Decontaminating General Laboratory Waste

Within budget and without hurting yourself!

-by Glenda Arendse

CLAIMERS

- I am neither a chemist nor a scientist, however I have studied
- Chemistry at a tertiary level and have more than 30 years' experience working at various laboratories including:
- Pharmaceutical and non-pharmaceutical (vitamins, herbal supplements), analytical reagents, pesticides and herbicides, soils and water testing.
- My studies include Biological and Applied Sciences, Linguistics and 2nd Language Acquisition which resulted in a teaching qualification.
- My hope is to bring a combination of work and educational experience to share my ideas with you.

- Glenda Arendse, LabCon Nov 2025

To be sure! To be sure!

My intention is to improve on existing procedures not to oust recommended procedures by professional sources.

….. to share my ideas in good faith and confidence that they will help improve your management of laboratory waste.

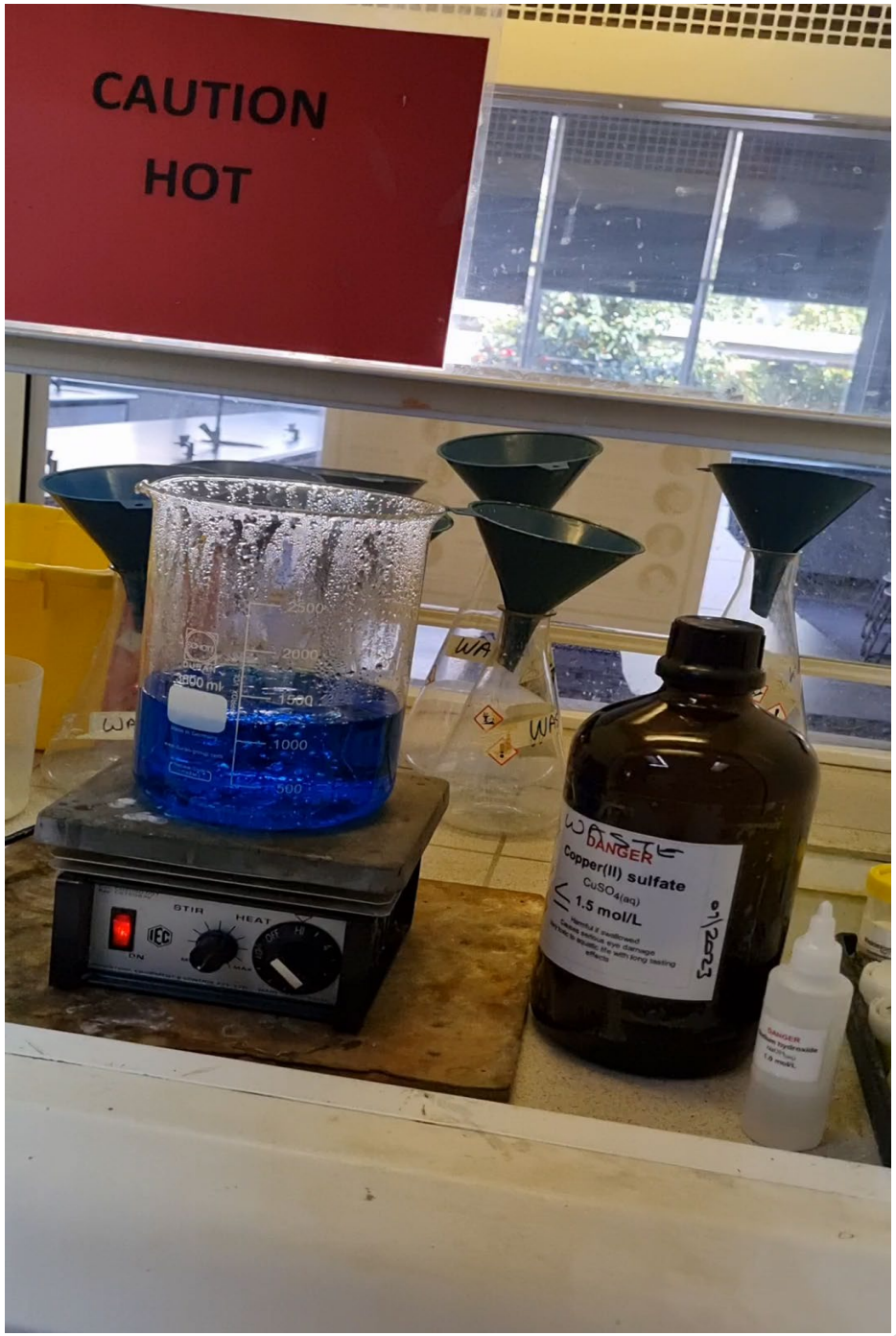
All suggestions made in this presentation assume the upholding of good laboratory practices and health & safety guidelines.

Introduction

- To minimise onsite chemical waste accumulation, and reduce potentially harmful effects to the environment, maximum efforts are made to decontaminate chemical waste produced in school laboratory practicals. Chemical processes of extraction and precipitation of harmful metal ions from inorganic compounds are employed to reduce volumes of hazardous waste stored onsite and ensure that any flushed waste is not detrimental to the environment.

- Soln(aq) + Reagent -> Precipitate + Salt Soln(aq)

Plan B


CAUTION
HOT
DANGER
Copper(II) sulfate
$CuSO_{4(aq)}$
1.5 mol/L
STIR
HEAT

The chemistry in brief:

The decontamination process involves breaking ionic bonds of inorganic substances to form new bonds between cations and anions.

1/ $BaCl_2(aq) + Na_2CO_3(s/aq) \rightarrow BaCO_3(s) + 2NaCl(aq)$

2a/ $CuSO_4(aq) + 2NaOH(s/aq) \rightarrow Cu(OH)_2(s) + Na_2SO_4(aq)$

2b/ $CuSO_4(aq) + 2NaHCO_3(s/aq) \rightarrow CuCO_3(s) + Na_2SO_4(aq) + H_2O(l) + CO_2(g)$

The setup

*Ensure fumehood is on.

*Prepare for the job: small or large quantities.

*Use dedicated equipment for waste disposal.

Making the slurry

*Work with what you have!

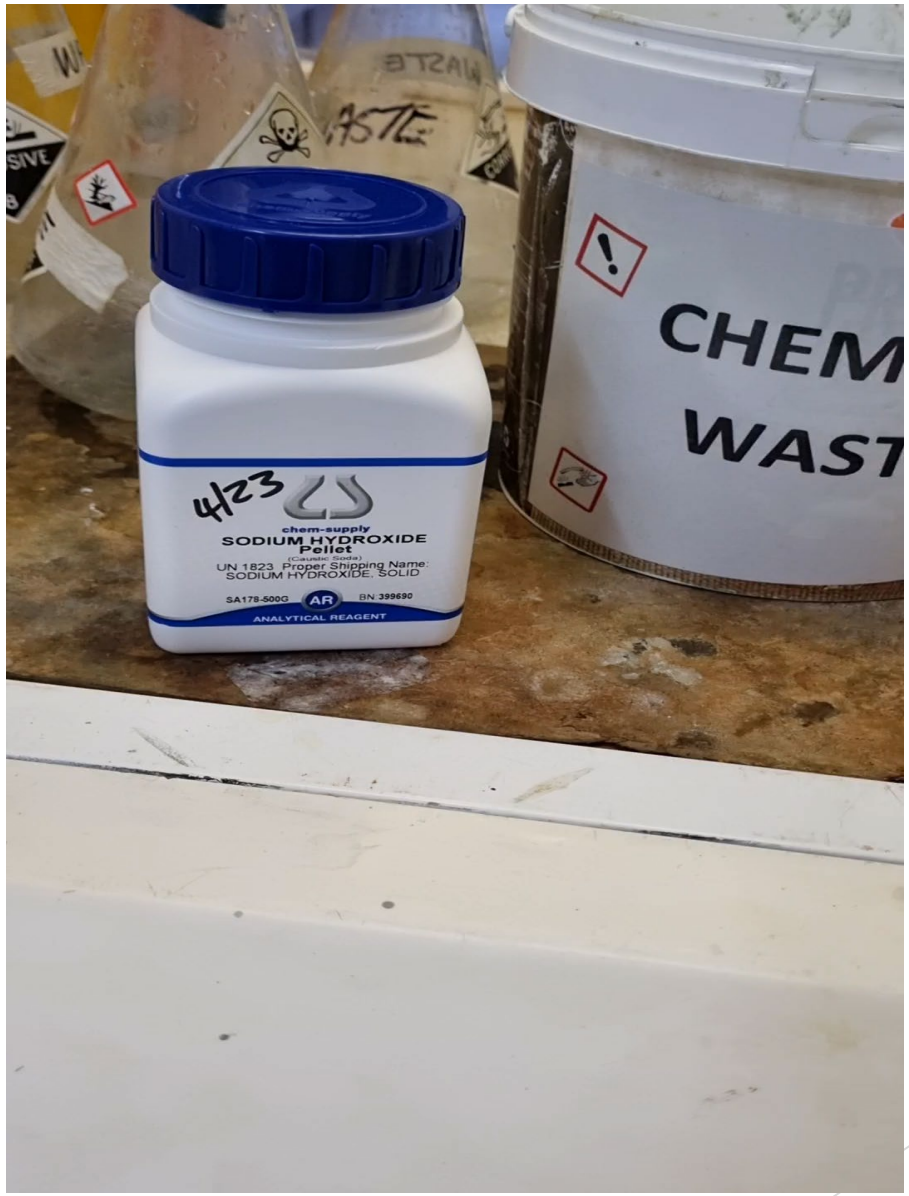
*Don’t be in a hurry to throw out old stock!

*Waste not, want not!

Making the slurry

Use pellets, flakes, discarded solutions, expired stock,….

….whatever is available!



Slurry consistency

Decanting the slurry!

Always use a jug with handle for ease of pouring

Decanting the slurry

- Work with small quantities to avoid spillage

- Fill paper to three quarters max

FILTER the slurry

Time for a coffee break!

Capturing the precipitate

Need for rework at a glance!

*Use NaOH to speed up the rework process

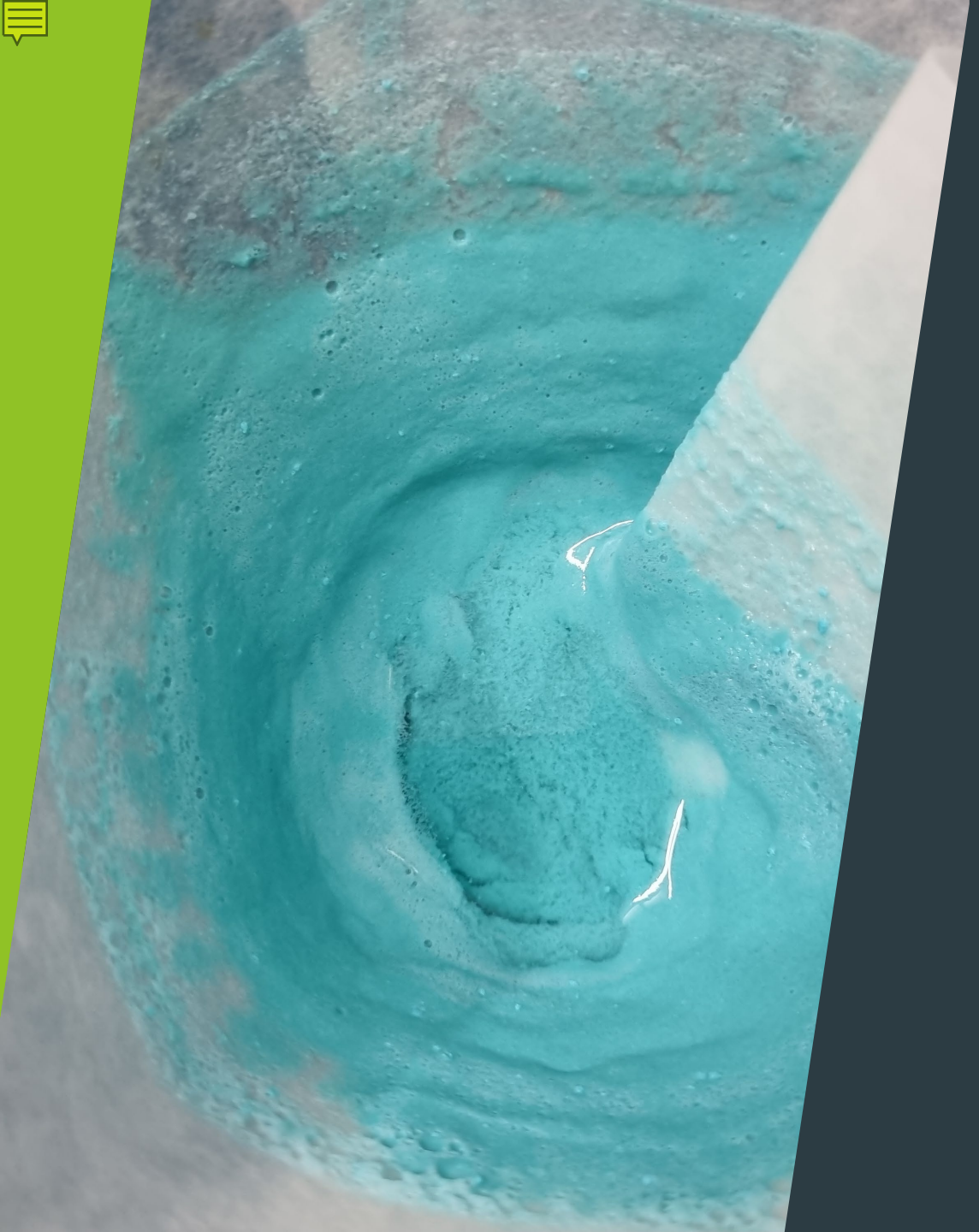
Using Bicarb

- Slower process; rework is generally required

Good guesstimating!

*When filtrate is colourless, no need for reworking!

Practice makes perfect – getting it right first time!



Captured precipitate

- Next step?

Checking the filtrate

*most of the copper has clearly been captured

*the filtrate is virtually colourless

Test pH of filtrate

Using Universal Indicator

Quick pH Checking

Using pH paper

Adjust pH to neutralize solution

*Using appropriate reagent (acid or base)

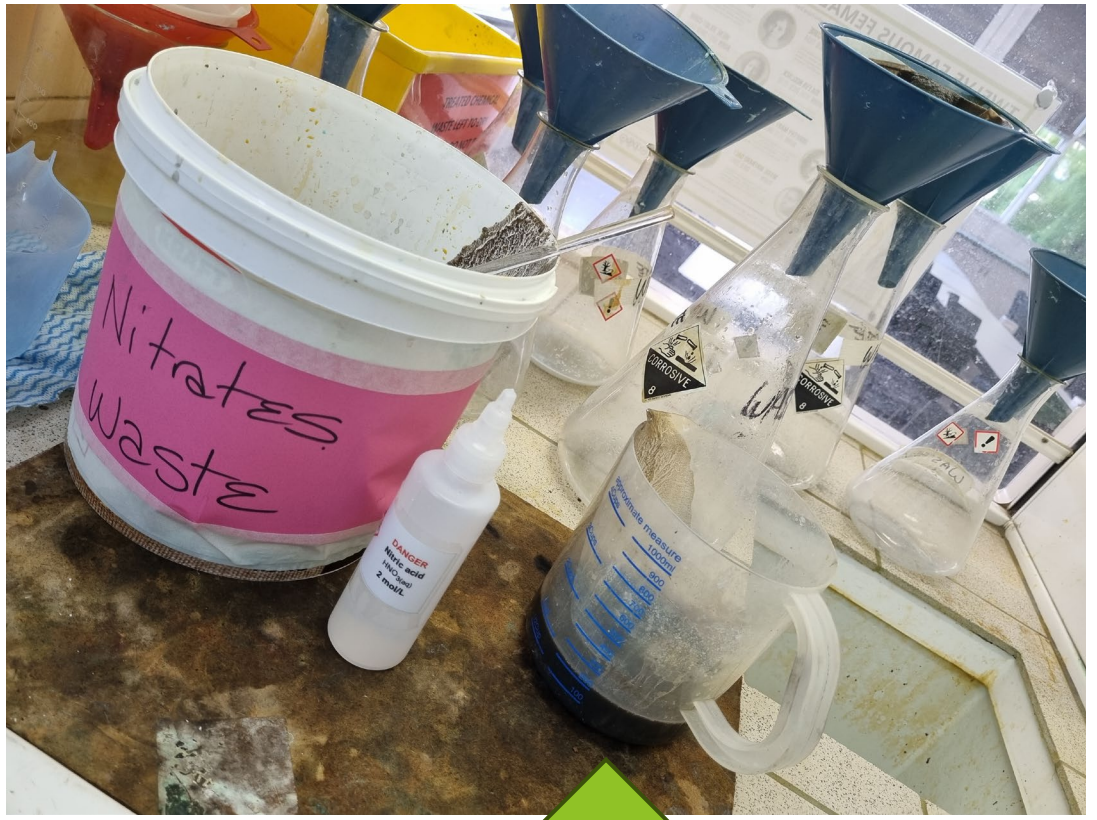
*Flush away using standard 1:20 dilution

pH looking good!

- Flush away using 1:20 dilution

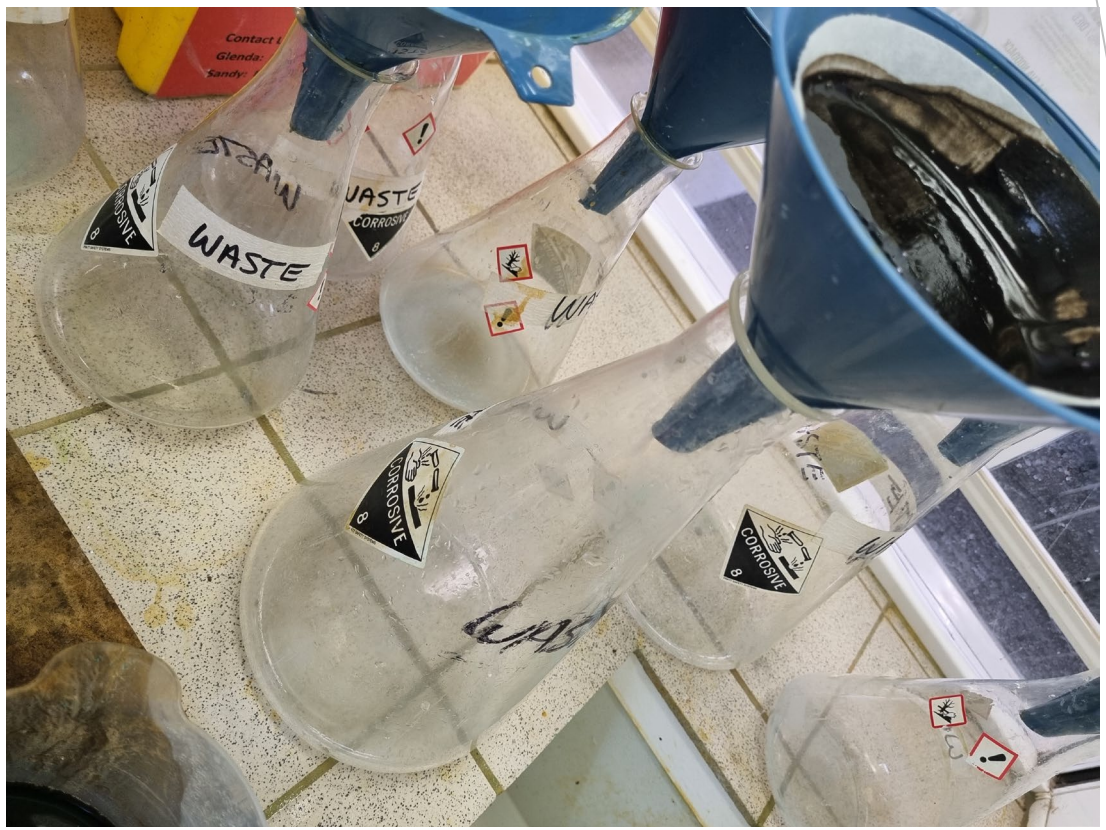
Incoming!

- Surely that is NOT nitrate waste alone???



First aid response!

Add sodium carbonate → make a slurry then filter!



Nitrate sludge dream run!

Clear filtrate suggests no rework is necessary!

To be sure!
To be sure!

*Treat “Nitrate” filtrate with dilute HCl

*Reaction should produce a salt and nitric acid

*Nitric acid can be neutralised with NaOH

*Flush away using 1:20 dilution

Overnight drying

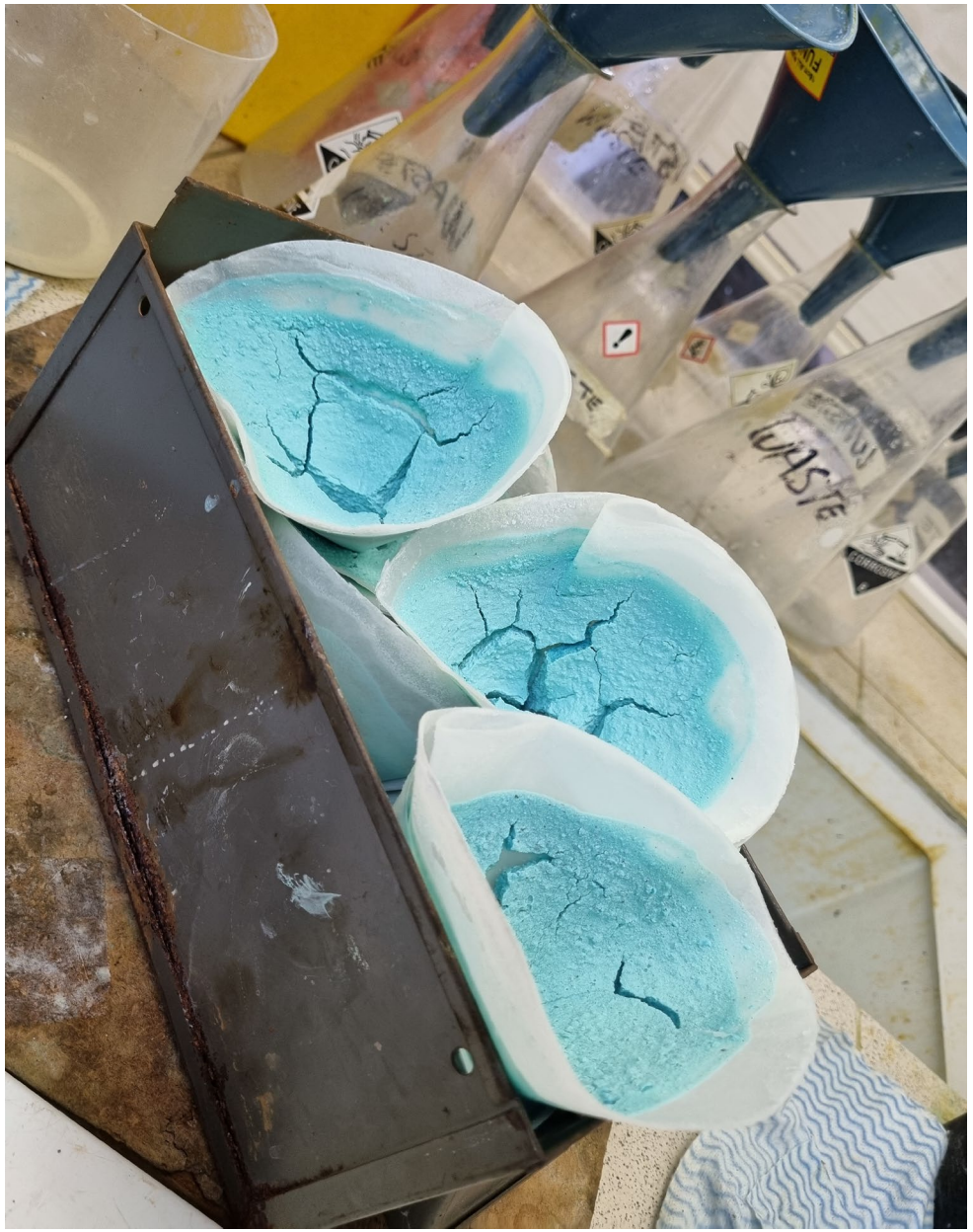
- Ideally allow to dry naturally under hood

Surprising formations!

Captured copper – oxide and carbonate mixes

Oven baked

- Baked to perfection!



Optional Drying

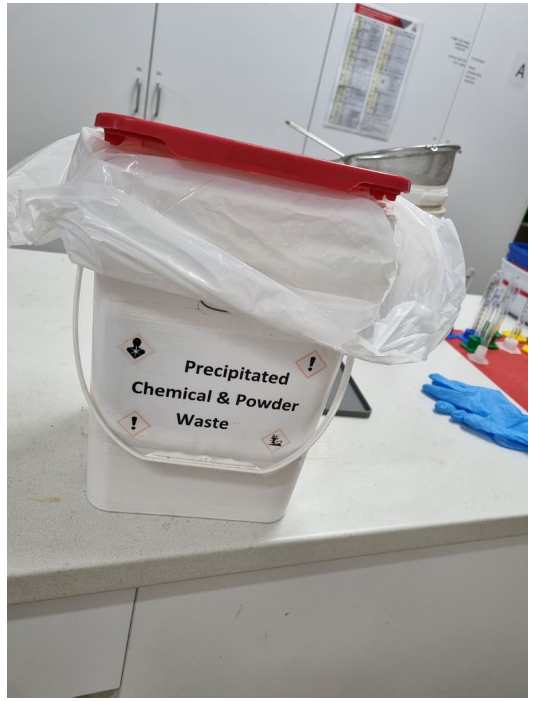
Re-purposing of old things

- making use of what you have!

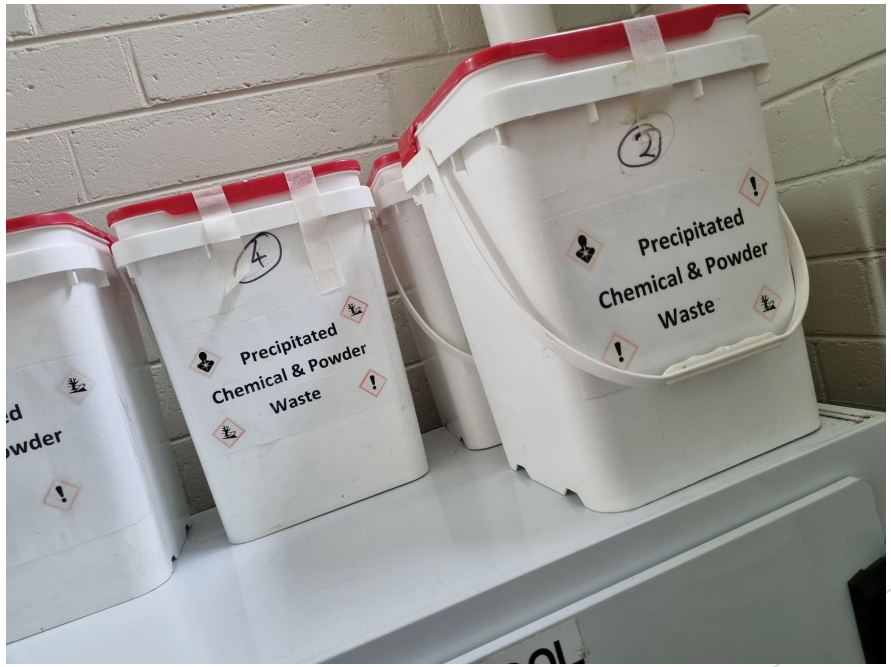
- for dedicated usage only!

Keep waste separate

Clearly labelled and double bagged



Ready for pick up!



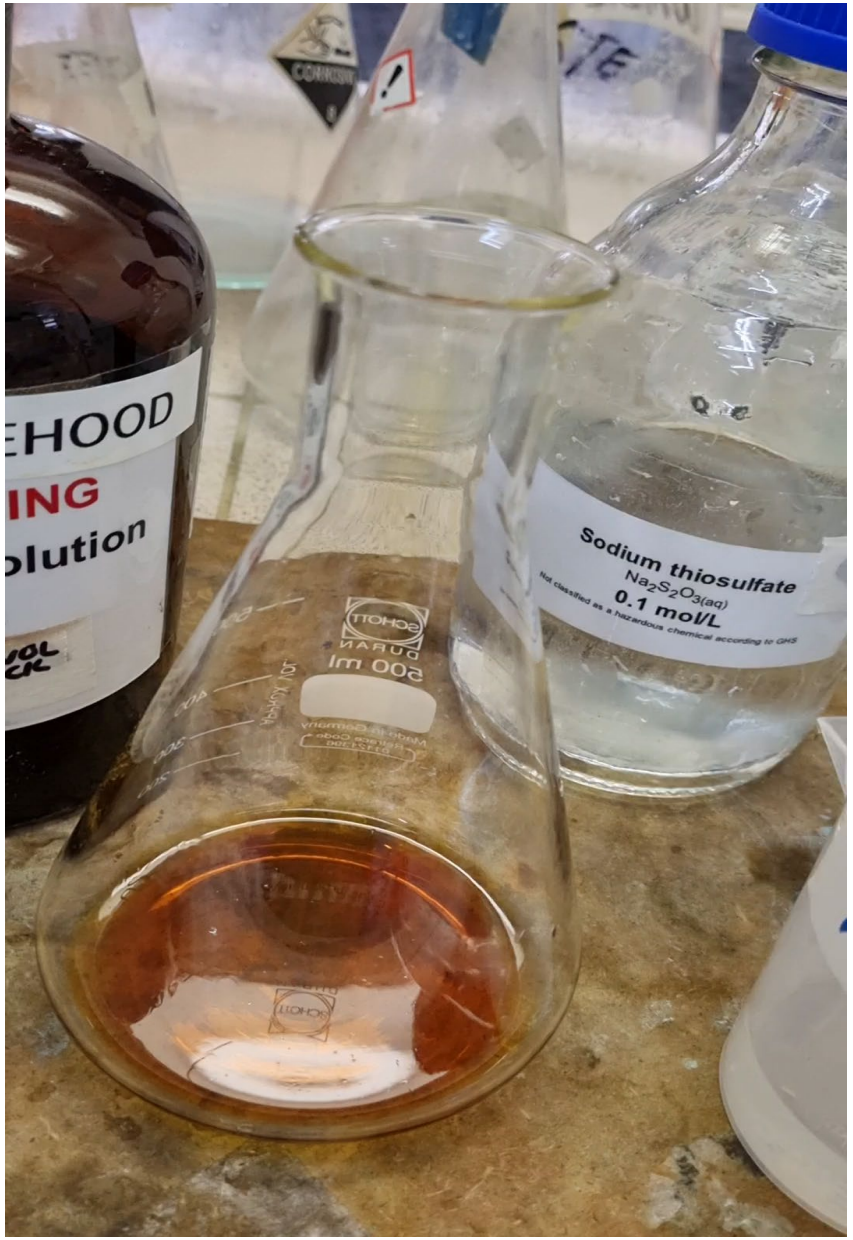
Re-purposing of old things

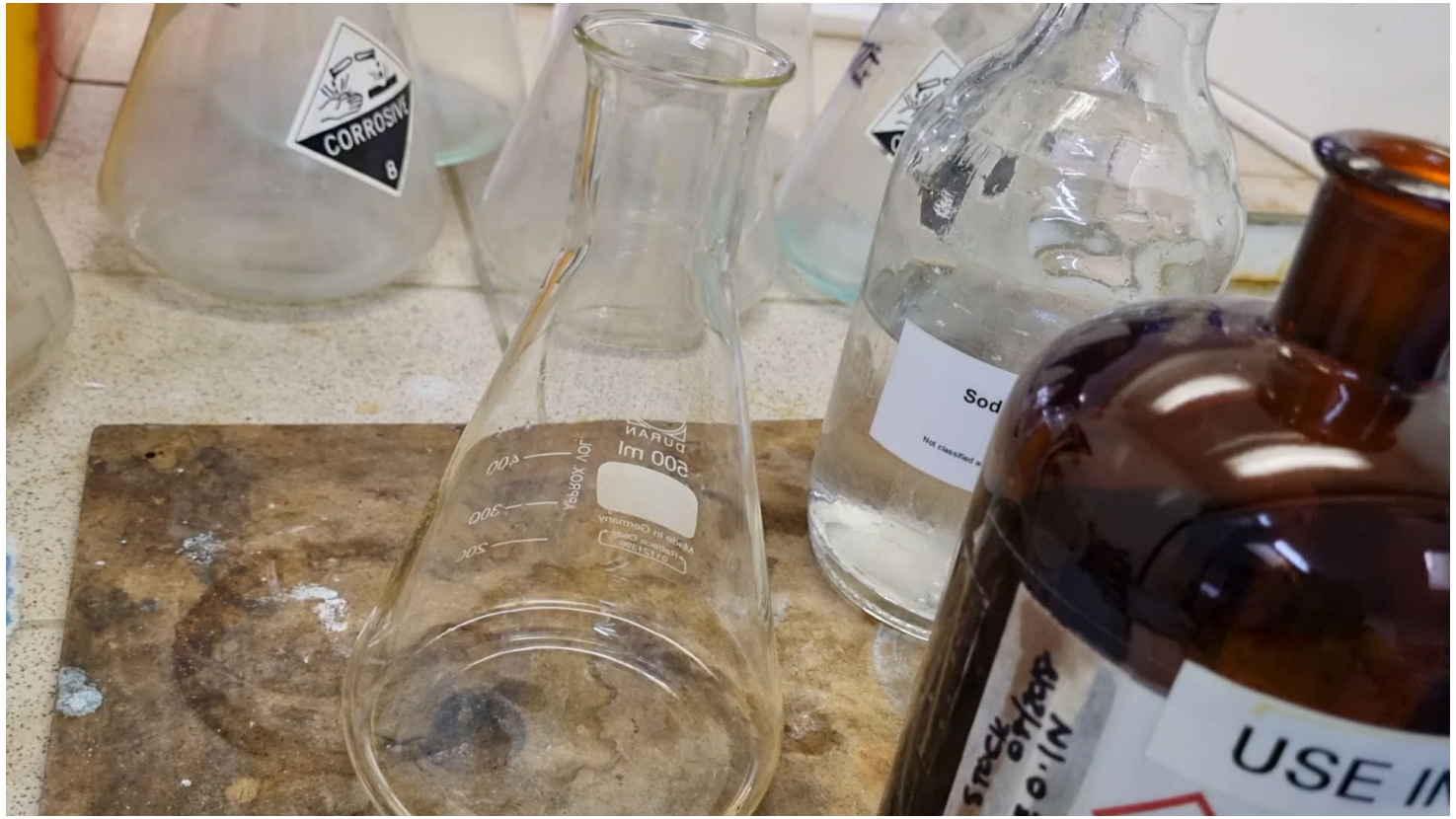
- Professor Bones still works in the Junior School Science Centre. A lifetime employee, although now retired, he's a great asset to the Lab Techs keeping a watchful eye on everyone!

Iodine Disposal

Iodine and Thiosulphate

- Redox reactions at work
  - to our benefit!





Check if reaction is complete before flushing:

*Add thiosulphate in excess

*Can add starch to check for unreacted iodine

Thiosulphate at work again!

Reactions with HCl

Rates of Reaction

$Na_2S_2O_3(aq) + 2HCl(aq) \rightarrow S(s) + SO_2(g) + 2NaCl(aq) + H_2O$

*Work in the fumehood!

*Filter the waste solutions to capture any sulphur precipitate

* Check filtrate for chemical neutrality before applying the dilution flush

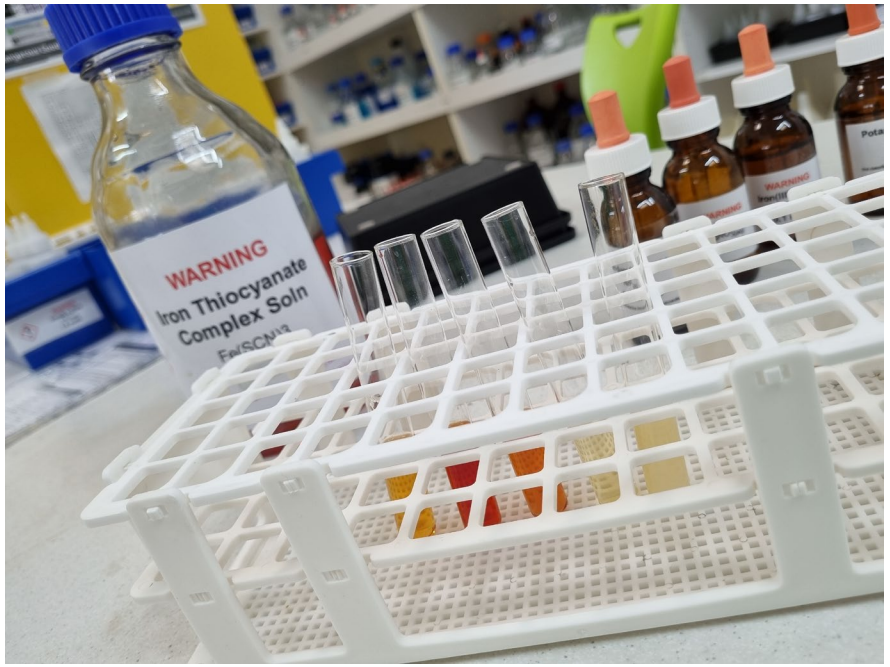
Teacher Demos

*Usually very small quantities

*Filter asap and process filtrates as per usual

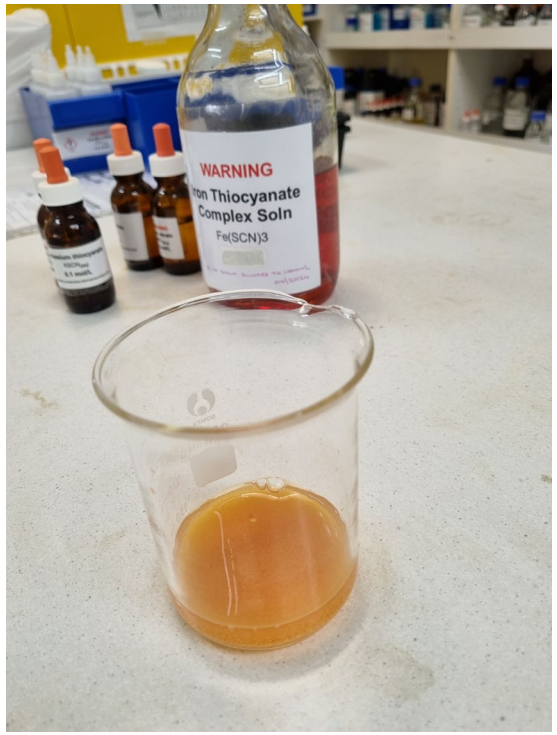
Equilibrium shifts and Complex issues

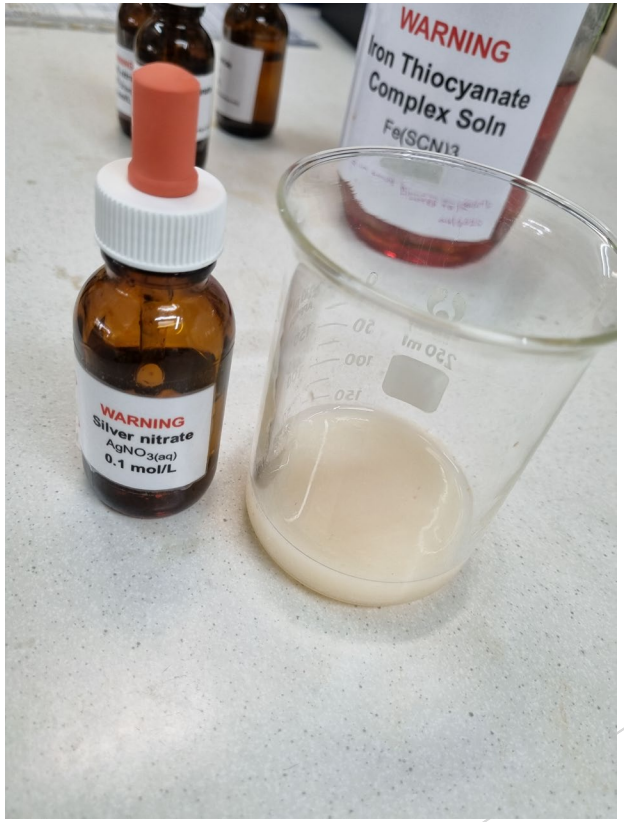
Iron Thiocyanate



Ammonium Molybdate

Concentration & Equilibrium yields: $Fe(NO_3)_3$ + KSCN + NaF + $AgNO_3$





Disposing of Ammonium Molybdate After PO4 testing

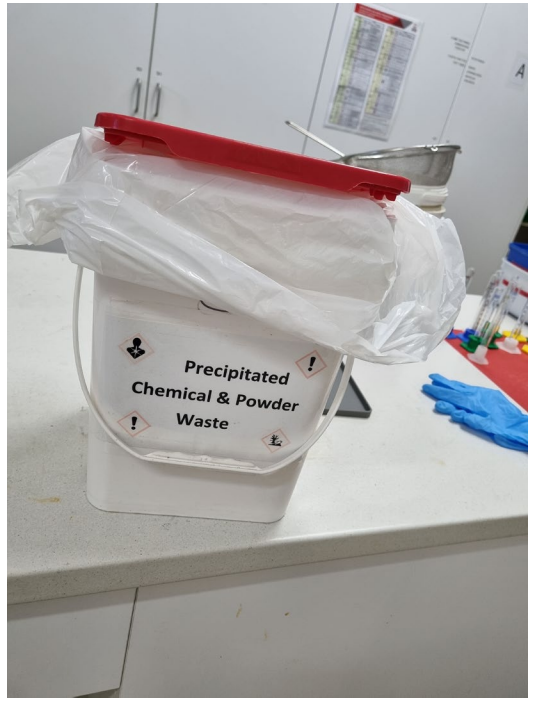
- To the dark blue mix add 1M $Fe(NO_3)_3$ to instigate the precipitation
- Add K_2HPO_4 +/- Na_2CO_3 to buffer and aid precipitation
- Allow to digest, if possible o'nite
- Pour off the supernatant layer – if still blue in colour, add $Fe(NO_3)_3$ to instigate further precipitation process before filtering.
- Filter the slurry at the bottom of container

Organic Solvents

- Small quantities (<100mL)– evaporate using steam bath under hood.
- Large quantities (>100mL)- separate halogenated from unhalogenated waste and store in cool, dry, well-ventilated place until removed from site. Preferable not to allow to accumulate to more than 2.5L each.

Reminder to keep waste separate

Clearly labelled and double bagged



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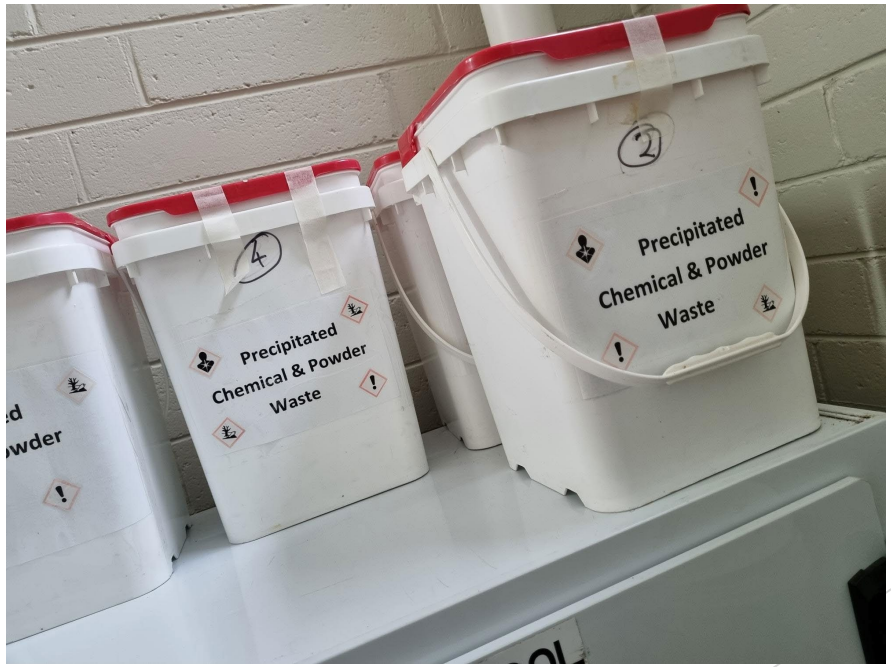

THE

Extract

Neutralise

Dilute