Lessons Learned

Chemical Explosion Causes Eye Injury

ANSI-approved safety glasses—and other personal protective equipment specified in the Standard Operating Procedures (SOPs)—are essential whenever working with hazardous materials. SOPs also indicate other precautions that must be followed to ensure safety, such as performing work with energetic or explosive materials behind a fume hood sash or blast shield.

What happened?

A graduate student researcher was working at a laboratory bench synthesizing approximately one gram of diazonium perchlorate crystals. The student was transferring synthesized perchlorate using a metal spatula when the material exploded, sending porcelain fragments into his face. The fragments shattered the lenses of his eyeglasses and lacerated his left cornea.

A researcher in an adjacent room assisted the student to the eyewash and called campus police. The student was taken to the hospital where he underwent surgery on his eye, and treatment for several facial lacerations. He was released from the hospital that same evening.

What went right?

- The student was wearing a flame-resistant (FR) coat and nitrile gloves, as called for in the relevant SOP.[1]
- The student had previously read and signed the relevant SOP, and had completed *EHS 101: Laboratory Safety Fundamentals* training.
- Emergency protocol was followed once the incident took place (eye wash, contacting emergency personnel).

What should have been done differently?

- The student was not wearing ANSI-approved safety glasses as is called for in the SOP and in UC policy.
- The student was alone in the room while working with highly hazardous materials.
- The work was being performed on an open benchtop, without the use of a fume hood sash or blast shield.
- The transfer was performed using a metal spatula, while the SOP calls for use of a non-metal one.

What was the cause of the explosion?

Perchlorate salts are unstable and potentially explosive. Most likely, the explosion was caused by friction between the metal spatula and the porcelain funnel. An igniting static charge may have been produced from the metal spatula as well.

Photo 1 - Researcher's glasses after explosion. One lens and a temple bar have been blown away. The other lens is shattered.

What corrective actions have been taken?

Since the accident, the research group members met to discuss the incident and establish corrective actions. Researchers in that lab have reviewed and signed the latest SOP for Potentially Explosive Compounds (PEC).

As a new precaution, researchers in this lab are expected to write the chemical and corresponding H-code[2] in their lab notebook for all reactions, and then again review the latest SOP any time materials with high-risk H-codes (ending in "0" or "1") will be used.

Finally, any researchers in this lab working with any amounts of perchlorates are now required to obtain advance written approval for the work from the principal investigator (PI).

[1] *Standard Operating Procedure for Potentially Explosive Compounds*

[2] An alphanumeric code corresponding to the hazard statement associated with a chemical, according to the Globally Harmonized System (GHS) for hazard classification.

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How can incidents like this be prevented?

If research requires the use of potentially explosive compounds, all involved personnel must understand that certain precautions and measures will need to be taken prior to that work being conducted. In addition to completing the required *EHS 101: Laboratory Safety Fundamentals* training, all researchers must be trained on how to safely use hazardous materials. Any applicable SOPs must be created, reviewed by the PI, and signed by researchers. The following are some general considerations when handling chemicals with explosive properties:

- Prior to beginning work, define the scope of the activity, identify the hazards of the materials and establish controls. Questions should be directed to supervisors. Safety Data Sheets are a useful source of information.
- Study the new Globally Harmonized Standard (GHS) hazard classification system, and become familiar with the codes relevant to the group of chemicals being used. A printable pictogram guide can be found on the EH&S website, and a description of H-codes is available via the Sigma-Aldrich website.
- Ensure that all necessary SOPs have been written, reviewed, and signed by all members of the lab working with these chemicals. More information on SOPs can be found on the EH&S website.
- Identify safer chemical alternatives (i.e. materials without explosive properties) if possible. Otherwise, purchase and use only the minimum amount needed. Maximum safe working amounts should be listed in your SOP.
- Conduct work in a fume hood using the sash or a blast shield as a barrier.
- Do not conduct hazardous work alone, and make nearby researchers aware of your activities.
- Wear all appropriate PPE as defined by your SOP. For any hazardous chemical work, the following are required: ANSI-approved safety glasses with side shields, appropriate impermeable gloves, a laboratory coat, long pants, and shoes with closed toes and heels. When working with potentially-explosive materials, additional PPE such as a face shield, may be required.
- Know your reagents. For example, when working with PECs, avoid rough handling such as disturbing the container, avoid the use of heat, and use Teflon-coated tools rather than metal ones.
- Know the location of the emergency eyewash and safety shower, so that decontamination can occur quickly.
- Know what to do if something goes wrong. Practice incident scenarios periodically, and discuss them in group meetings, so that everyone knows what to do in case of a real emergency.

Campus Guidelines for Potentially Explosive Chemical Safe Storage and Handling:
http://ehs.berkeley.edu/sites/default/files/lines-of-services/hazardous-materials/pecguidelines.pdffa

For additional assistance, contact EH&S at ehs@berkeley.edu or (510) 642-3073,
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