Laboratory Lessons Learned

Incident Overview:

A PhD candidate was working with Nital. Nital is a mixture of nitric acid and ethanol. The primary use is as an etchant. Once the process was complete, the person was looking to dispose of the used and excess Nital.

At the end of the day, the individual had approximately 200 mL of waste Nital. They deposited this leftover Nital in a waste container (Nalgene) that contained between 100 to 200 mL of a solution containing 50% nitric acid and 50% water. The container had been labelled with this mixture. The container was sealed and left in a storage cabinet overnight. The next day, the bottle of Nalgene was discovered ripped open (as if from an explosion) and the contents were strewn about the cabinet.

Figure 1: Image showing the destroyed waste bottle.

What went right?

The waste material was stored in a Nalgene material. Nital is incompatible with glass (it is an etchant).

What went wrong?

Concentrated nitric acid contains 68 – 70% nitric acid (HNO3) by weight. It is a very strong acid that dissociates completely in solution. It is highly corrosive and toxic to the mucous membranes, skin, and eyes. It is also a powerful oxidizing agent and will react violently with reducing agents and organic compounds. During this reaction, it can generate toxic oxides of nitrogen (NO) and (NO2).

Nital is a mixture of nitric acid and ethanol in a very precise ratio. Once the ratio of nitric acid to organic material rises above 9%, dangerous, violent, and toxic gas forming reactions may occur.

By mixing Nital with the material in the waste container (nitric acid and water), the ratio of nitric acid to alcohol in the resulting mixture became dangerously high. This resulted in a reaction that likely resulted in the rapid production of some toxic nitrogen oxides.

There are three main root causes to this incident:

1. The individual using the material did not fully understand the nature of the chemical they were working with. If the properties were understood, the nital would never have been mixed with anything but waste Nital
2. The SOP that was used did not properly describe how waste Nital is to be handled. It did not identify that waste Nital should be diluted prior to disposal to help ensure a hazardous concentration of nitric acid was not reached.
3. The lab personnel are not required to sign off on the SOPs that they are using.

What else could have gone wrong?

- If an individual opened the storage cabinet prior to the explosion, they may have been severely injured
- Other reactions could have occurred as a result of the etchant being released into the cabinet.
- A fire may have resulted if enough heat was generated

What Corrective and Preventative Actions were Implemented in this Lab?

The supervisor instituted the following controls to prevent this incident from reoccurrence:

- Updated the SOP to reflect current usage controls and disposal practices for Nital
- Required students to complete a risk assessment before beginning new research projects – which is reviewed by her: General Laboratory Process Risk Assessment
- SOPs for dangerous chemicals or processes must be signed off by students before being allowed to use those chemicals or perform those processes.
- Completed an orientation on proper waste disposal with all students

Lessons Learned