Student's Card 2 **Separation of copper and iron - two approaches**

Module 2

Objective: Ion exchange

Introduction

Anion exchanging

In chemistry there are known different types of bonds between atoms. One of them is an ionic bond which is involved in the formation of salts. As you may remember from the first experiment, dissolved ions can form substances different than the starting materials in chemical reactions. Ion exchangers are organic substances that can do the same thing. They contain an Ion that can be exchanged for another one without altering the remaining organic molecule. Here a Cation exchanger Lewatit TP 207 is used to separate iron from copper.

It is a macroporous polymer in spherical form. Weakly acidic, reactive groups are bound to the polymer, which are able to selectively bind metal ions. The stability of these so-called complexes depends on the pH value of the solutions fed to the ion exchanger.

Necessities

Reagents	Formula	!	Quantity (g) or Concentration (M)
Iron (II) sulfate heptahydrate	$FeSO_4 \times 7\ H_2O$	GHS 07	c = 0,02 mol x L^{-1}
Copper (II) sulphate pentahydrate	$Cu\ (II)\ SO_4 \times 5\ H_2O$	GHS 07, GHS 09	c = 0,03 mol x L^{-1}
Lewatit TP 207		none	Ca. 50 g
Water demin.	H_2O		
Potassium ferricyanide (III)	$K_3\ [(CN)_6\ ]$	none	Some crystals
Ammonium solution	NH_4OH	GHS 05, GHS 07, GHS 09	c = 25 % Some drops
Sulfuric acid	H_2SO_4	GHS 07	c = 1 mol x L^{-1}

List of materials/tools

- Separator column
- Dropping funnel
- Stand with clamps
- Different beakers
- Materials set from "Precipitation and leaching"

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Lab Procedure

Preparation of stock solutions and Ion exchanger

Prepare a stock solution of the metal salts to be separated as described below.

Therefore please weigh 0,03 mol $CuSO_4 \cdot 5H_2O$ and 0,02 mol $FeSO_4 \times 7\ H_2O$ and place both in a 1L volumetric flask. Add approximately half of the flask's volume of distilled water and shake well. Now add more distilled water to the clear solution until the flask's marking isreached. Mix well again.

Experimental procedure

Separation

The 150 ml of the make-up solution is poured into the dropping funnel attached to the stand above the chromatography column. Then allow the solution to drip slowly (approx. 2 drops per second) into the column, adjusting the outlet so that the liquid level in the column remains constant and the inlet front is parallel to the surface. The eluate is collected in a beaker.
The column is then rinsed with 500 ml of demineralised water.
The ion exchanger is regenerated by rinsing with 2 n sulphuric acid until the ion exchanger shows no colouration, this eluate also being collected in a beaker.
The column is then rinsed with deionized water until pH neutral.

Detection reactions

1. Eluate

Add a few drops of NH_4OH solution to a sample of about 2 ml of the first eluate.
A second sample is mixed with a few crystals of potassium ferricyanide (III).

2. Eluate

Proceed in the same way with samples of the second eluate.

Questions/Quiz

1. Why is a macroporous structure important for ion exchange?
2. What happens in the exchanger column, where does the blue colour come from?
3. What happens when NH_4OH solution is added to the first eluate?