Lesson Learned Briefing

No.: LL18-0015

Title: After Hours Over-Pressurization of Nitric Acid Waste Container

Event: LBNL Event

Event Date: 04/12/2018

Category: ESH-Chemical - Chemical Hygiene-General, Corrosives

Lesson Learned Statement:
Nitric acid is a reagent encountered frequently in explosive incidents due to its effective oxidizing capacity. It reacts violently with even trace amounts of organic compounds to yield gaseous carbon dioxide and various gaseous oxides of nitrogen. The resulting pressure increase can be sufficient to shatter a sealed container. The reaction of nitric acid with incompatible materials is not immediately apparent, as induction times characteristic to this reaction are often surprisingly long. But this induction period is followed by an extremely vigorous self-accelerating reaction (https://www.youtube.com/watch?v=duJgPnV8ZV8&feature=youtu.be&t=28), which further necessitates proper treatment and storage of nitric acid wastes.

Discussion:
Event Location: UC Berkeley Main Campus

Event Description:

A graduate student researcher was consolidating aqueous nitric acid solutions into a repurposed 4-L bottle marked as hazardous waste. The bottle was stored inside a fume hood along with other waste bottles, a number of organic reagent bottles, a hotplate, and an oil bath. The fume hood sash was left at operating height when all researchers left at the end of the day.

Several hours later, a custodian entered the lab and saw broken glass and brown liquid on the floor. Most of the bottles stored in the hood were broken. It appears that the nitric acid waste container had contained enough residual organic compounds to generate high pressure, thus shattering the holding vessel and the surrounding glassware. The photos attached show the laboratory as it was found after the incident.

Important Factors:
- LBNL policy requires deactivation of nitric acid wastes under certain conditions (detailed below). UCB lab personnel should follow Bench Top Treatment regulations (https://ehs.berkeley.edu/sites/default/files/lines-of-services/hazardous-materials/50BenchTop.pdf) when treating laboratory waste.
- The glass bottle selected for nitric acid waste had previously contained an incompatible material and some of that material may have remained in the bottle
- The hood sash was left open at operating height after use, which may have resulted in serious injury if researchers were present in the lab during the incident
- The group was in the process of a chemical cleanout, which led to staging of multiple chemical containers in the fume hood (see attached photographs)
- Secondary containers were not being used to store liquids

Safe Practices for Managing Nitric Acid Waste:

Because of the high likelihood of nitric acid waste coming into contact with incompatible materials, coupled with the violent nature of those reactions, LBNL policy requires deactivation of any experimental reaction mixture or waste solution that contains nitric acid (HNO_3) if:
- The nitric acid solution is >5% by weight (0.8 M or pH<1)
- Organic constituents are present and the solution contains nitric acid at any concentration

Such solutions must be deactivated using an approved benchtop treatment procedure (http://www2.lbl.gov/ehs/waste/doc/FactSheetBenchTopTreatment.pdf) and an authorized Work Planning Control (WPC) activity. Treatment (e.g. through neutralization) will ensure safe storage in a satellite accumulation area (SAA). It will also prevent safety hazards in the laboratory caused by inadvertently mixing such wastes with incompatible materials. The EH&S Research Support Team (RST) is available for consultation as needed to develop and implement safe procedures.

Additional Considerations:

- Nitric acid solutions <5% by weight that do not contain organic constituents do not need to be neutralized prior to storage in the SAA.
- Empty organic reagent bottles should never be utilized for collecting nitric acid waste, even if pre-rinsed and dried. If an empty container must be repurposed for waste, compatibility must be assured. It is best to avoid repurposing empty containers for waste storage whenever possible.

- Avoid consolidating multiple waste containers, which may contain different trace materials and introduce new incompatibility issues. It is safer to label each container and have them disposed separately.
- Any work, including waste disposal and consolidation, should not be performed in areas where temporary chemical storage is necessary. In this incident, subsequent spill and glass breakage could have been minimized by using secondary containment, which is required for storage of liquids (whether inside fume hoods or flammable cabinets etc. when not being actively used).
- While it is acceptable to stage chemical containers briefly in a fume hood during chemical cleanouts, it is important to keep incompatible chemicals well separated and to keep any other materials and equipment away from the staged chemical containers. Any chemical container that is not staged in such a way should be stored properly when not in use.
- The fume hood sash should be closed at the end of the day, and when not in use. If there are any issues preventing the hood from being used properly (such as alarm when closed fully), contact the RST for assistance with recalibration.

Please contact the following subject matter experts if you have any questions regarding this briefing:
- Davies, Evelyn L (ELDavies@lbl.gov), Chemical Safety
- Kassis, Maram M (MMKassis@lbl.gov), Waste Management
- Davis, Laurel A (LADavis@lbl.gov), Ventilation and Fume Hoods

Lessons Learned are part of the ISM Core Function 5, Feedback and Improvement. Applicable Lessons Learned are to be considered during working planning activities and incorporated in work processes, prior to performing work.

Please contact the following subject matter experts if you have any questions regarding this briefing.

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Uploaded documents/attachments:

Inside hood.jpg
Lab floor.jpg

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