

Laboratory Lessons Learned

Incident Overview:

A PhD candidate was working with several acids (Sulphuric and Phosphoric). Once complete, they disposed of both in a waste container containing ethanol. The acids reacted with the organic creating a rapid expansion of gas, shattering the glass waste bottle.

What went right?

The waste container was stored in a secondary containment bin containing the explosion. Only a small amount of broken glass and material was found outside the bin.

What went wrong?

Concentrated sulfuric acid is a strong oxidant that reacts violently with flammable, combustible, and reducing materials. When reacted with reducing agents and metals it will form hydrogen gas (flammable/explosive). With water it generates heat, and with flammables and combustibles it can cause fire.

Concentrated phosphoric acid is a medium strength acid. It will violently polymerize in the presence of azo compounds and epoxides. On contact with alcohols, aldehydes, cyanides, ketones, phenols, esters, sulfides and halogenated organics phosphoric acid will decompose forming toxic fumes (phosphorus oxides). Like sulfuric acid, phosphoric acid will also form hydrogen gas on contact with metals.

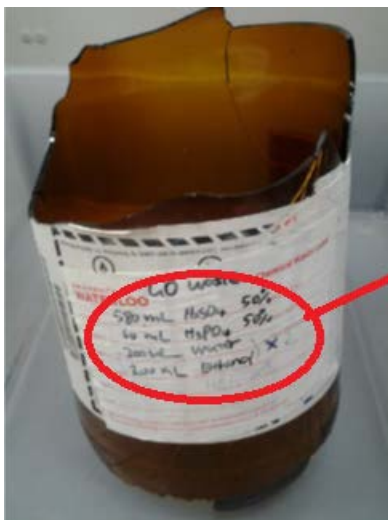
As described above, both sulfuric acid and phosphoric acid are incompatible with alcohols (ethanol) and will thus react adversely with this substance. Heat, and toxic gas will be generated and evolved. In a closed container the gas and heat formed could cause an explosion, which occurred here.

There are three main root causes to this incident:

1. The individual using the sulfuric and phosphoric acids was not aware of how to handle and safely dispose of the two acids.
2. No SOP was in place for this project
3. No risk assessment was completed identifying waste disposal as a safety risk
4. Individuals were not given proper training on chemical waste disposal

What else could have gone wrong?

- If an individual opened the storage cabinet prior to the explosion, they may have been severely injured



Bottle is labelled with acids (H₂SO₄ and H₃PO₄) and organics (ethanol)

Figure 1: Broken waste bottle from inappropriately stored wastes.

EXPLOSION FROM INAPPROPRIATE DISPOSAL OF ACIDS WITH ORGANICS

- Other reactions could have occurred if the material contacted other chemicals or metals.
- A fire may have resulted if combustible substances were close

What Corrective and Preventative Actions are required to prevent this incident from happening again?

- Supervisor needs to develop a laboratory orientation that includes a section on how to handle and dispose of chemical wastes
- For each project a student or researcher performs, a risk assessment should be conducted that will allow them to identify risks and plan out how to minimize them.
- Training on chemical handling and use is required for all staff.