	Potassium amide	Tetrafluoroethylene
Divinyl acetylene	Potassium metal	Vinylidene chloride

**Class B: These chemicals are a peroxide hazard on concentration (distillation/evaporation).** Test these chemicals for peroxides prior to distillation or evaporation or discard after 12 months.

Acetal	Dicyclopentadiene	Methyl acetylene
Cumene	Diethylene glycol dimethyl ether (diglyme)	Methyl cyclopentane
Cyclohexene	Diethyl ether	Methyl-isobutyl ketone
Cyclooctene	Dioxane (p-dioxane)	Tetrahydrofuran
Cyclopentene	Ethylene glycol dimethyl ether (glyme)	Tetrahydronaphthalene
Diaacetylene	Furan	Vinyl ethers

**Class C: Unsaturated monomers that may autopolymerize as a result of peroxide accumulation if inhibitors have been removed or are depleted.** Test for peroxide formation prior to use or discard after one year.

Acrylic acid	Ethyl acrylate	Vinyl acetate
Butadiene	Methyl methacrylate	Vinyl chloride
Chlorotrifluoroethylene	Styrene	Vinyl pyridine

## **Peroxide Testing**

Peroxide test strips, which change color to indicate the presence of peroxides, may be purchased through most chemical manufacturing companies. Follow the manufacturer's instructions for proper testing. **Testing should not be conducted on peroxide-forming chemicals that have expired, of unknown age or origin, if crystals are present around the lip of the container or if the liquid appears cloudy.**

## **Additional Resources**

### *OSHA Guideline for Dioxane*

<http://www.osha.gov/SLTC/healthguidelines/dioxane/recognition.html>

### *Organic Peroxides- Appendix B to §1910.1200 - Physical Hazard Criteria*

<http://www.osha.gov/dsg/hazcom/hazcom-appendix-b.html>

### *Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards*

<http://www.ehs.uconn.edu/Chemical/Prudent%20Practices%20in%20the%20Laboratory.pdf>

### *Sigma-Aldrich: Peroxide Forming Solvents*

<http://www.sigmaaldrich.com/chemistry/solvents/learning-center/peroxide-formation.html>