Parr Bomb Explosion

What happened?

Researcher #1 set up an experiment with acetic acid, polyethylene, and a catalyst in a common type stainless steel pressure vessel known as a "Parr bomb". The vessel was then pressurized with a moderate pressure of oxygen and heated in a thermostatically controlled oil bath. There was a magnetic stir bar inside the bomb and a stir plate underneath the oil bath. The experiment was set up behind a blast shield inside a fume hood. The Parr bomb was fitted with a pressure gauge and bursting disk, designed to pop out at a high pressure, but was set to be well below the pressure at which the body of the bomb would be in danger of failing. After setting up the experiment, Researcher #1 left the lab to let the experiment run. Later in the day Researcher #2 reported hearing a loud bang and reported it to Researcher #1. The lab was unoccupied at the time of the incident.

Researcher #1 returned to the lab to find the oil bath smoking and turned off the heat. They realized that the emergency pressure relief bursting disk had blown out, which had apparently shot upwards and cracked the roof panel of the fume hood into two pieces. The fume hood sash was also cracked and a removable access panel of the fume hood was dislodged. Silicone oil used for heating was splashed in the hood and on the blast shield. The bomb, oil bath, stir plate, and blast shield all remained in position. Researcher #1 cleaned up the debris and hazardous materials and contacted their PI to inform them of the incident. The PI emailed Lab Safety to report the incident and EH&S responded to investigate. PD was not notified.

Hazards

If the chemical potential energy is sufficient to significantly increase the temperature of the Parr bomb plus contents, then there is potential for thermal runaway.

Injury

This incident did not result in injury.

Contributing Factors

Scale-up of experimental parameters without proper calculations to assess the possible degree of danger.

Corrective Actions

- Parr bomb should be fitted with a bursting disk designed to open at a relatively low pressure (e.g. 50 atm).
- A shield or cage should be provided to retain the disk if it pops out, so it does not become a projectile and cause damage.
- Consider fitting an additional spring loaded pressure relief valve operating at lower pressure than the bursting disk.
- To prevent overheating, use a second thermocouple in the oil bath connected to a cut-out circuit which cuts power to the system if the temperature rises past a setpoint that is suitably above the normal operating temperature.
- Calculations should be performed to determine the chemical potential energy (enthalpy) contained in the oxygen-fuel mixture inside the bomb.
- PD should be contacted before contacting PIs or managers.