Welcome to the Wonderful World of Waste

and the School Laboratory

Part VI

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This quarter's article will make mention of two of the nastiest and filthiest chemicals we have come across during collection and disposal operations. One of these we have only encountered in the school laboratory and both of them have no place in the school laboratory, no matter what the Chemistry teacher says.

The number one rotten chemical, only ever encountered in the school laboratory, is white phosphorous. Yellow phosphorous is the same thing and white phosphorous turns yellow on ageing. Red phosphorous, or amorphous phosphorous, is much more stable and will not burst into flame on contact with air. White phosphorous is a class 4.2 dangerous good i.e. spontaneously flammable, the red is a class 4.1 flammable solid.

The trouble with white phosphorous is its pyrophoric property, requiring it to be stored under water. It is also very toxic at very low levels, not only to us humans, but to marine life like fish. The liver, in both humans and fish, is the target organ. Also, kidneys and heart for humans.

Over years of collecting chemicals from schools, whenever we came across white phosphorous and asked the question as to what it was doing in the lab, invariably it was just to demonstrate its pyrophoric properties by taking a piece out to the school oval and watching it ignite, burn and emit copious white clouds of smoke. Those white fumes are phosphorous pentoxide, a corrosive and choking attacker of mucous membranes and tissues. Why on earth this would be considered educational, let alone safe practice, remains a mystery and we are pretty sure this dubious practice is no longer in vogue.

I worked in various analytical laboratories before I saw the light and became a waste chemist. Phosphorous, in either allotrope, was just never seen in these laboratories. It is too nasty and has virtually zero usage in this form. Phosphorous, as either a phosphate salt or phosphoric acid, is commonplace and a far safer way to study and handle this very weird element. It must be stored under water, and if you do come across some which is not fully covered, you had better call us.

There is a good reference for more phosphorous horror stories, including phossy jaw or osteonecrosis of the jaw (usually fatal and highly painful) that the white phosphorous based match industry workers were often subject to.

The Shocking History of Phosphorous - a biography of the devil's element, by John Emsley, Pan Books

Our other rotten chemical to steer clear of is hydrofluoric acid, HF. This acid just loves calcium, and as humans do contain a fair amount in their bones, skin and teeth, HF is not welcome. A 160 cm^2 area of skin exposed to strong HF can cause hypocalcemia (low serum calcium) and is almost always fatal. It will dissolve most oxides and silicates, so is commonly used to dissolve minerals and ores in the analytical laboratory. These procedures, of course, are not common in the school lab. The most common form of silicate that HF will dissolve is glass. HF is therefore always stored in special plastic bottles, rarely in volumes greater than 1 litre and with spill and drip proof fittings. It is used to produce frosted glass and etch printed circuit boards for electronic work. Again, not normal activities in a school. We haven't seen a lot of HF in school labs, unless of course the "gift" of chemicals from a parent or industrial laboratory contains some HF. I have mentioned this before - get the generous donor to wear the disposal cost of these chemicals when invariably we get called in. There is no place for HF in the school lab, along with its good buddy, white phosphorous.

What else? Mentioned below, without further detail, the following really should be phased out of schools. Don't just have them on the shelf to show students or just in case a new practical utilising them comes up.

Chromium trioxide and other Cr VI salts. Chrome III salts, such as chromates, are much safer by comparison, but have a good look at these metals, as well as Cobalt and Cadmium salts, especially the water-soluble ones.

Most of the nastier organics are now persona non grata such as toluene, xylene, benzene and other aromatics; halogenated solvents such as chloroform, carbon tetrachloride and dichloromethane; highly flammable solvents such as diethyl ether and carbon disulphide. The latter is a real beauty. It has a putrid odour, is even more flammable and volatile than diethyl ether and will dissolve phosphorous. That's a winning combination if ever there was one.

A genuine and thorough risk assessment should identify many chemicals that are far too nasty for use in school laboratories. Don't forget the first risk control in the hierarchy is always Elimination!

Next article we will look at some nice chemicals, and yes there are plenty.

If you have any comments, good bad or otherwise, please feel free to contact myself, or Jessica, the Lablines editor. If there are any chemical topics that you would like to see addressed, please also get in touch.