

Pyridinium Dichromate (PDC) Explosion



Figure 1: Hotplate that was damaged in the explosion the reaction in the hood and wearing a lab coat, safety glasses, and chemical-resistant gloves, which likely minimized their injuries.

Incident:

An explosion occurred during a routine pyridinium dichromate (PDC) oxidation, which injured a researcher (who is expected to make a full recovery) and damaged equipment. This reaction was run on 7 g scale (20 g of PDC), and had been run several times previously with the same conditions and reagents. The reaction vessel contained the starting material dissolved in dichloromethane, PDC, and acetic anhydride. It was stirring at room temperature in an open flask (24/40 joint opening) at the time of the explosion. The researcher was following protocol by running

Suspected Cause of Explosion:

The cause of incident is still under investigation, however we believe **contaminated reagents** may have contributed. The PDC used was from a freshly opened bottle, but the color was very different (dark brown versus orange). Another contributing factor may have been an **uncontrolled exothermic reaction**. The researcher previously observed a minor exothermic reaction, but an ice bath was not in use during this reaction.

Precautions During PDC Reactions

Though this reaction is routine for many labs, we recommend the following precautions during gram-scale PDC reactions (and other potentially energetic oxidations):

- Always run the reaction in the fume hood with the sash lowered and utilize any sliding sashes
- Use a cooling bath and add reagents in a slow and controlled manner
- Use a thermometer to monitor internal reaction temperature and watch for rapid spikes

General Safe Work Practices

It is best practice to use protective equipment designed to contain the worst case scenario emergency. This means:

- Working in a fume hood with the sash lowered to working height (lower than 18 in)
- Using a blast shield for gram-scale energetic reactions
- Wearing a lab coat, chemical-resistant gloves, and safety glasses during routine chemical work

Working safely while physically distanced: While current public health guidelines call for physical distancing of greater than 6 feet, this incident is a reminder of why working alone is not recommended. The researcher was running what was considered to be a standard, non-high risk reaction at the time of the explosion. Because this incident occurred during standard working hours, a physically-distanced coworker was nearby and assisted in the response.

Pyridinium Dichromate (PDC) Explosion (cont.)

SOPs, Hazard Assessment and Management of Change

Each PI must have written [Standard Operating Procedures \(SOPs\)](#) for high-risk materials and research protocols conducted in their laboratory. Most often laboratory notebooks serve as the individual reaction SOP. However, a risk assessment must be performed when a new high-risk process is implemented and a reassessment must be performed when major changes are implemented (e.g. scale up, novel reactions, etc.). Research staff must be trained on the applicable SOPs and that training must be documented (usually during initial or annual lab-specific training).

Examples of “High-Risk” Processes (NOT COMPREHENSIVE)

- Reactions with energetic material (pyrophoric, explosive, strong oxidizers, strong corrosives, etc.)
- High temperature/pressure or low temperature/pressure reactions (especially if in a sealed vessel)
- Gram-scale procedures or reactions that have been scaled-up
- Novel reactions where the chemistry is not fully understood

Resources for Hazard Assessment

- [ACS “Identifying and Evaluating Hazards in Research Laboratories” Document \(download\)](#)
- [Hazard Assessment in Research Laboratories](#)
- Prudent Practices in the Laboratory, [Chapter 4 Evaluating Hazards and Assessing Risks in the Laboratory](#)

Hazard Class SOP Templates (file download)

- [Flammable Hazard Class](#)
- [Oxidizer Hazard Class](#)
- [Corrosive Hazard Class](#)
- [Reactive Hazard Class: Storage, Transportation, and Disposal](#)
- [Toxic Hazard Class](#)
- [Compressed Gasses Hazard Class](#)

Emergency Procedure Reminders

- If a personal injury has occurred, if there is a fire (even if it is currently out), or a spill in a public area, **call 911!** Stay on scene to inform emergency responders of what happened and where the emergency is.
- Notify University Health and Safety (UHS) and your Department Safety Officer as soon as possible
- Additional reading: [UHS Emergency Procedures Fact sheet](#)

UHS Consultations and Contact Information

Your [Research Safety Partner](#) can help you with hazard assessments and general safe work practices. Contact the [University Health and Safety](#) main office with any additional questions at (612) 626-6002 or uhs@umn.edu.