May 8, 2024

Hello Everyone,

I would like to share a few safety incidents/near misses reported to me from January 2024 to date. Some near misses, such as laboratory broken vessel or small, incidental spills are not mentioned here. However, please use caution and don't rush through tasks while working in the lab, as this can easily lead to more serious safety incidents. Please report safety incidents and near misses promptly, and discuss them in your group meetings. Be assured that no one will ever get in trouble for reporting safety incidents and near misses; these are learning opportunities that help prevent similar events from happening in the future and make our research community safer and.

To submit a safety incident report/near miss, visit https://engineering.purdue.edu/ChE/aboutus/safety, fill out Safety Incident/Near Miss Report, and send it to nagyg@purdue.edu. Please visit the ChE safety page often and review the important information in the safety documents posted there.

1. January 22, 2024: Plastic tube damaged potentially by exposure to bromine

Description: While removing a waste bag located in the fume hood, a researcher noticed that a plastic tubing used for a thermostat nearby is damaged (se picture to the right). The tubing was close to a can containing 99% bromine. A closer inspection of the can showed that this was corroded on one side, which may have caused the damage to the plastic tubing.

Immediate Action: The researcher immediately removed their nitrile gloves in the fume hood, and washed their hands thoroughly with soap and water. Researchers in the lab were alerted and the fume hood containing the corroded can was taken out of use until the can with bromine was correctly disposed of via EHS.

Recommendations: Check chemical inventory and chemical containers regularly and dispose of old, unwanted chemicals, or of those found in damaged containers via EHS. If unsure of how to handle a damaged chemical container, or need guidance on how to dispose of the chemical, please reach out to EHS Hazardous Waste Disposal team at 765-494-0121.

2. March 7, 2024 – Rupture disc activation in Parr reactor

Description: During a reaction performed in a 100 mL Parr reactor at 280°C and 175 bar, involving corn stover biomass, catalyst and methanol, the pressure started to increase fast after 1 hour of normal operation. The pressure reached the maximum operational pressure of 206 bar, when the rupture disc was activated releasing the built-up pressure along with the reactor contents. The experiment was conducted in the fume hood and no injuries occurred. The same reaction was previously performed safely with small strain biomass and this was the first time when longer strain fiber biomass was used for this reaction. While the smaller strain fiber allowed for operation of the reactor at 70% capacity, the longer fiber likely caused the volume of the reaction mass to increase and the reactor to be operated at above 70% capacity.

Immediate Action: The researcher turned off the reactor heating and removed the heating jacket to allow for cooling to room temperature. The reactor and fume hood were cleaned, and a new rupture disc was installed.

Recommendations: Changing the texture/size of the reactants (e.g.: particle size, physical form, etc.) can change the operational parameters for the reactor. Before proceeding with the change, perform a Management of Change and adjust the previously used quantities to ensure you operate the reactor in the parameters recommended by the manufacturer. Monitor the reaction closely, especially when it is performed first time after a change was implemented.

3. March 12, 2024 – Damaged "Gas use" valve on LN2 tank

Description: While trying to connect a LN2 tank to a glove box, two researchers were unable to open the "gas use" valve, needed for glove box operation. The valve was not frozen closed. A third researcher tried to open the valve too, but was also unsuccessful. The researcher then used a monkey wrench to try loosen the valve, but due to the force applied the knob for the valve and the stem that connects it to the valve sheared in two pieces, leaving the valve permanently shut (see photo to the right).
Immediate Action: All debris were placed on the benchtop nearby. No sharp objects or sharp pieces were created when the knob sheared in two. The tank was used for liquid dispense only, and once emptied it was sent for repair.
Recommendations: The incident occurred due to tools being used to open a valve. When the gas (or liquid dispensing) valve on a LN2 tank becomes difficult to open by hand, it is an indication that the equipment requires repair. **Tools must never be used to force a valve open.** Other indicators that repairs may be needed include: (1) Corrosion or damage to the cylinder body or valves, (2) Broken or inaccurate gauges, (3) Loss of product due to insufficient vacuum insulation, (4) Frequent venting of gas through the pressure release device, (5) Frost formation on the valve handles or tank body.
Nitrogen gas rapidly expands to approximately 700 times its liquid volume, displacing oxygen and posing a significant asphyxiation hazard. Skin contact with the liquid can result in serious burns. Although in this case there was no uncontrolled release of nitrogen in the lab, the potential release was present due to the broken valve on the tank.

4. March 15, 2024 – Superficial cut on finger when handling glass

Description: A researcher prepared rails for the deposition step in the process of solar cell production. This process involves cutting clean glass and adding tape on the glass pieces. To prevent cuts, researches in this group use thick nitrile gloves during this step. However, in this case the correct glove size was not available in the lab and the researcher used available thin gloves. Upon removing the gloves at the end of the process they found the gloves having cuts. The researcher checked their hands but could not see any cuts to the fingers then, but at the end of the day the superficial cuts became visible.
Immediate Action: The researcher washed their hands for 15 minutes at the sink in the lab. There were other occasions in the past when the rail preparation by this method resulted in similar cuts, even when using thick nitrile gloves.
Recommendations: The procedure of rail preparation for the deposition step should be revisited and additional controls should be put in place to make this step safer. **Cut resistant gloves** should be used for this task, even though they may reduce the level of dexterity. If the cut resistant gloves reduce dexterity to the point where it is impossible to perform the task, an alternative procedure for this step should be developed, or other PPE should be used to prevent cuts to the hand. **Use the correct PPE for the task to protect yourself**.

5. April 18, 2024 - Chemical spill affecting the face

Description: A researcher used a 5L continuously stirred tank reactor to perform a chemical reaction that involved the addition of a mixture containing sulfuric acid to the reactor. To feed the system, which was placed in the fume hood, the researcher used a 1 L separator funnel, secured with a clamp around the narrow base. This caused the separating funnel to be in an unstable position. During the process, the motor used to facilitate the stirring stalled, causing the glassware to vibrate and slip from the clamp. The feed flask containing 1 L of the sulfuric acid mixture fell and spilled in the fume hood. Splashes of the spilled mixture got on the researcher's face in the areas not protected by their safety glasses. The researcher suffered minor chemical burns to the face, but no additional medical attention was needed.

Immediate Action: The researcher immediately went to the sink and washed their face with water for 15 minutes or more. They decided that no medical attention is needed. The reactor was stopped, reaction mixture drained and disposed of as hazardous waste. Other members of the group used the spill kit to clean up the spill. Debris were collected and disposed of via EHS, along with the used spill kit items.
Recommendations: The experiment should be carefully planned and a hazard assessment should be performed before proceeding with the experiment. The separating funnel is not a suitable way to feed the reactor if this can't be secured correctly. Instead, alternative methods, such as using a peristaltic pump should be considered for this task. A Standard Operating Procedure (SOP) should be developed and followed.

6. April 24, 2024 – Organic waste splash on lab coat while transferring waste

Description: After washing glassware with organic solvents, a researcher proceeded to empty the rinsate waste into the organic waste container. While emptying it, they noticed that the organic waste container was full and needed to be immediately emptied into the larger container used for waste submission to EHS. Although the researcher was very careful when pouring the liquid waste into the large waste container, some of the waste spilled and also splashed on the researcher's lab coat.
Immediate Action: The researcher recapped both waste containers and immediately removed their lab coat and checked for any exposed skin that may have come in contact with the organic waste, but couldn't find any. They washed their hands, donned a new lab coat and finished transferring the waste to the big collection container.
Recommendations: Always check the level of waste in the waste container before adding new waste. When the waste level reaches 80% of the container capacity, this should be submitted to EHS for proper disposal. **Avoid transferring waste from one container to another**. Waste should be collected near the point of generation, in a suitable container labeled correctly with the orange Hazardous Waste Disposal Tag. The waste container should be kept closed unless new waste is added, and a pick-up request should be submitted to EHS when the waste reaches 80-85% of the container capacity.

Some lessons learned and *general* recommendations:

1. Visit the ChE Safety website (https://engineering.purdue.edu/ChE/aboutus/safety) often and review the information in the safety documents posted. Discuss these in your safety group meetings regularly.
2. Keep PPE on at all times in the lab, and only remove it when you are sure you leave the lab.
3. No one should work alone in the lab; it is good practice to always have at least one other person in the lab to assist each other in case of an emergency/incident.
4. Check chemical inventory and chemical containers regularly and dispose of old, unwanted chemicals, or of those found in damaged containers via EHS.
5. Should you change quantities, physical form or any other parameters for a reaction, perform a Management of Change and evaluate the impact of the change on your system. Adjust the previously used parameters/quantities to ensure you operate the reactor within the manufacturer's recommended limits. Monitor the reaction closely, especially when the reaction is performed first time after the change was implemented.
6. When the gas (or liquid dispensing) valve on a LN2 tank becomes difficult to open by hand, it is an indication that the equipment requires repair. **Tools must never be used on a LN2 tank to force a valve open.**
7. Check the mechanical integrity of the LN2 tank and for signs indicating the tank might need servicing or repairing (see page 2 above) before bringing it in the building and using it.

8. While working with glass and sharp edges, use cut-resistant gloves whenever possible. For operations where cut-resistant gloves are not viable, consider alternative ways to perform the task and take additional precautions to prevent cuts to the hand. **Use the correct PPE for the task to protect yourself**.
9. Carefully plan your experiments and perform a hazard assessment before proceeding with the experiments. Do not improvise and do not use equipment not intended for the task. If the correct tool is not available, evaluate alternative methods or equipment for their feasibility in your case.
10. Always check the level of waste before adding new waste to a container. Once the level of waste reaches 80-85% of the container capacity, this should be submitted to EHS for proper disposal.
11. **Avoid transferring waste from one container to another**. Waste should be collected near the point of generation, in a suitable container labeled correctly, and kept closed unless new waste is added.
12. Per Purdue guidelines, whenever an employee is injured (no matter how small the injury is), a "First Report of Injury" (FROI) should be completed and sent through the FROI portal First Report of Injury (FROI) within 24 hours. This will ensure that the University stays in compliance with OSHA and if needed, medical attention related to the incident (even if this is later than the incident) is covered by the Purdue worker's compensation plan.

Incidents and near misses are great tools to learn from previous situations/events. Please continue to report any safety incidents and near misses that occur in your work area; sharing them with everyone in our School will raise safety awareness and prevent similar situations from happening.

Sincerely,

Gabriela
On behalf of the ChE Safety Committee