For Teachers **Let's make recycling Blue**

Module 1

Objective: Synthesis of Prussian Blue

Necessities

Reagents	Formula		Quantity (g) or Concentration (M)
Hexacyanoferrate trihydrate	$K_4[Fe(CN)_6]\cdot 3H_2O$		1.0 g in 10 ml of distilled water
Ferric chloride hexahydrate	$FeCl_3 \cdot 6H_2O$		2.6 g in 10 ml of distilled water

List of materials/tools

- 4 beakers
- Glass-rod stirrer
- Magnetic stirrer with heating plate
- Stirring bar
- Plastic spatula
- Graduated pipette
- Graduated cylinder
- Buchner funnel

Lab Procedure

There are two different syntheses. The first one allows you to produce more compound than the second.
The following reaction is the commercial one:
$4FeCl_3 \cdot 6H_2O + 3K_4[Fe(CN)_6] \cdot 3H_2O \rightarrow Fe_4[Fe(CN)_6]_3 + 12KCl$
The precipitate obtained must be filtered.

<u>1° synthesis</u>:

I. 2:1 stoichiometric ratio between $FeCl_3$ and $K_4[Fe(CN)_6]$.
II. 2.6 g of $FeCl_3$ were dissolved in 10 ml of distilled water.
III. 1.0 g of $K_4[Fe(CN)_6]$ was dissolved in 10 ml of distilled water.
IV. The two solutions were mixed and a blue precipitate was obtained (Prussian Blue).

2° synthesis:

I. 1:1 stoichiometric ratio between $FeCl_3$ and $K_4[Fe(CN)_6]$.

II. The same methodology of the first one but with the addition of $C_6H_8O_7$.

The best synthesis is the one with a stoichiometric ratio between the reagents of 2:1 ($FeCl_3$ and $K_4[Fe(CN)_6]$).

- 2.6 g of $FeCl_3$ were dissolved in 10 ml of distilled water.
- 1.0 g of $K_4[Fe(CN)_6]$ was dissolved in 10 ml of distilled water.
- The two solutions were mixed and a blue precipitate was obtained (Prussian Blue).
- Prepare the paper filter to be inserted in the buchner funnel.
- Filter the precipitate obtained with a buchner funnel.
- Blue precipitate was obtained (Prussian Blue).
- Allow to dry before proceeding with Module 2.

Additional Safety Notes

$K_4[Fe(CN)_6]$ has a long-lasting harmful effect on aquatic life, and it must not be dispersed in the environment.

$FeCl_3$ is corrosive, therefore it can cause skin and eye burns. Use protective gloves and goggles.

Calculations (optional: it is a way to brush up on old concepts)

It might be interesting to have the quantities of reagents needed to produce a certain amount of Prussian Blue and the yield of synthesis calculated. If this is done, an exercise on this calculation should also be included in the evaluation.

Mass of Prussian Blue obtained: ..... g (actual mass)

mol $FeCl_3 \cdot 6H_2O$ =

mol $K_4[Fe(CN)_6]\cdot 3H_2O$ =

mol $Fe_4[Fe(CN)_6]_3$ =

g $Fe_4[Fe(CN)_6]_3$ = (Theoretical mass)

Theoretical mass of Prussian Blue (which you should have obtained theoretically by making calculations with the reaction ratio): ..... g

Reaction percentage yield = Actual mass / Theoretical mass * 100

Conclusions

This synthesis of Prussian blue has high yields and a low cost.
The obtained product can be used for the recovery of metals from water.