Safety Alert

Dangers of Peroxide Formers—Explosion at UMN

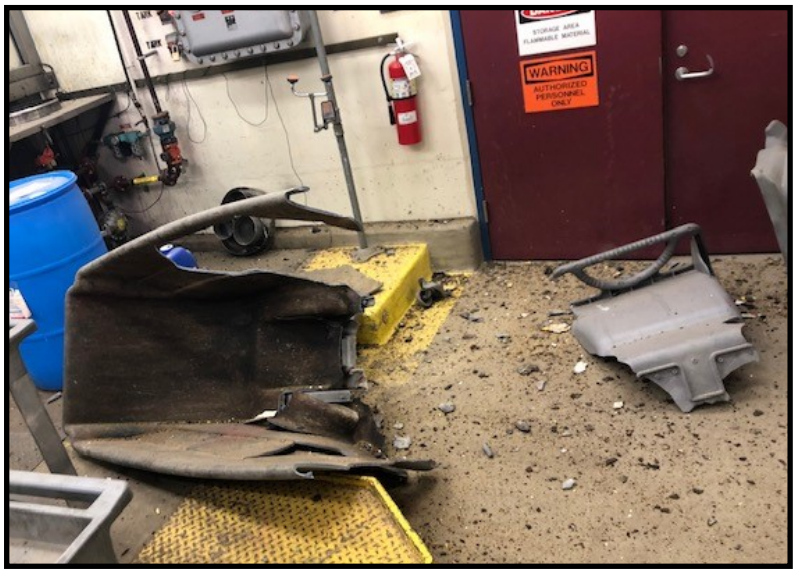

Figure 1: Damaged cart and glass fragmentation from the detonation.

Incident:

A large explosion occurred while a UHS Environmental Health and Safety Technician was processing organic waste from a laboratory cleanout. The technician was in the process of combining flammable solvent waste into a "bulking drum", which is a standard practice at our facility. Upon disposal of an emptied glass bottle into a tip cart for recycling, a large detonation occurred in the cart. The shockwave from the detonation was large enough to rip the cart in half (Figure 1), blow open the doors in the room, cause damage to adjacent rooms, and shake the windows in the facility. The technician survived the blast without major injuries.

Likely Cause of Explosion:

After a thorough investigation, the most likely cause of the explosion was determined to be **shock sensitive residue from a peroxide forming chemical** deposited inside an empty bottle. While in solution, any shock sensitive crystals may have been stabilized. After the solvent was removed and the residue dried, a detonation of the residual peroxide crystals could have been initiated by friction from the discarded bottles in the cart.

What are Peroxide Forming Chemicals (PFCs)?

PFCs are chemicals that can "auto-oxidize" with atmospheric oxygen under ambient conditions to form organic peroxides (contain an –O–O– bond). Many common organic laboratory solvents, such as ethers or tetrahydrofuran, are at high risk of peroxide formation if not stored or used appropriately. A larger list of chemicals, including common laboratory chemicals such as isopropyl alcohol, can also form peroxides if best practices are not followed. Once formed, organic peroxides are sensitive to thermal or mechanical shock and can be violently explosive in concentrated form or as solids.

University Health and Safety Response:

- Review and expand testing procedures for PFCs when processing hazardous waste.
- Flag PFCs and potentially explosive chemicals in Chematix, our chemical inventory system, and create search capabilities so labs can easily locate these chemicals in their labs.
- Discuss the incident both nationally and UMN-wide, including with department safety committees, department safety officers, and in any hazard training sessions offered by UHS.
- Encourage and help facilitate more timely lab close-outs and pay attention to PFCs during phased retirements.
- Continue to check for PFCs during lab inspections and consultations.

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Dangers of Peroxide Formers (cont.)

Instructions for Researchers:

- **Review** the Peroxide Forming Chemicals Guidance Document.
- **Check** your lab for PFCs. Even seemingly stable solvents may form peroxides in certain circumstances.
- **Inventory** the chemicals in your lab using Chematix, which can be used to run reports for PFCs.
- **Inspect** all chemical bottles for signs of decomposition (e.g. solvent discoloration, crystal or solid formation, bottle/cap/label degradation, etc.). Do not open suspect containers and contact UHS for disposal assistance.
- **Routinely test** peroxide forming solvents and adhere to disposal recommendations.
- **Dispose** of all PFCs and other highly reactive chemicals by their expiration dates, whether or not they have been opened. Pay close attention to any inhibitor-free chemicals. Dispose of all PFCs within 2 years of receipt.
- **Close out** labs in a timely manner and discard PFC's rather than saving them or donating them to other laboratories. Never donate chemicals that are past their expiration dates or where quality is questionable.

Take Immediate Action:

- If you suspect peroxides may have formed in one of your solvent containers (e.g., compounds past their expiration dates, untested open PFC containers, visible crystal formation, or other suspicious observations).
- Avoid opening all suspect containers and never open suspect containers with metal screw caps or a glass stopper.

Contact the UMN Regulated Waste Program at (612) 626-1604 for assistance.

Testing for Peroxides:

1. Obtain quantitative peroxide test strips (e.g. Quantofix for Peroxide), store under recommended conditions, and check the expiration date.
2. Follow manufacturer instructions for testing: 1. Working in a fume hood, drip a sample of solvent on the strip and shake to dry; 2. Submerge the strip in water for one second and shake in the air to dry; 3. Determine concentration based on the color gradient on the strip container (note: reading must be taken in a timely manner).
3. Peroxide concentrations < 100 ppm, the solvent is okay for use. Concentrations between 100 ppm - 400 ppm must be disposed of as hazardous waste. Concentrations > 400 ppm require immediate action.

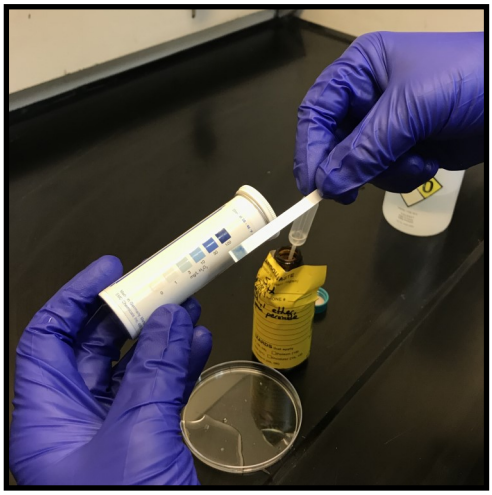

Figure 2: Testing for Peroxides

Additional Resources:

- Peroxide Forming Chemicals Guidance Document
- NRC Prudent Practices in the Laboratory: Organic Peroxides and Peroxidizable Compounds
- If you have any questions or concerns, consult with the Research Safety Professional assigned to your area or contact the University Health and Safety main office at (612) 626-6002 or uhs@umn.edu.