

Many common laboratory chemicals have the potential to form peroxides over time. As the level of peroxides increase, the chemical can become dangerously unstable to the point where it can actually become explosive. Because they are potentially so dangerous, it is extremely important to know what chemicals in your laboratory are peroxide formers and how they should be managed to ensure safety while they are stored or in use.

What is a Peroxide Former?

A peroxide former is a chemical which reacts with oxygen or oxidizing impurities to create peroxy compounds. These compounds have potentially explosive R-O-O-R peroxide bonds (where R = organic group). Exposure to light and heat often accelerates this reaction. These compounds are very sensitive to mechanical shock, friction, intense light, rapid temperature changes, and heating.

Peroxide forming chemicals are divided into 3 primary classes:

- **Class A Peroxide Formers:** These chemicals form explosive levels of peroxides under normal storage conditions without any concentration.
- **Class B Peroxide Formers:** These chemicals form peroxides which can become explosive upon concentration by distillation or evaporation.
- **Class C Peroxide Formers:** These chemicals can undergo polymerization due to the formation of peroxides. Such polymerization events can be highly energetic and dangerous.

See **Table A** for a list of common peroxide forming chemicals.

Managing Peroxide Formers in the Laboratory:

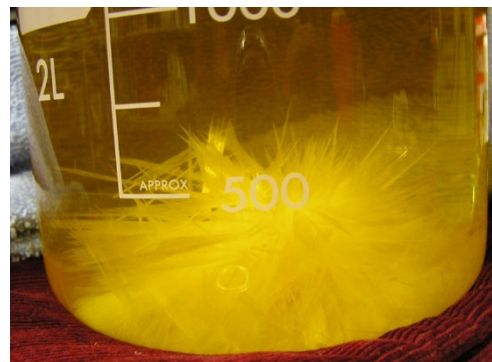
1. When working with peroxide forming chemicals, one of the best management solutions is to purchase in small quantities and reorder as needed. Quick inventory turnover reduces the time a chemical has to form peroxides. Waste peroxide forming chemicals should be sent for disposal soon after generation to limit time in storage.
2. Whenever possible, only purchase chemicals with inhibitors or stabilizers added. This helps to improve safety, but remember that inhibitors get depleted over time and while working with the chemical. Peroxides can still form!
3. Keep a detailed chemical inventory of all peroxide formers in the laboratory using ChemTracker in BioRAFT to track the received and expiration dates of containers. Write the date received, the date opened, and expiration date on all containers of peroxide forming chemicals.
4. Safe Storage Practices:
 - a. Keep containers sealed at all times when not in use.
 - b. Store containers in a flammable storage cabinet to keep them out of the light.
 - c. Store containers away from any sources of heat.
 - d. Inspect containers for evidence of discoloration, crystallization, or phase separation.
 - e. Do not allow containers to become contaminated with chemicals or substances.
5. Test peroxide forming chemicals for the presence of peroxides prior to use. This is particularly important for work involving rotovapping, distillation, or other process where peroxides could become concentrated.
 - a. It is a good practice to record the test date and peroxide concentration on a label on the container.

Peroxide Former Warning Signs:

It is important to always give a visual inspection of a container holding a peroxide forming chemical prior to moving or opening it. This is especially true where you do not know the age or history of the container. Look out for the following conditions:

- **Contents:** If the container is transparent, look for evidence of crystallization, solids, discoloration, or separation of liquid into layers.
- **Cap or Lid:** Check to see if there are any solids or crystal growth visible at the cap area of the container. If this is present, DO NOT OPEN the container. The friction from unscrewing a cap can detonate peroxides.
- **Evaporation:** Over time peroxide forming solvents can evaporate. This can be a sign of age, or a damaged or loose cap. Regardless of the cause, evaporation can concentrate peroxides to dangerous levels. Increased oxygen in the container can also allow peroxides to form more readily.
- **Expired/Old Containers:** If you find a peroxide forming chemical that has expired or that is in an old style container that is no longer produced, do not handle the container.

If you observe any of these conditions, immediately contact Laboratory Safety at 856.256.5105, and warn other laboratory personnel of the potential danger. Do not attempt to move or open the container!



Disposing of Peroxide Formers:

It is important to dispose of unused, waste, and expired peroxide forming chemicals when they are identified as such. The longer a peroxide former is in storage, the greater the opportunity for peroxides to potentially develop. Chemicals with low levels of peroxides can generally be disposed of like any other typical laboratory hazardous waste. Peroxide forming chemicals should be sent for disposal when peroxide concentrations reach or exceed 100ppm. This testing can be performed with commercially available peroxide test strips. See **Table B** for a list of recommended storage lengths before a peroxide former should be sent for disposal.

Peroxide formers which have degraded to the point where they have visual evidence of potential peroxide formation will require careful handling. The inherent instability associated with high peroxide concentrations can also make them too dangerous to ship for disposal. These conditions result in the need for expensive specialized reactive chemical services through a hazardous waste disposal company. These services can include remote opening of containers and even intentional controlled detonation of containers too hazardous to ship. In order to ensure laboratory safety and keep hazardous waste costs at a minimum, it is important that peroxide forming chemicals are properly managed at all times by laboratories.

To arrange for the disposal of laboratory waste, please complete an electronic [pickup request form](#) from the [Laboratory Safety Website](#). If you have any questions or concerns, you may contact Laboratory Safety at 856.256.5105 or LabSafety@Rowan.edu.

Table A: Peroxide Former Classes & Chemicals*

Class A Peroxide Formers: Form explosive levels of peroxides under normal storage conditions without any concentration.

Butadiene	Divinylacetylene	Tetrafluoroethylene
Chloroprene	Isopropyl ether	Vinylidene Chloride

Class B Peroxide Formers: Form peroxides which can become explosive upon concentration by distillation or evaporation.

Acetal	Diethyl Ether	4-methyl-2-pentanol
Acetaldehyde	Diglyme	2-Pentanol
Benzyl Alcohol	Dioxanes	4-Pentene-1-ol
2-Butanol	Glyme	1-Phenylethanol
Cyclohexanol	4-Hepitanol	2-Phenylethanol
2-Cyclohexen-1-ol	2-Hexanol	2-Propanol
Cyclohexene	Methyl Acetylene	Tetrahydrofuran
Decahydronaphthalene	3-Methyl-1-butanol	Tetrahydronaphthalene
Diacetylene	Methylcyclopentane	Vinyl Ethers
Dicyclopentadiene	Methyl Isobutyl Ketone	Other Secondary Alcohols

Class C Peroxide Formers: Undergo polymerization due to the formation of peroxides. Such polymerization events can be highly energetic and dangerous.

Acrylic Acid	Methyl Methacrylate	Vinylacetylene
Acrylonitrile	Styrene	Vinyl Chloride
Butadiene	Tetrafluoroethylene	Vinylpyridine
Chloroprene	Vinyl Acetate	Vinylidene Chloride
Chlorotrifluoroethylene		

*This list is not intended to be all inclusive. Always consult SDS's, supplier data, and relevant literature for all chemical hazards.

Table B: Peroxide Former Storage Best Practices

Closed Containers	Dispose of After*:	Testing for Peroxides:
Unopened/Sealed Containers from Manufacturer	18 Months	<ul style="list-style-type: none"> It is a good practice to periodically test stored peroxide formers for the presence of peroxides and before work which could potentially concentrate peroxides. When peroxide concentrations reach or exceed 100ppm, the chemical should not be used and should be sent for disposal.
Opened Containers	Dispose of After*:	
Class A	3 Months	
Class B	12 Months	
Class C - Uninhibited	24 Hours	
Class C - Inhibited	12 Months	
* Unless otherwise specified by the chemical manufacturer.		
<ul style="list-style-type: none"> Store in a tightly sealed original manufacturer container. Store containers in a flammable storage cabinet. Store away from sources of intense light and heat. Keep container labels visible. 		<ul style="list-style-type: none"> Regularly inspect containers for physical changes. Do not allow contamination with chemicals or debris. Do not allow peroxide formers to evaporate. Keep an up-to-date chemical inventory with expiration dates.