HAZARD ALERT - ROTARY EVAPORATOR (ROTOVAP) FIRE

A fire started while a worker was conducting an experiment using a rotovap and approximately 100 mls of carbon disulfide. (CS₂)

ROTARY EVAPORATOR – ROTOVAP

CARBON DISULFIDE (CS₂)

Upon start up of the rotovap the heating element was activated for the heated water bath. The rotovap operates in a vacuum which serves two purposes. The first is designed for lowering the internal pressure of the system, enabling in such a way distillation processes at lower temperatures. The second is a practical one. i.e., to guarantee the sample flask doesn't fall into the warm bath.

Upon initiation of the experiment a small amount of CS₂ flashed from the sample flask into the solvent receiver. (It was determined later that this was because a stronger vacuum than required was applied via the vacuum screw adjuster.) As a result the procedure needed to be restarted. In order to re-start the procedure, the solvent receiver was detached from the rotovap and the reflux valve was closed to maintain the vacuum. (It was determined later that not enough vacuum was applied in order to maintain the sample flask and the clamp failed to maintain the flask adhered to the tip of the rotating shaft.)

Once the solvent receiver was detached the worker then went to the fumehood about 8 m away to recover the CS₂ from the solvent receiver in order to restart distillation. The worker was under the direct supervision of a 'competent worker' as the worker involved in the incident had not yet been deemed competent in the use and handling of CS₂. The worker who was supervising momentarily stepped away at the time the incident occurred.

While at the fumehood the worker heard a noise that sounded like an explosion and turned to find flames coming from the vicinity of the rotovap. The worker extinguished the flames with a nearby fire extinguisher. About 30 seconds later an overhead sprinkler activated the building fire system which led to further complications arising from the water generated by the sprinkler activation.

There are three hypothesis about what caused the explosion and subsequent fire. The first is that as CS₂ is more dense than water, once the clamp failed and the sample flask fell, the vapor rose to the top of the water bath and then moved down to the vicinity of the heating element where it ignited the vapor and caused the explosion. The second is that the vapor flowed along the surface of the lab bench to an ignition source and flashed back burning the electrical outlet directly behind the rotovap and starting the fire. The third is that when the clamp failed and the sample flask fell, water from the bath splashed onto the electrical outlet directly behind the rotovap causing the explosion.
LEARNINGS
- Prior to using CS₂ it should first be determined if it is required for the task or if it can be replaced with a less hazardous substance. A hazard review should be conducted of the replacement product to ensure it doesn`t create an alternate hazard.
- Standard Operating Procedures (SOP`s) should be written and reviewed by workers prior to all hazardous operations.
- Explicit written instructions should be incorporated into the rotary evaporator Standard Operating Procedure regarding the direct close surveillance of its operation until stationary solvent distillation is secured. (No pressure build up)
- At the time of the incident the rotovap was located outside of the fume hood. Had it been inside the fume hood the fire may still have started but would have been contained and extinguished before the sprinkler head was activated.
- Mechanical clamps on rotovaps should be inspected for defects and wear on a regular basis and replaced as required.
- Workers must be aware of the properties of the chemicals they are working with. (i.e. CS₂ is denser than some other solvents and a different amount of vacuum is required to hold the sample flask in place.)
- Workers who are not yet deemed to be `competent` in a task must be under the direct supervision of a competent worker at all times. The work must stop, or someone must take their place, if the supervisor is going to be absent at any time during the process.
- Workers must be supplied job specific training applicable to all tasks they do as well as general safety training such as WHMIS.
- A training needs analysis should be set up for all lab workers to include both lab specific and general safety training. All workers must undertake the required training before work begins.
- Inspections of the work area should be conducted on a pre-determined ongoing basis.
- Hazard Identification and Assessment for should be conducted for every task.