

Laboratory Lessons Learned

Incident Overview:

A Postdoc researcher had a solid sample of carbon (0.2 g) and sulfur (0.8 g) in a solution of carbon disulfide (5 mL). The mixture was in a small beaker. In order to dry the sample, the Postdoctoral researcher placed the beaker directly onto the hotplate and proceeded to heat the solution at a setting of 75°C.

After a short period of time a flame erupted from the hotplate and beaker. It is likely that heating the beaker caused fumes of carbon disulfide to interact with the hot plate and ignite.

What went right?

The process was being performed in a fume hood. This likely contained the toxic sulfur dioxide fumes that would have been formed when the carbon disulfide ignited. This protected the researcher and any other Postdoctoral researchers in the laboratory.

What went wrong?

Carbon disulfide is an extremely flammable liquid. It is sensitive to shock, friction, and impact. It may explode on heating or may ignite spontaneously on contact with hot surfaces producing toxic fumes (sulfur dioxide). It can also react violently with oxidants causing fire and/or explosions.

There are five main causes to this incident:

1. The Postdoctoral researcher was not given a practical orientation to the laboratory
2. The Postdoctoral researcher did not understand the properties of the substance they were working with
3. The Postdoctoral researcher did not fully understand precautions that should be taken when working with a hotplate
4. No risk assessment was performed prior to performing this project, and no one reviewed the project before it was allowed to proceed
5. No SOP was in place for this project

Direct heating of low boiling point solvents (like carbon disulfide or ether) should be avoided. If these substances need to be heated, a water or sand bath should be used. Furthermore, if boiling of the solvents is required, attach a condenser to the apparatus. See Figure 2.

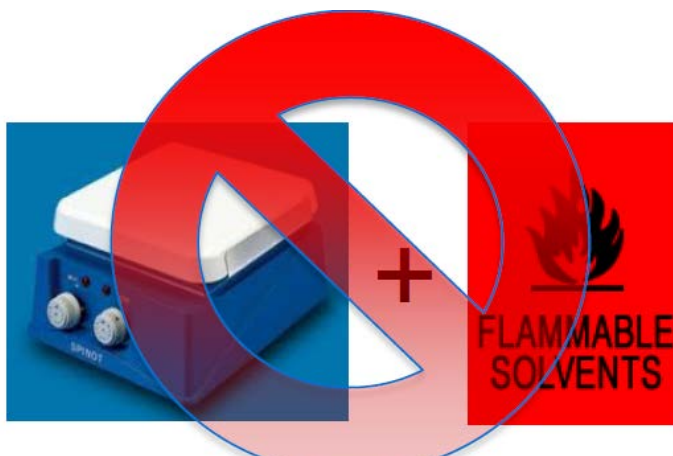


Figure 1: Direct heating of a flammable solvent should not be done with a hotplate.

CARBON DISULPHIDE HEATED DIRECTLY ON A HOTPLATE

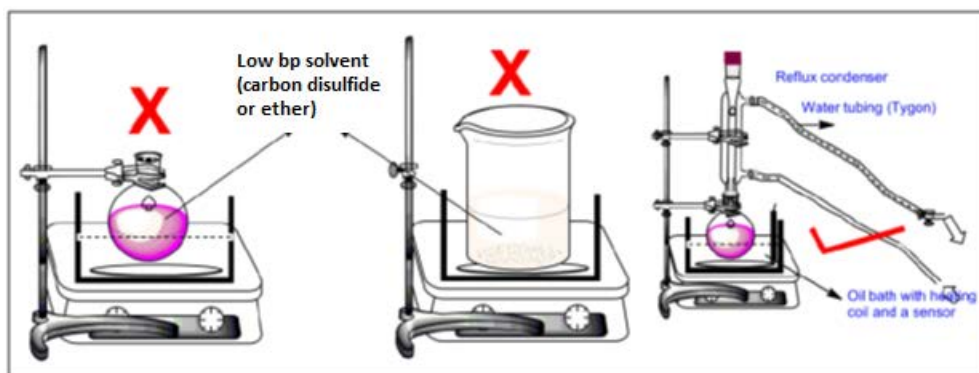


Figure 2: Proper use of a hotplate to boil a low bp solvent.

What else could have gone wrong?

- Other reactions could have occurred with chemicals found in the fume hood
- The researcher could have been burnt by the fire

What Corrective and Preventative Actions were Implemented in this Lab?

The following actions were taken to correct the identified root causes and to ensure the problem did not happen again:

- An SOP was created for this process
- The entire lab was notified of this SOP and trained on it
- The department issued a notification about the proper use of hotplates to all researchers
- The department also now asks researchers to complete risk assessments for new projects