Trouble in store

You can scarcely have managed to avoid the pre-Christmas furore that was caused by 2016's chemical of the year, 2,4-dinitrophenylhydrazine. The hazards of this substance were, it must be said, rather over-hyped by the media and it is a tribute to the professionalism and good sense of teachers, technicians and school management, as well as Local Authorities, that EOD (the 'Bomb Squad') have been conspicuous by their absence from Scottish schools.

It has, however, been a useful opportunity to look again at how we manage the storage of chemicals: the whole 2,4-DNPH issue did, after all, only arise where the substance might not have been stored appropriately.

Before going on to discuss any specific substances, there are a few general matters that should be considered to ensure safe storage.

Date Marking - It is good practice to mark the arrival date on all the chemicals that come in to your school. That way you can ensure that older stock is used up first and minimise waste. In the case of chemicals that have safe shelf lives, it is even more important so you know when things need to be disposed of.

Stock check - You should aim to carry out an inventory of your chemicals on an annual basis. Knowing how much of any particular chemical you have, and how much it has changed, will allow you to rationalise your ordering and not overbuy - a common reason for overcrowded chemical stores.

Record keeping and communication - a big part of the problem with 2,4-DNPH was that there were many schools that had stocks but no one knew anything about how it had been stored. Many technicians will have a perfectly good working knowledge of everything that needs doing and be going about their business in an organised and effective way but if records are not kept then a change of personnel can 'throw a spanner in the works'. If you have kept your 2,4-DNPH well hydrated but have no record of it and then leave, a new teacher or technician might look at a bottle that is 10 years old and, in the absence of any other information, quite reasonably err on the side of caution and assume it may have dried out. So, there should be a check list of the various checks carried out over and above the stock check.

As far as individual substances go, it should be said that the vast majority of chemicals have no specific storage requirements at all and can just be left on the shelf in the chemical store quite happily between stock checks. There are a few chemicals, however, that perhaps need to be examined more frequently and certainly more carefully. These might include:

Termly

2,4-DNPH (and also 2,4-dinitrophenol and 2,4,6-trinitrophenol (picric acid)) - these three substances can all become hazardous in varying degrees if they are allowed to dry out. They are supplied wet so addition of a few cm^3 of distilled/deionised water should maintain this situation as long as the lid is sealed properly. (If it is clearly wet then there is no need to add extra water). You should also wipe down the lids, particularly any screw threads, after using, to ensure none is caught there where it could dry out.

Potassium metal - all the alkali metals (sodium potassium and lithium) as well as barium should be checked regularly to make sure there is still a sufficient covering of oil and topped up if need be. In addition, potassium has a tendency to form a coating of potentially explosive superoxide and thus has a safe shelf life of only 2 years. A termly check of potassium will ensure no potential problems. Any potassium which has developed a yellowish crust should be taken out of service and disposed of at the next uplift.

Bromine - if bought and stored in ampoules there are no issues but if you have a bottle of liquid bromine, it has a tendency to corrode the seal on the cap, allowing bromine fumes into the store. A regular check on the integrity of the seal, replacing the cap if necessary, will prevent this.

Water reactives such as aluminium chloride, phosphorus halides and silicon tetrachloride - these can react with water in the atmosphere and cause a build-up of pressure inside the container. Carefully opening these for a second to release any pressure build up will prevent the issue becoming dangerous.

Annually

Along with the annual stock check, there are a few other checks that should be carried out.

Check the dates - on any chemicals with a **safe** shelf life and dispose as needed.

Damaged containers (or lids) - should be replaced. Susceptible solvents - such as ethoxyethane and propan-2-ol should be checked to see if they are developing peroxides.

Segregation - Make sure that incompatible chemicals are still properly segregated: in a busy chemical store with chemicals going in and out as well as new ones coming in, they sometimes get placed where it is most convenient rather than in necessarily the best position.

It should be emphasised again that the vast majority of chemicals in the vast majority of stores are being kept perfectly well. But this extra set of measures should ensure an even greater level of safety without a great deal of extra work.

Safety alert! The use of caffeine on human subjects in school projects

The Biology Team at SSERC has, for some time, been uneasy about students administering caffeine in various forms to other students in school/college for the purposes of investigating caffeine's cognitive and physiological effects. While we are aware that protocols exist 'out there' for ways in which such investigations may be carried out in schools, our misgivings have remained.

Over time we have received enquiries from various schools/colleges about investigations proposing the delivery of caffeine via cups of coffee, 'energy drinks' and in tablet form. Some proposed investigations have related to senior students giving their peers caffeine, some have alarmingly proposed giving caffeine to younger groups of students, for example, to 'the whole of second year' and then measuring how fast they can run. We have advised that these investigations should not be done. Having ourselves sought the advice of a consultant toxicologist on this matter, we are reassured that our advice is sound.

We recently posted the following statement on the teachers' discussion forum, SYNAPSE:

At SSERC we are aware that protocols do exist for carrying out investigations into the effects of caffeine on human subjects. However, following recent discussions with a consultant toxicologist, it is our advice that such investigations should not be carried out in school.

Caffeine can promote a range of physiological changes in the body, some of which may be adverse in certain individuals.

Caffeine is addictive and stopping taking it after a period of use may cause symptoms in some people.

Caffeine may also react adversely with some prescription drugs.

Our current advice is that a substance known to have physiological effects on the subjects who consume it should not be administered in school for the purpose of investigation.

Additionally, we would make the point, relating to investigation design, that uncontrollable confounding variables in such an investigation make the generation of meaningful data difficult.

You should note that SSERC is the specialist Science and Technology Health and Safety Adviser for local authorities, and for independent schools who are members of SSERC. Should you wish to carry out investigations on human subjects using caffeine you would need to carry out a detailed risk assessment and seek your employer's permission to proceed.

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