Peroxide Forming Chemicals

Chemicals that react with oxygen to make peroxides create materials that can explode with impact, heat, or friction (a partial list is available here). Peroxide-forming compounds can be divided into three hazard categories based on method of reaction.

- Spontaneous Decomposition: Compounds such as divinyl acetylene and isopropyl ether form peroxides that can spontaneously decompose.
- Requires External Energy for Decomposition: Compounds that form peroxides, but require the addition of a certain amount of energy to decompose explosively. Examples of these chemicals include dicyclopentadiene, diethyl ether, dioxane, tetrahydrofuran and vinyl ethers.
- Shock and Heat Sensitive: Materials that can form peroxide polymers, a highly reactive form of peroxide, which is extremely shock and heat sensitive. Representative compounds include butadiene, chloroprene, methyl methacrylate, vinyl pyridine, tetrafluoroethylene, acrylonitrile and styrene.

To prevent accidents, peroxidizable compounds should be dated upon opening, and evaluated for safe use by the expiration date. Do not store peroxidizable compounds in colorless glass bottles. Formation of peroxides is catalyzed by light. Peroxide test strips may be obtained from EH&S by calling 644-8916 or 644-8800.

Use these precautions when handling peroxide-forming agents:

- Know the properties and hazards of the material you are using through adequate research and study, including reading the label, SDS and other sources of information.
- When receiving a bottle of the material, write “Received on” and the date on the label. Ensure that the chemical has been entered into the chemical inventory.
- When opening the bottle for the first time, write “Opened on” and the date on the label.
- Establish a laboratory routine to test all peroxide-forming chemicals by the expiration date or earlier and every 6 months thereafter. Test strips may be obtained from EH&S by calling 644-8916 or 644-8800.
- Do not purchase more of the chemical than can be reasonably used in three month’s time of the "open" date. Peroxides can build up over time as solvent evaporates and/or air seeps into the bottle.
- If possible, purchase material that contains an appropriate peroxide inhibitor such as BHT (butylated hydroxyl toluene). If non-inhibited material must be stored, be sure to store the material under an inert atmosphere of nitrogen or argon and test it for peroxides at least once a month. Inhibitors may slow, but do not prevent peroxide formation, and inhibitors may be depleted as peroxides accumulate.
- Do not distill, evaporate, or concentrate the material until it has been tested for the presence of peroxides. Peroxides are usually less volatile than their parent material and tend to concentrate upon distillation.
- Do not store peroxide-forming materials in clear glass bottles (light can accelerate the chemical reactions that form peroxides). Always use an amber, but transparent bottle. Do not store the material in a metal can or other container which must be opened to see inside.

- Do not store peroxide-forming chemicals near heat, sunlight or ignition sources. Avoid places that undergo temperature variations which can cause the bottle to “breathe in” oxygen.
- Do not purchase or use high-risk items such as di-isopropyl ether: use less hazardous alternatives.
- NEVER touch or attempt to open a container of a peroxide-forming liquid if there are crystals around the cap and/or in the bottle. The vibration/friction of screwing the cap could detonate the bottle with disastrous results. Peroxides and peroxide forming chemicals should never be stored in containers with a screw cap or ground glass stopper, as the action of opening the container may produce friction.

Additional Information and Resources

- Partial list of some peroxide forming chemicals
- Classes of Chemicals that can form Peroxides upon Aging
- Lab explosion of suspected tetrahydrofuran/diethyl ether solution
- Peroxides in depth discussion
- More on chemical storage and testing
- Chemical Health and Safety
    - Clark; Volume 8, Issue 5, September-October 2001, Pages 12-22
    - Ashbrook, Houts; Volume 10, Issue 1, January-February 2003, Page 42
    - “Management of Time Sensitive Chemicals (I): Misconceptions leading to Incidents” (J. of Chemical Health and Safety Bailey, et al.; Volume 11, Issue 5, September-October 2004, Pages 14-17
    - "Management of Time Sensitive Chemicals (II): their identification, chemistry and management" Bailey, et al.; Volume 11, Issue 6, November-December 2004, Pages 17-24
- Journal of Chemical Health and Safety
    - "Management of Time Sensitive Chemicals (III): Stabilization and Treatment "Quigley, et al.; Volume 13, Issue 1, January-February 2006, Pages 24-29