

FDN(wh)Y Me?

As an aid to laboratories in avoiding FDNY Violation Orders (VO) and Summonses (SUM), EH&S distributes monthly FDNY inspection findings which resulted in a VO or SUM citation to an actual laboratory on either the Morningside or Medical Center campus. These real-life scenarios are meant to assist the research community in ensuring that such conditions do not exist in Columbia University laboratories.

May 2021 – Maintenance of Peroxide – Forming Chemicals

During weekly inspections, the FDNY inspector observes a variety of conditions in the laboratory. One issue that has experienced a recent increase in citations is the improper maintenance of peroxide forming chemicals. To begin to understand why this is an area of concern, a review of what peroxide is, in addition to their hazardous nature is warranted.

Peroxides are a class of chemical which contain a peroxy group, two oxygen atoms bound to each other in a $(-O-O-)$ sequence, as part of the molecule's structure. A common example of a peroxide is Hydrogen Peroxide, which is often found in antiseptic solutions. Organic Peroxides are also common, and the FDNY goes to great lengths to stress the importance of handling them safely. This is due to the explosion hazard, possible shock sensitivity, and degradation by-products that a peroxide can cause or further react into.²

As the name “peroxide forming chemicals” suggests, peroxide formers are substances which can form peroxides as a by-product within their own container. This usually occurs after the substance has been exposed to environmental factors such as light, heat, oxygen, moisture, or impurities.¹ In certain cases, the mere action of opening the chemical container once, or more dramatically - bringing a bottle into the light from a dark cabinet - could trigger the formation of peroxides in a stock bottle! The FDNY provides a table of common peroxide forming chemicals found in laboratories, and the table has been attached to this message.

The key to protecting laboratory personnel from dangerous to even deadly accidents related to these chemicals, is to carefully monitor their stability. Begin by identifying if there are any peroxide forming chemicals in the lab by cross referencing the aforementioned FDNY table. The FDNY requires the following actions be taken for any peroxide formers in a permitted laboratory:

- Mark any peroxide forming chemical bottle with the terminology “Date Received” and “Date Opened” along with the corresponding dates
- Test any peroxide forming chemical for peroxides every six months once the bottle has been opened
- Mark any open peroxide forming chemical bottle with “Date Tested” and the corresponding date

Various chemical tests are available to test chemicals for the presence of peroxides, including simple, qualitative test strips which change colour in the presence of these compounds.

With the hazardous nature of peroxides, the simplicity of testing for them, and the FDNY requirements as part of the C-14 Permit– there is plenty of motivation to monitor the storage these chemicals. If a laboratory would rather dispose of unused peroxide forming chemicals, please arrange

for the chemical to be picked up by EH&S via the chemical waste request form. Whichever route is chosen, EH&S will be glad to provide guidance with the overall goal of safety in mind.

FDNY Peroxide – Forming Chemicals Reference Table²

Table. Peroxide-Forming Chemicals

SOURCE: Clark, D.E., Peroxides and Peroxide - Forming Compounds, *Chemical Health and Safety*, 2001, 8 (5), 12-21

Group A		
Butadiene ^a	Isopropyl ether	Sodium amide
Chloroprene ^a	Potassium amide	Tetrafluoroethylene ^a
Divinyl acetylene	Potassium metal	Vinylidene chloride
Group B		
Acetal	Diacetylene (butadiyne)	Methyl-isobutyl ketone
Acetaldehyde	Dicyclopentadiene	4-Methyl-2-pentanol
Benzyl alcohol	Diethylene glycol dimethyl ether (diglyme)	4-Penten-1-ol
2-Butanol Dioxanes	Diethyl ether	1-Phenylethanol
Chlorofluoroethylene	Ethylene glycol ether acetates (cellosolves)	2-Phenylethanol
Cumene (isopropylbenzene)	Furan	Tetrahydrofuran
Cyclohexene	4-Heptanol	Tetrahydronaphthalene
2-Cyclohexen-1-ol	2-Hexanol	Vinyl ethers
Cyclopentene	Methyl acetylene	Other secondary alcohols
Decahydronaphthalene (decalin)	3-Methyl-1-butanol	
Group C		
Butadiene ^b	Styrene	Vinyl chloride
Chlorobutadiene	Tetrafluoroethylene ^b	Vinyl pyridine
Chloroprene ^b	Vinyl acetate	Vinyladiene chloride
Chlorotrifluoroethylene	Vinyl acetylene	

a. When stored as a liquid monomer.

b. Can form explosive levels of peroxides when stored as liquid. When stored as gas, peroxide accumulation may cause autopolymerization.

References

1. Smith, O. (2014, August 28). In Are You Using Peroxide Forming Compounds?. Retrieved April 23, 2021, from <https://www.triumvirate.com/blog/bid/112663/Are-You-Using-Peroxide-Forming-Compounds>
2. STUDY MATERIAL FOR THE EXAMINATION FOR CERTIFICATE OF FITNESS FOR SUPERVISION OF STORAGE, HANDLING AND USE OF CHEMICALS IN NON-PRODUCTION LABORATORIES (2019, March 28). In *C-14 Study Material*. Retrieved April 23, 2021, from <https://www1.nyc.gov/assets/fdny/downloads/pdf/business/cof-c14-noe-study-materials.pdf>
3. Peroxide Forming Solvents (n.d.). Retrieved April 23, 2021, from <https://www.sigmaaldrich.com/chemistry/solvents/learning-center/peroxide-formation.html>

Please note, the FDNY Laboratory Inspection Unit is on-site weekly at the Morningside and Irving Medical Center campuses. For a consultation before the FDNY inspector gets around to your lab, or for any question, concern, or help, please contact an EH&S Safety Advisor. <https://research.columbia.edu/safety-advisor-team>