

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 2024

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.



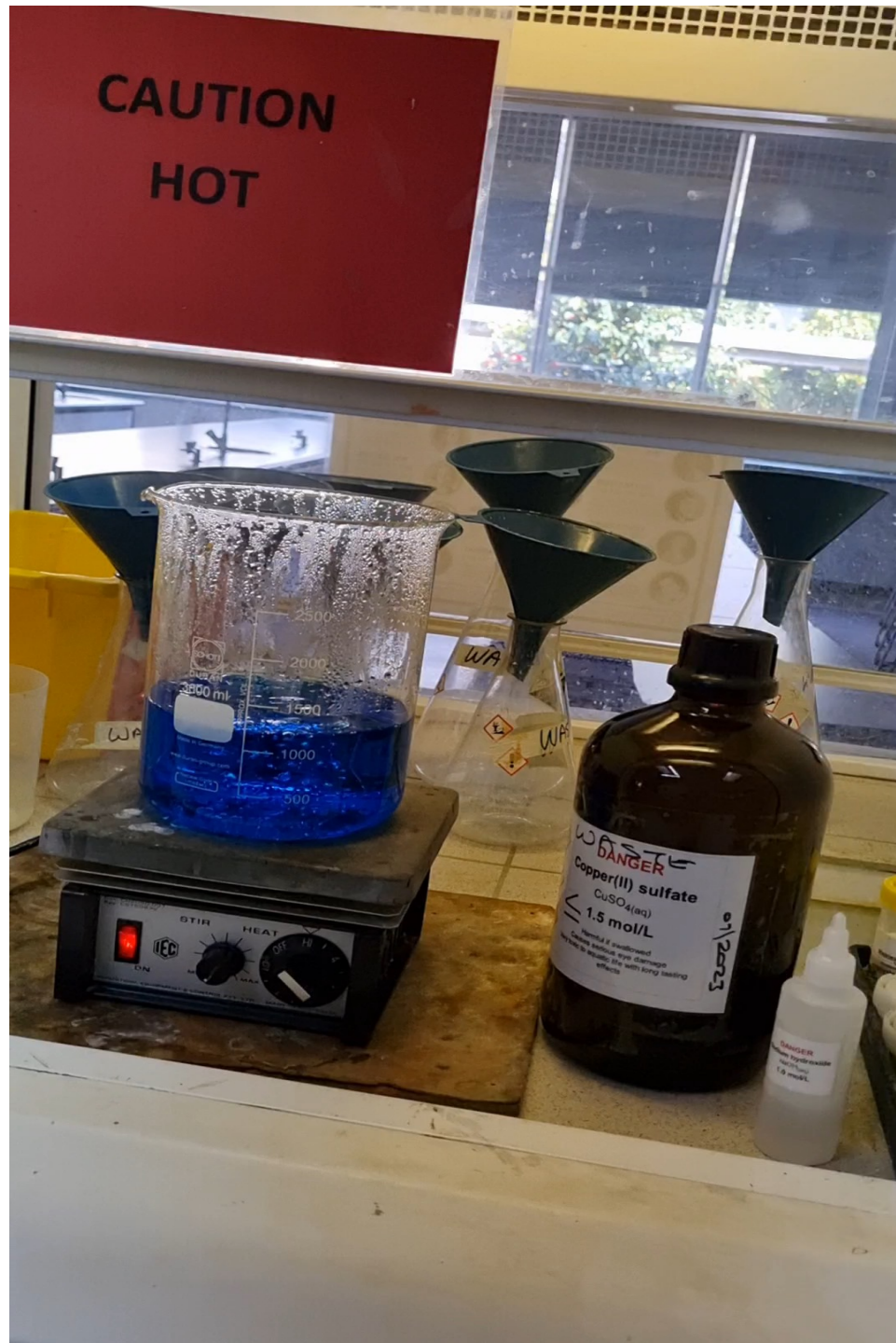
All suggestions made in this presentation assume the upholding of good laboratory practices and health & safety guidelines.

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.
- ▶ $\text{Soln(aq)} + \text{Reagent} \rightarrow \text{Precipitate} + \text{Salt Soln(aq)}$

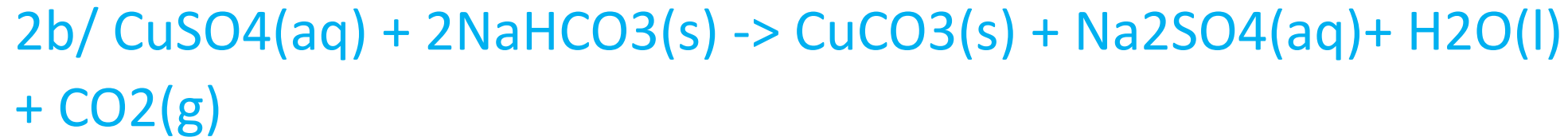


Plan B



The chemistry in brief:

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



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!

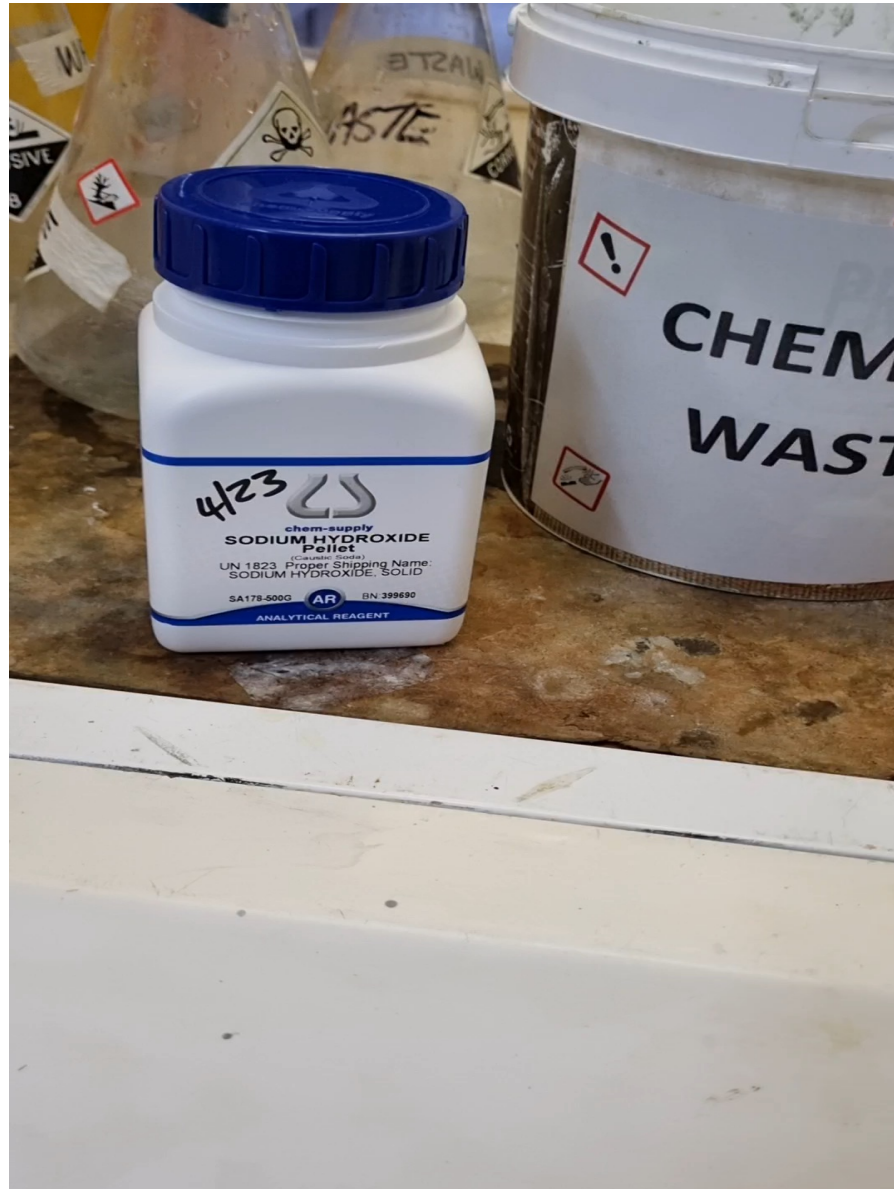
*Don't be in a hurry to throw out old stock!

*Waste not, want not!



Making the slurry

Use pellets, flakes, discarded solutions,
expired stock,....
....whatever is available!

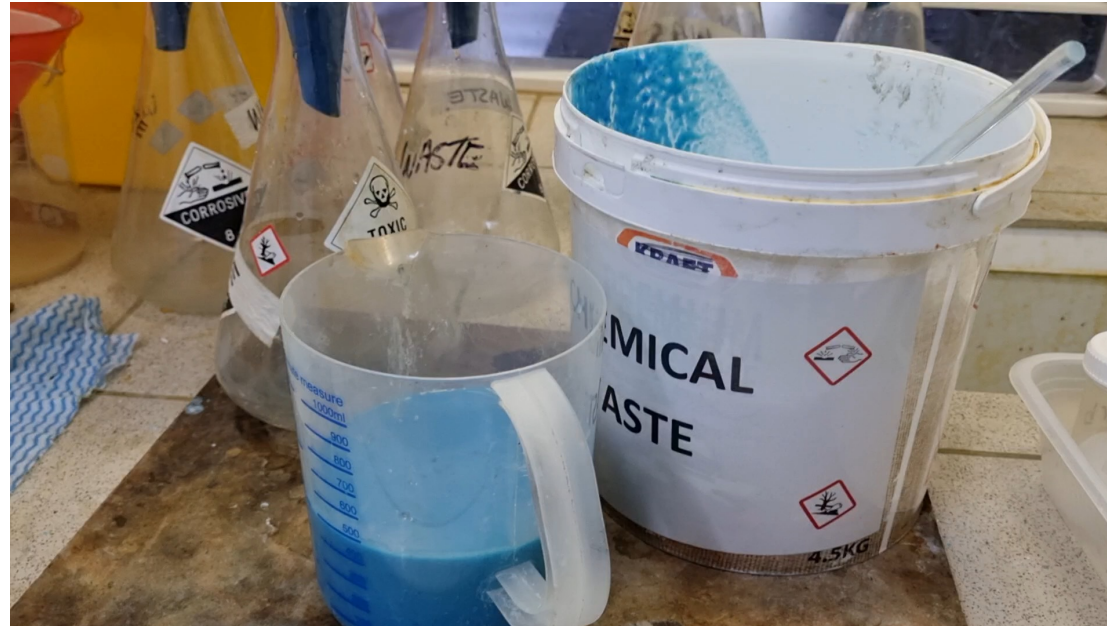




Slurry
consistency

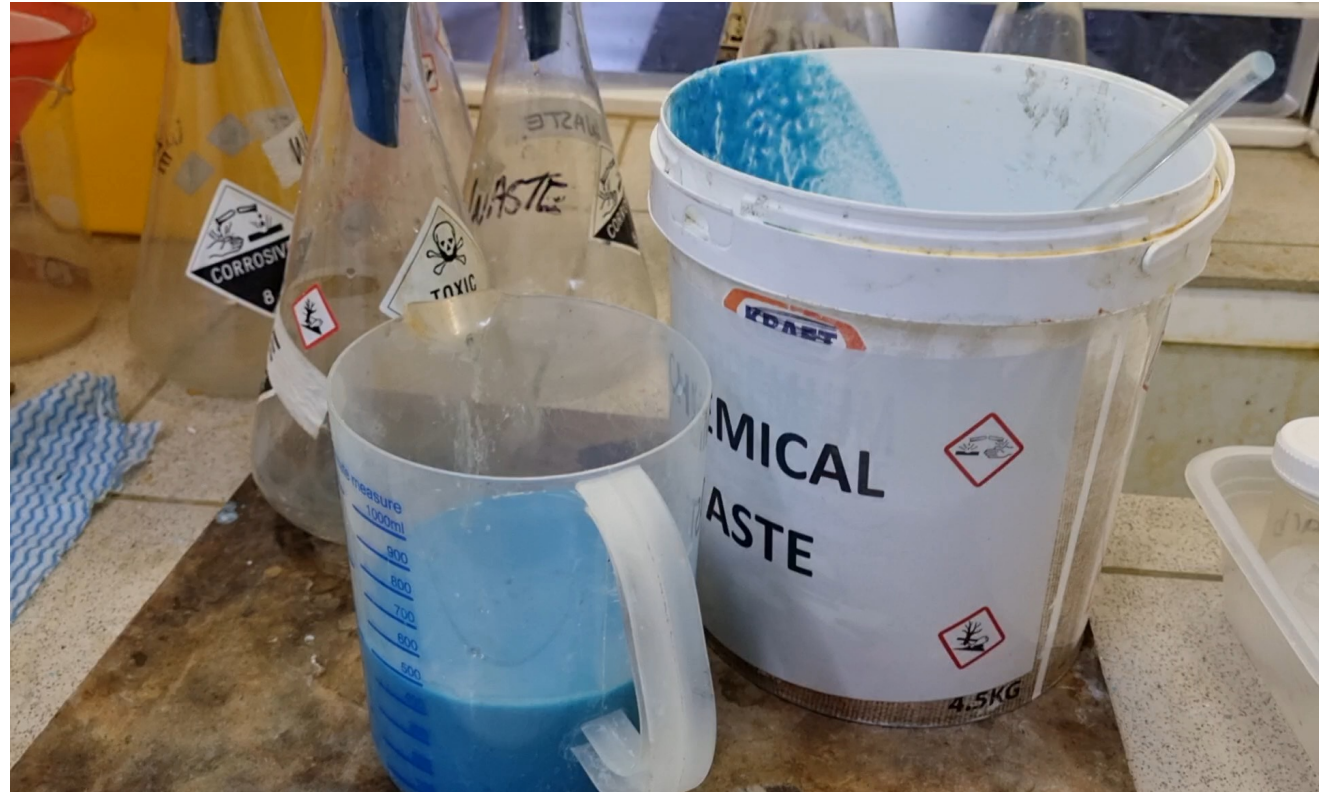
Decanting the slurry!

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

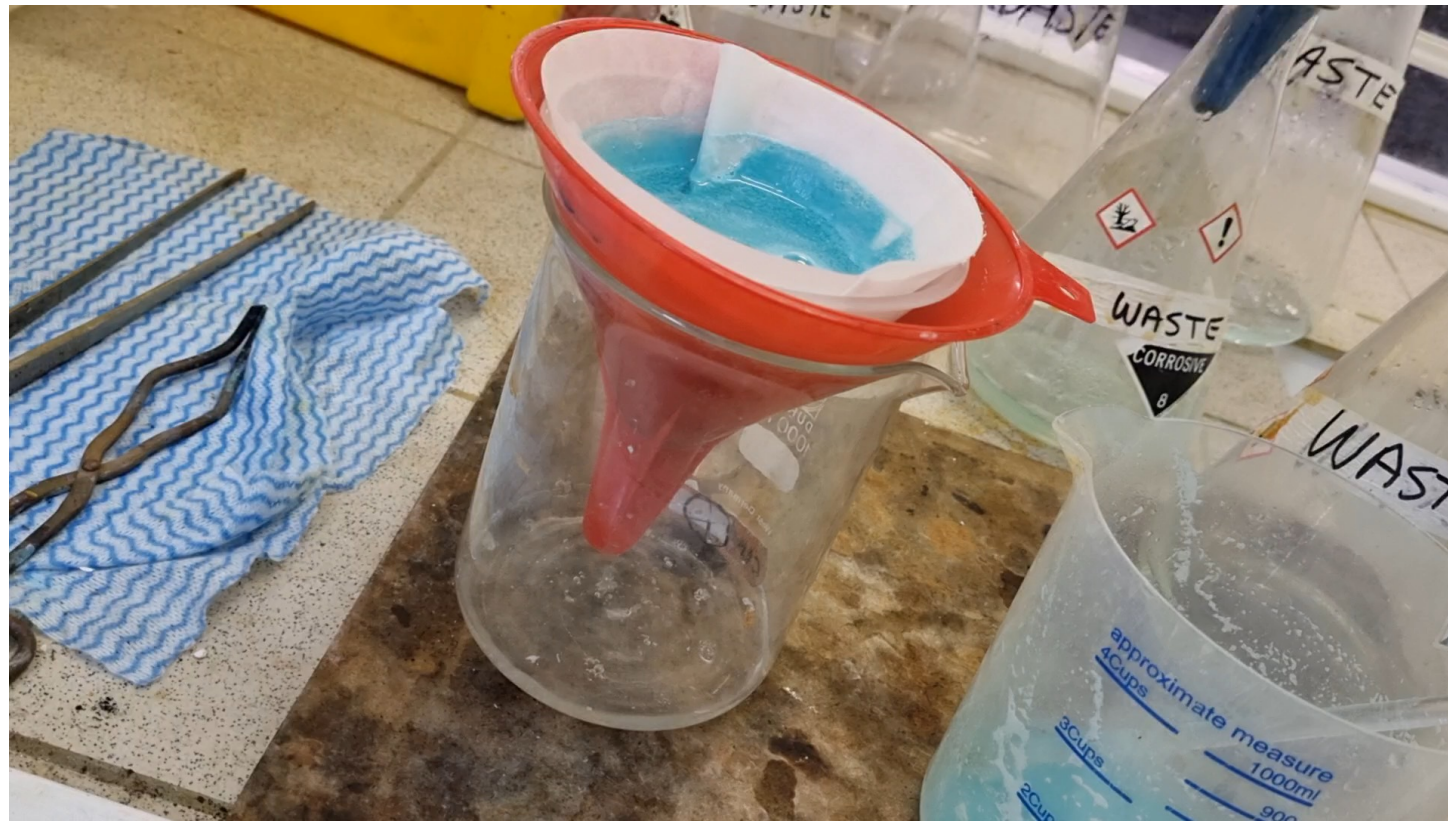


FILTER the slurry

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!





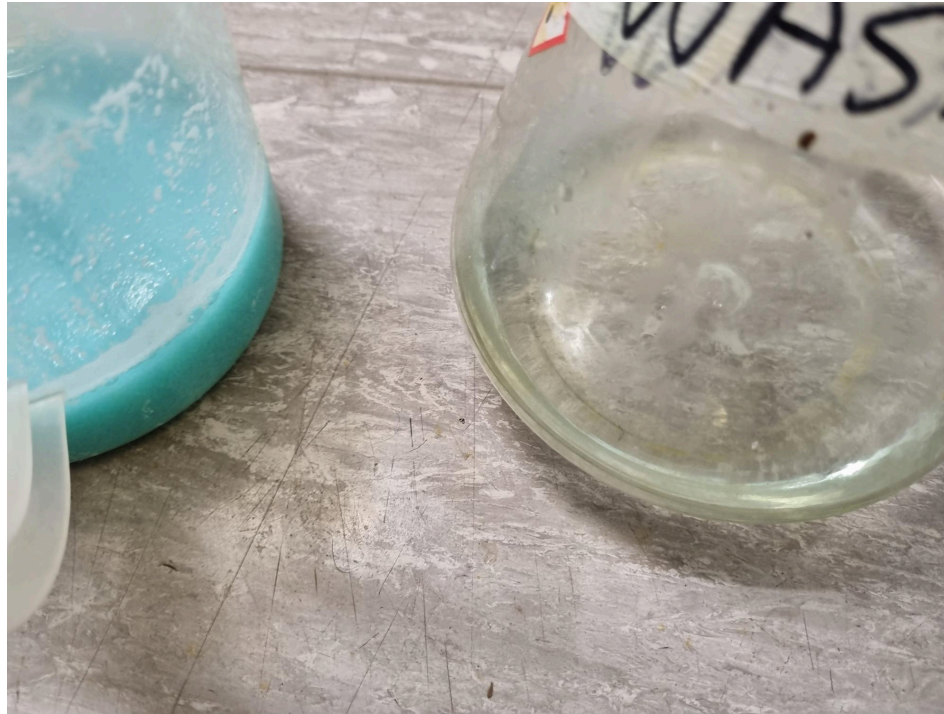
Captured precipitate

▶ Next step?

Checking the filtrate

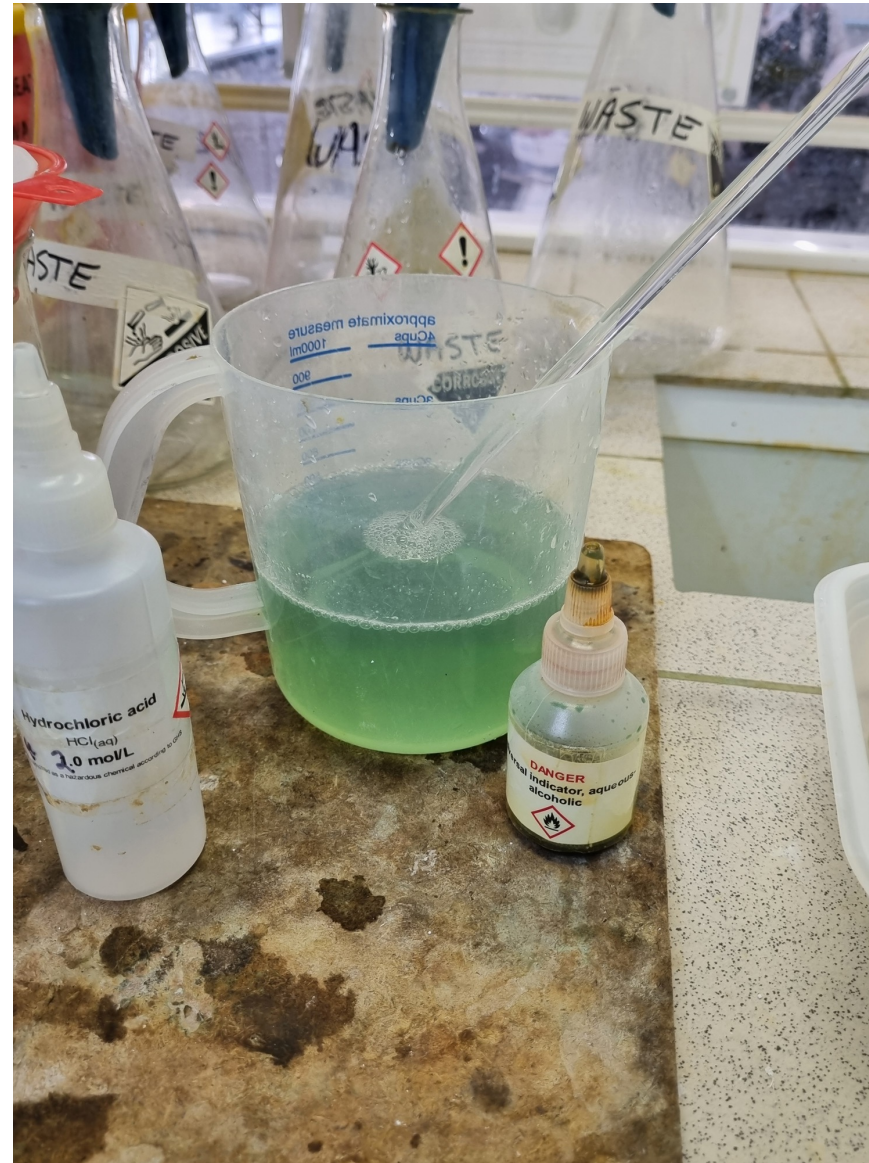
*most of the copper has clearly been captured

*the filtrate is virtually colourless



Test pH of filtrate

Using Universal Indicator



Quick pH Checking

Using pH paper

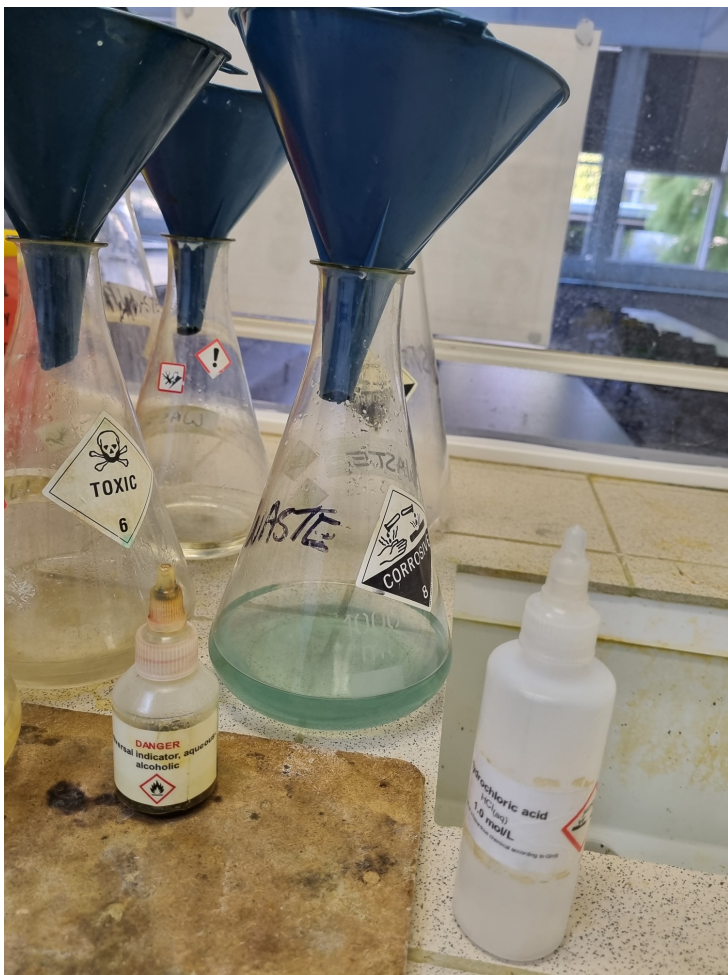


The background features a close-up of a laboratory flask containing a clear liquid, with a green overlay on the left and right sides. The text is centered on a white, semi-transparent area.

Adjust pH to neutralize solution

***Using appropriate reagent (acid or base)**

***Flush away using standard 1:20 dilution**

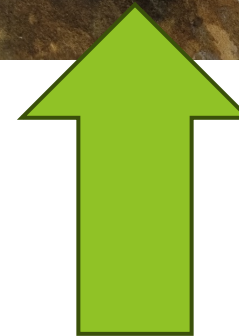
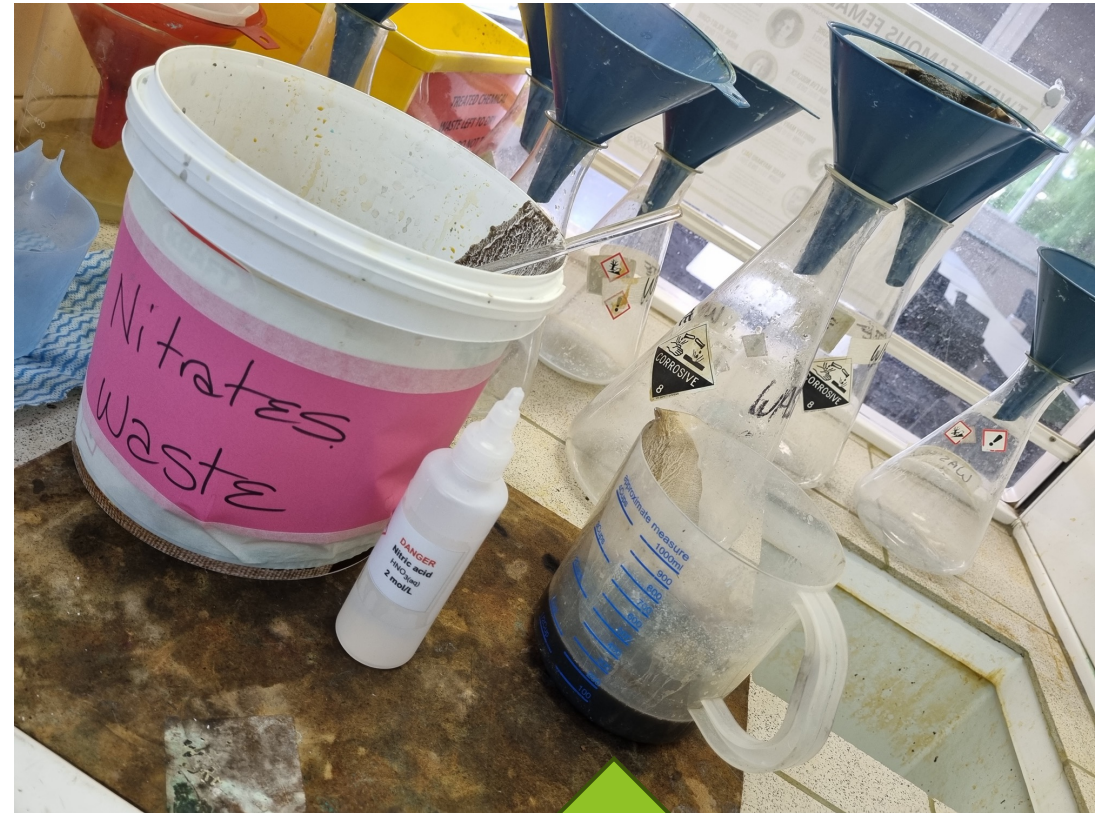


pH looking good!

- ▶ 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

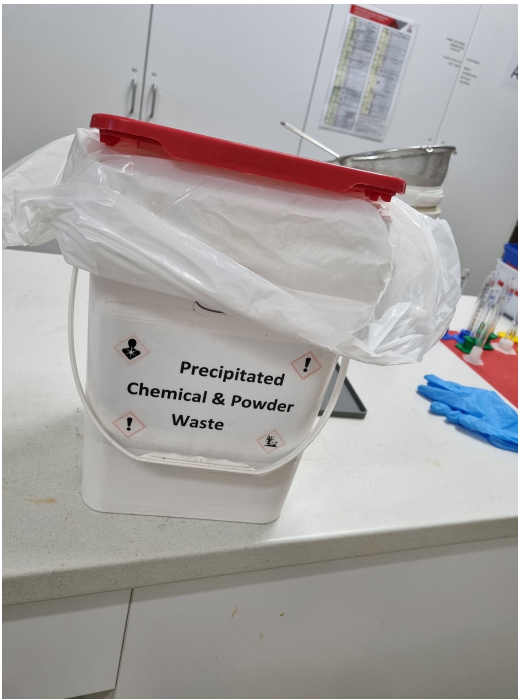
Re-purposing of old things

- 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

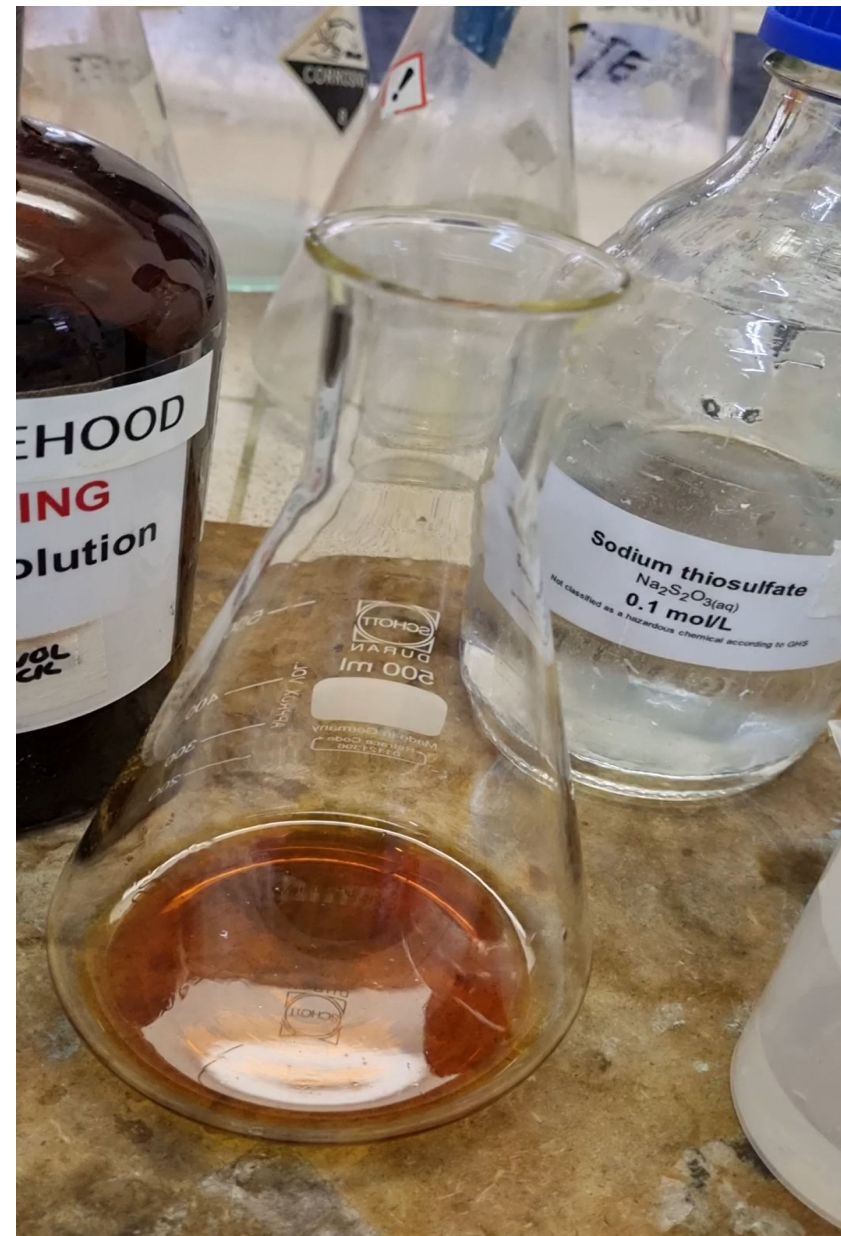
- ▶ Professor Bones still works in the Junior School Science Centre. A lifetime employee, although now retired, he's a great asset to the Lab Techs keeping a watchful eye on everyone!

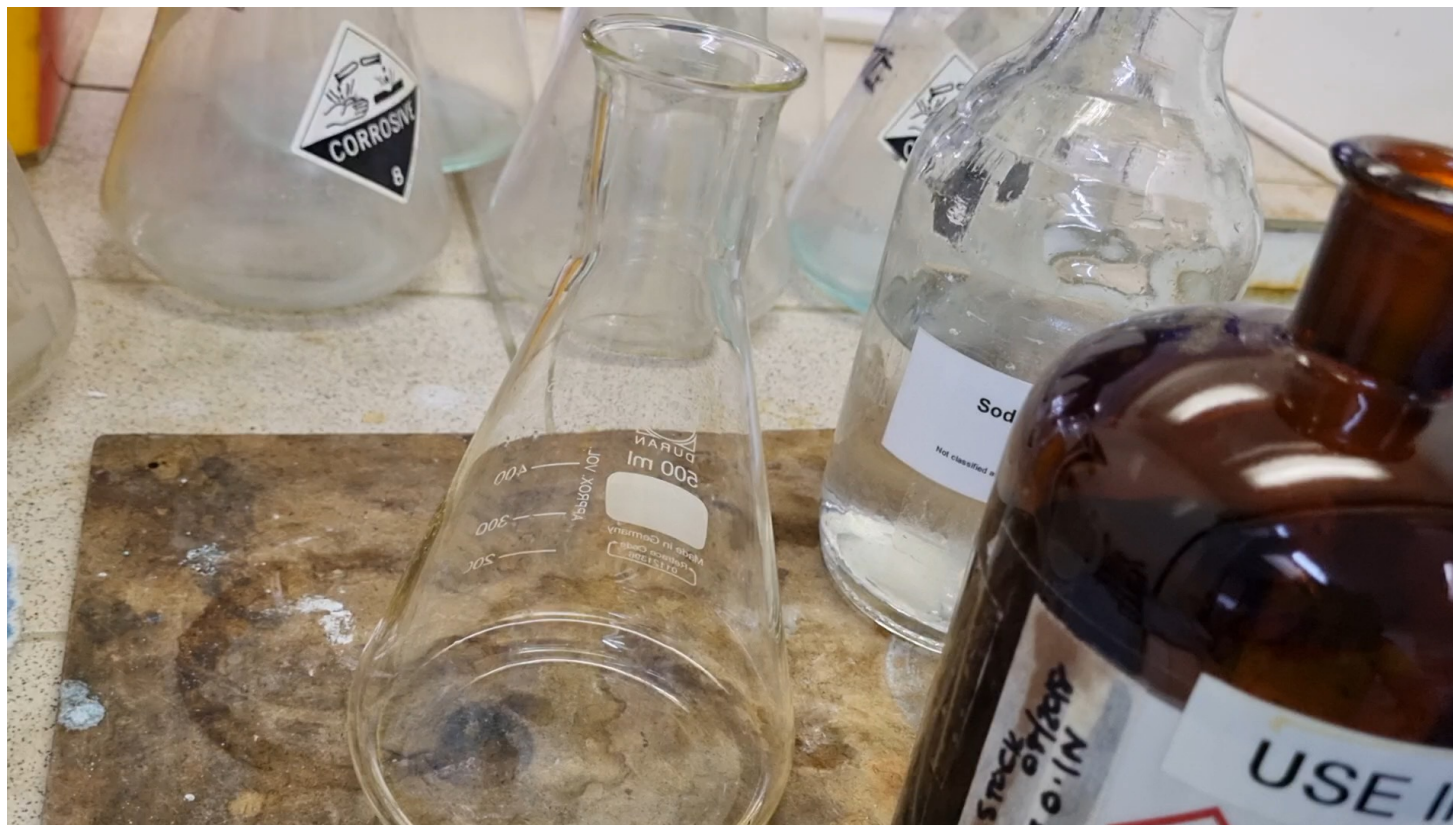
Iodine Disposal



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



*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

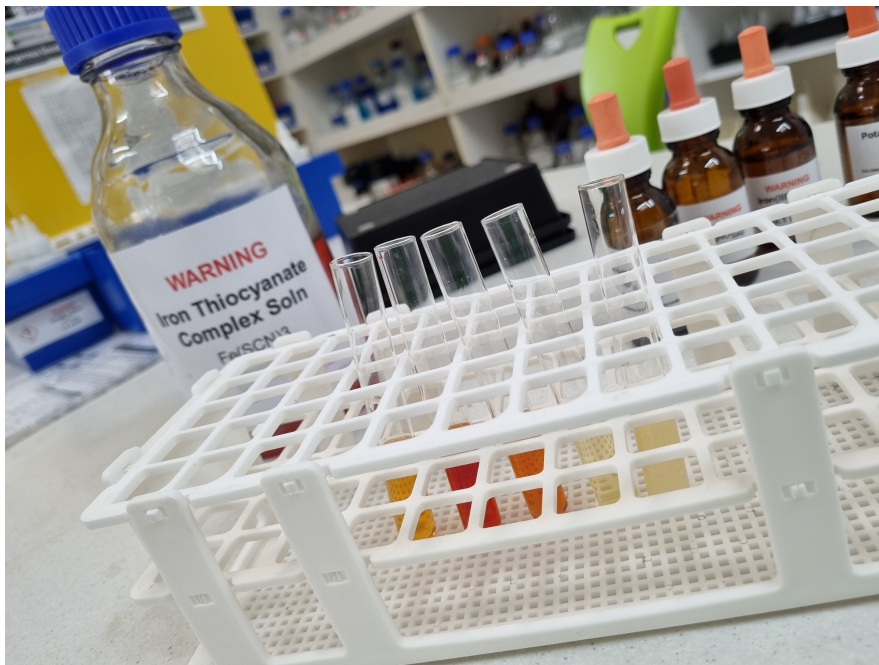
*Usually very small quantities

*Filter asap and process filtrates as per usual



Equilibrium shifts and Complex issues

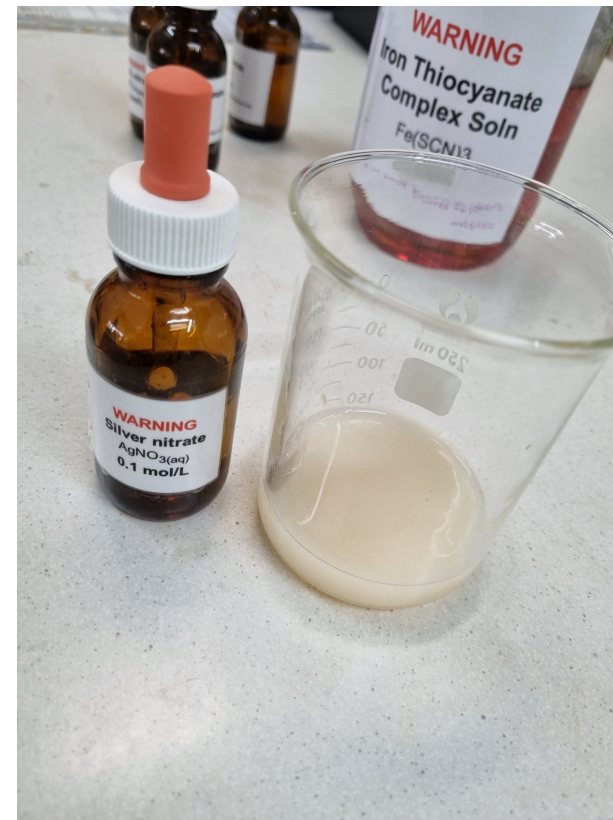
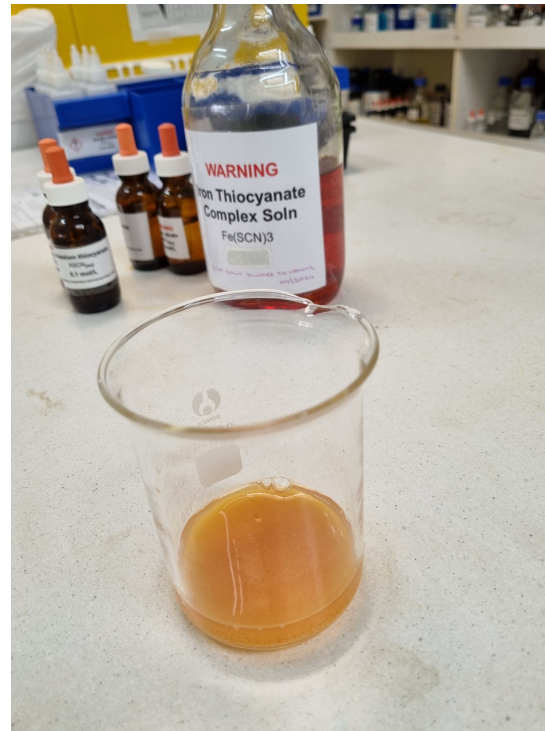
Iron Thiocyanate



Ammonium Molybdate



Concentration & Equilibrium yields: $\text{Fe}(\text{NO}_3)_3 + \text{KSCN} + \text{NaF} + \text{AgNO}_3$



“

Complex made simplex

”

Ammonium Molybdate comes undone!

STEP 1: Be patient!

STEP 2: Be more patient!

Capturing the molybdate

- ▶ To the dark blue mix add 1M $\text{Fe}(\text{NO}_3)_3$ 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 $\text{Fe}(\text{NO}_3)_3$ to instigate further precipitation process before filtering.
- ▶ Filter the slurry at the bottom of container



*If the supernatant layer is still a bluey colour, reprocess to extract residual molybdenum

*Filter as per usual process

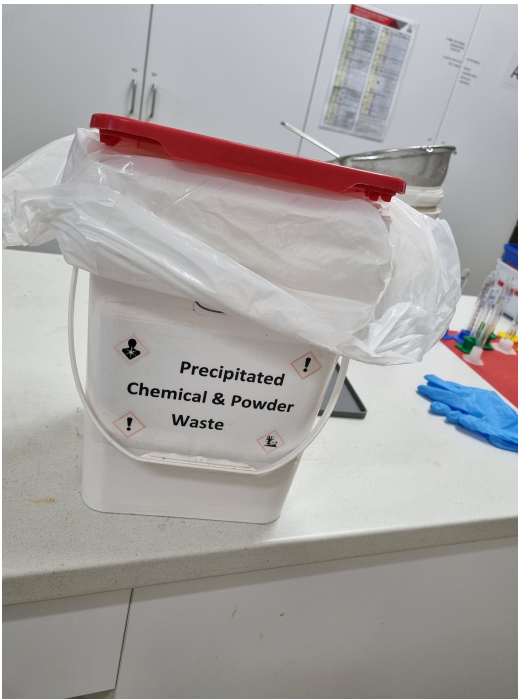
Precipitate is a blue-grey colour



*Filter the
slurry black-blue colour

Reminder to keep waste separate

Clearly labelled and
double bagged



Ready for pick up!



THE

Extract

Neutralise

Dilute