Laboratory Waste

Module 3

ROYAL SOCIETY OF CHEMISTRY

Health & Safety Essentials

Registered charity number 207890

The treatment of hazardous chemical waste before disposal

Some waste materials must be converted into a less hazardous form in order to limit damage to the environment and those handling the disposal chain. The precise reagents are dependent on the nature of the waste; some common examples are given here. If in doubt about the correct method of waste treatment, consult your chemical health and safety officer.

Pyrophorics

These reagents must be treated and made safe; poor handling can lead to fires, possibly explosions, and serious injury.

In general, 'slow' hydrolysis can be employed to perform a controlled reaction or 'quench'. For example, sodium can be treated with an alcohol (either iso-propyl alcohol, or ethanol, or tert-butanol). The prep should be performed in a fume cupboard (note: hydrogen is evolved in the process), employing small amounts of sodium, and 'good laboratory practice' see Laboratory Best Practices. To complete the hydrolysis, after the bubbles have stopped, small quantities of water (~ 0.5 ml) are added with constant stirring to ensure mixing. Where ethanol is employed, the resulting sodium alkoxide forms a gel with unreacted ethanol, and any unreacted sodium can be present in the gel.

Before attempting any disposal reactions check the chemical safety literature and ensure a COSHH assessment has been performed. Do not try and destroy large amounts in one go; consider batch processing or consult a specialist.

The following pyrophorics can be safely hydrolysed:

Lithium	1. Petrol / hexane / toluene wash 2. H_2O
Sodium	1. Petrol / hexane / toluene wash 2. absolute ethanol (or IPA), H_2O
Potassium	1. *iso*-propyl alcohol 2. absolute ethanol, H_2O
n-Butyllithium	1. *iso*-propyl alcohol under inert atmosphere 2. absolute ethanol, H_2O
t-Butyllithium	1. *iso*-propyl alcohol under inert atmosphere 2. absolute ethanol, H_2O
Sodium / potassium hydroxide	1. Suspend in toluene under inert atmosphere 2. absolute ethanol (slowly), H_2O
Calcium hydride	1. ethanol, H_2O
Lithium aluminium hydride	1. quench in reaction vessel with 2M sodium hydroxide **or** 1. *iso*-propyl alcohol 2. absolute ethanol, H_2O
Phosphorus pentoxide	1. spread out in large evaporating dish in fume cupboard and leave **or** 1. suspend in absolute ethanol 2. add H_2O (slowly)

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Toxic substances

Substances that are toxic or produce hazardous fumes must be treated in the laboratory, or disposed of as special waste if in large quantities. This prevents contamination of sewers or sewerage treatment plants. Some reagents and procedures are listed below.

Some examples

Cyanide	Small quantities of cyanide waste should be converted to carbonate by mixing it in a large beaker in a fume cupboard with a slight excess of sodium hypochlorite solution. The reaction is normally complete in a couple of days. When the cyanide has been destroyed, (test with a few drops of iron (II) sulfate and a mineral acid; a blue colour indicates unreacted cyanide), the resultant waste may then be sent to drain after heavy dilution with water.
Chromium (VI)	Waste containing chromium (VI) should be reduced to the less toxic chromium (III) with an appropriate agent (iron (II) solution / sodium sulfite). Chromium (III) forms an insoluble precipitate with hydroxide ions.
Sulfide	The addition of zinc sulfate to a solution of sulfide will precipitate solid zinc sulfide, which may be collected in a suitable container. The remaining solution can be sent to drain.