The University of Akron
OHIO's POLYTECHNIC UNIVERSITY
College of Polymer Science and Polymer Engineering
Office of Operations - Safety Office

LESSONS LEARNED

February 2016 – Lab Fire

What happened?

A graduate student researcher was conducting a process to purify 1000 ml benzene with sodium metal. The benzene was frozen using liquid nitrogen. A valve was opened to allow volatile impurities and gases to evaporate. The rewarming process utilized a metal water bath, which created a large thermal gradient. The water level was also below the benzene level, causing non uniform thawing. The combination lead to stress cracking on the glass wall of the flask. The researcher recognized the cracking and moved the flask with the water bath to the hood where the flask continued to crack. The water contacted the sodium metal generating heat and igniting the benzene. The fire was extinguished using liquid nitrogen.

Incident photos

Cause of Fire

The fire was caused by sodium reacting with water after a flask cracked due to improper thawing methods.

What went right?

- Researcher was wearing safety glasses and gloves.
- Researcher was not working alone.
- Researcher recognized the potential for fire and moved the experiment to the hood.

What went wrong?

- Researcher failed to contact safety personnel. Reported incident 24 hours later.
- SOP was deficient in much of the required information to safely conduct this experiment. Researcher deviated from the material that did exist.
- Researcher did not review SDS to understand freezing points of benzene. Liquid nitrogen use was unnecessary, and was the primary factor in the thermal cracking of the glass.
- Sodium was not a proper choice for this experimental setup, and is not called for in the SOP.
- Oversight of the student experiments was not as robust as it should have been.
- Using liquid nitrogen to extinguish the fire could have resulted in further injury or fire spread.

What Corrective Action Was Taken?

- 90 minutes of 1 on 1 safety training and the importance of notifying safety personnel.
- Revision of SOP to properly document experiment procedures.
- On site faculty member experienced in synthesis to provide oversight of future experiments.

How Can Incidents Like This Be Prevented?

- Standard Operating Procedures should be written for all routine processes. SOP's include risk analysis, review of SDS, procedure steps, PPE, incompatible conditions and materials, emergency procedures, first aid, hazardous waste requirements. SOP's should be followed without deviation unless approved by the PI.
- Experiments with potential for fire should be conducted inside the hood.
- Training should be conducted by the PI or competent senior student prior to the experiment.
- Emergency contact numbers should be entered into researcher's phones.

Resources:

Standard Operating Procedures (SOP) is a set of written procedures explaining how to safely work with hazardous chemicals. SOPs are required in order to make the Chemical Hygiene Plan (CHP) a legal document; principal investigators must add laboratory-specific procedures to the plan. SOP's are required additions to the CHP in any labs engaging in activities not covered by the CHP.

There are three categories of SOPs:

1. Process (distillation, synthesis, instrument, etc.) **2**. Individual Hazardous Chemical **3.** Hazardous Chemical Class

Sections of the SOP:

- **Section 1:** Process, Hazardous Chemical, or Hazard Class.
- **Section 2:** Describe Process, Hazardous Chemical, or Hazard Class.
- **Section 3:** Potential Hazards.
- **Section 4:** Personal Protective Equipment.
- **Section 5:** Engineering Controls.
- **Section 6:** Special Handling and Storage Requirements.
- **Section 7:** Spill and Accident Procedures.
- **Section 8:** Decontamination Procedures.
- **Section 9:** Waste Disposal Procedures.
- **Section 10:** Material Safety Data Sheet Location.
- **Section 11:** Protocol(s).