

EH&S - Safety Alert - Managing Nitric Acid Waste Streams
 February 3, 2017

On Friday August 12, 2016, a chemistry research laboratory had a chemical waste container rupture with violent force. The incident occurred after a graduate student added a nitric acid and acetone mixture to a container and tightly capped the bottle. The shattered container broke an adjacent formalin waste container, shattered the secondary containment tray the waste bottles were stored in and blew open the cabinet door. No one was injured in the incident.

On Tuesday November 25, 2014, a chemistry research laboratory had a chemical waste container rupture with violent force. The incident occurred when 50 milliliters (mL) of nitric acid was added to a 4-liter glass container containing approximately 500 mL hydrochloric acid and formic acid. After the addition of the nitric acid a rapid release of gases occurred resulting in a buildup of pressure inside the sealed container. Within a few minutes the pressure became too great and the glass container ruptured. The force of the rupture was strong enough to blow open the chemical storage cabinet door, blow a hole in the back of the safety cabinet, rupture a trichloroethylene container near the waste bottle and blow a hole in the spill containment tray under the bottle. Fortunately, no one was injured in the incident.

On Friday, December 2, 2011, an engineering graduate student using nitric acid to remove a polymer layer on a compact disk, placed the waste acid along with an ethanol rinse of the disk into a sealed glass container. The container was in a fume hood with partially closed safety shield. The container ruptured with such force that it cracked the fume hood safety shield, blew glass shrapnel across the laboratory, which showered the graduate student walking away from the hood. The graduate student, however, was not injured.

Researchers at other institutions have been seriously injured in similar incidents.

2016 Waste Nitric Acid Mixture Incident	2014 Waste Nitric Acid Mixture Incident	2011 Waste Nitric Acid Mixture Incident
		

Root Cause Analysis

In diagnosing the incidents, the graduate students involved, their Principal Investigators (PIs), and the chairs of the department safety committees determined there appeared to be a thought-process disconnect between chemical knowledge/safety information and the behavior that occurs when managing unwanted chemicals (waste). The graduate students typically understand from a pedagogic standpoint that nitric acid is a strong oxidizing agent and will react with reducing agents and organic material, such as the acetone, formic acid and ethanol involved in the Washington University incidents. (Reactions from these mixtures proceed over time in the waste containers, sometimes quickly, sometimes slowly, resulting in off-gassing and pressure build-up if a container is sealed.) However, from a concern of wanting to meet US Environmental Protection Agency (EPA) and Missouri Department of Natural Resources (MDNR) hazardous waste requirements, graduate students focused on collecting hazardous waste (or “unwanted material” as waste is designated under our EPA Subpart K hazardous waste program) in EPA/MDNR properly labeled and closed containers. The fear of fines and penalties for not meeting EPA “unwanted material” container requirements and simply following waste collection procedures used for all other waste streams seemed to be the default mindset that the graduate students used at the end of their experiments. They forgot the basic chemical safety involved with the materials they were containerizing, in spite of the fact that training, Safety Data Sheets and previous warnings about nitric acid waste have pointed out this concern.

Recommendations

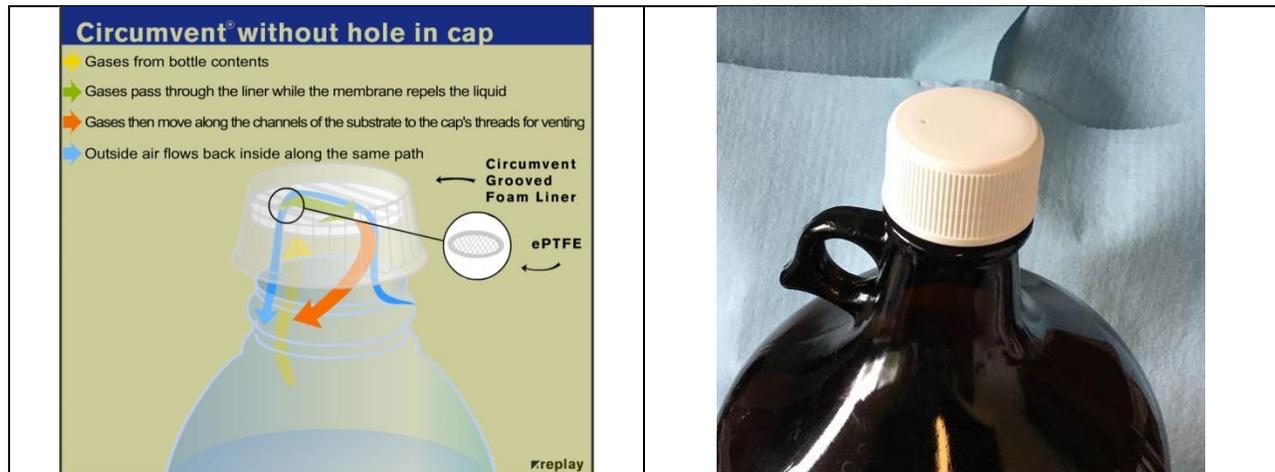
It is important that all PIs and laboratory managers remind faculty, staff and students that while the US Environmental Protection Agency (EPA), Missouri Department of Natural Resources (MDNR) and Environmental Health and Safety (EH&S) guidance require that unwanted chemical containers need to be closed at all times, all these agencies issue safety warnings about the concern of pressure build-up and they do allow the use of safety pressure-relief caps for containers if mixtures are going to continue to react and off-gas.

Nitric Acid Waste Management Recommendations Include:

- Have all faculty, staff and students who work with nitric acid to review the short Northwestern University [safety video](#) on managing nitric acid mixtures
- When and where possible, collect nitric acid waste separate from other chemical waste
- If nitric acid waste streams contain other constituents that could result in off-gassing and pressure build-up in sealed containers, use pressure relief caps on the waste containers
 - The Washington University Chemistry Stockroom has pressure relief caps available for University researchers, Part Number 8-905 and the current cost is \$0.44 each
- In the Washington University incidents, the use of engineering controls, such as chemical fume hood safety shields and chemical storage cabinets, minimized the damage and potential harm caused by these rupturing containers, and this is reminder to use these and other engineering controls, as well as personal protective equipment (PPE) at all times in laboratories
- Post signs and posters near “unwanted material” containers, reminding researchers of the danger

Please contact EH&S at 314-362-6816 if you have any questions. Thank you.

Safety Pressure Relief Caps, Washington University in St. Louis Department of Chemistry
Stockroom, Part Number 8-905



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