Two Hot Plate Incidents- July and August 2017

What happened?

In July, a lab was following a well-established procedure at a scale (10g) that had been completed numerous times in a Teflon capped pressure vessel. The researcher placed the reaction in a silicon oil bath behind a blast shield, closed the fume hood's sash, and wrote their emergency contact and reaction information on the sash before heading to a group meeting. The temperature of the silicon oil bath exceeded the 120°C the hot plate was set to. The pressure vessel cap burst, the flammable vapors escaped, and a fire ignited. The lab members that were around were not comfortable using an extinguisher, so they evacuated and a more experience lab member was able to extinguish the fire.

In August, a different lab was polymerizing styrene in 4 separate reaction vials each at a 5g scale. They had the reactions under nitrogen through a Schlenk line. The lab set up the reaction in a sand bath and the temperature of the hot plate was set to 80°C. The researcher closed the hood and went to the office while it was heating up. Lab members heard a loud pop and saw that the rubber septas on the reaction vials had been dislodged and polymer on the top of the hood's baffles. The other lab members alerted the researcher who had set up the reaction and he noted the hot plate's temperature was reading >110°C.

Neither incident resulted in any injuries nor any significant property damage. Both labs reported the incidents to the Lab Safety Specialist immediately and assisted with the incident investigations.

What was the cause?

In both incidents the cause of the hot plates overheating was human error. There are numerous documented events where hot plates have malfunctioned and overheated, however we do not suspect that to be the case in either of these. In the July fire, the lab identified that the wrong temperature probe was placed in the silicon oil bath, as two identical hot plates with temperature probes were adjacent to each other in an otherwise uncluttered fume hood.

In August, the lab had placed the temperature probe inside a vial filled with silicon oil inside the sand bath. It was determined that by the time the silicon oil reached the 80°C the hot plate was set to the sand bath was around 140°C. The stored heat in the sand then transferred to the reaction vials until equilibrium between the sand and reactions was reached at a much higher temperature than the 80°C the hot plate was set to.

What were some of the things done well?

The labs that were involved in both these incidents do great science and are some of the best labs in terms of safety on campus. In these incidents there was a high potential for injury and significant damage, however these labs did a number things correctly. Please compare your lab's practices with some that are listed below.

- The pressure reaction was set up behind a blast shield
- Both labs completely shut the sash of the fume hood when they walked away, however only one of the labs wrote down their emergency contact and reaction information.

- The fume hoods were relatively uncluttered.
- Both labs were completing reactions that they have run before at reasonable scales.
- The researchers were current with Fire Safety and Chemical Hygiene Plan trainings.
- Personnel not comfortable using a fire extinguisher did not use one, but found someone who was and that researcher was able to extinguish the fire.
- Both labs had appropriate PPE for hazards present and were wearing it when setting up the reactions.
- Both labs reported the incidents immediately.

What are some lessons learned from the incident?

Hot plates are ubiquitous in research labs and can often be overlooked as hazardous. These two incidents highlight that additional care should be taken when working with temperature controlled hot plates. Some steps that should be followed include:

- When the possibility of wires or tubes getting mixed up and crossed use colored tape or other easily identifiable methods to distinguish between items.
- Always watch the initial heating of hot plates.
- Provide emergency contact information and reaction conditions anytime a reaction is going to be unattended.
- Take your time and double check the different components of the hot plate to ensure everything is in proper working condition.

References and Resources

1. University of Chicago's Chemical Hygiene Plan template
2. University of Chicago's Overnight/Unattended Reaction Form

Photos