

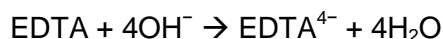
Synthesis of iron(III) EDTA complex, Na[Fe(EDTA)].3H₂O

Student worksheet

Soluble iron(III) salts dissolve in water to give a solution of hexaaquairon(III) ions, [Fe(H₂O)₆]³⁺.

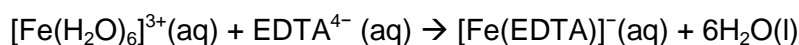
Ethylenediaminetetraacetic acid has the molecular formula C₁₀H₁₆N₂O₈ and structural formula (HOOCCH₂)₂NCH₂CH₂N(CH₂COOH)₂. It is usually abbreviated to EDTA.

When dissolved in an alkali such as sodium hydroxide solution, the four carboxylic acid groups ionise to give a 4⁻ ion. This can be represented by:

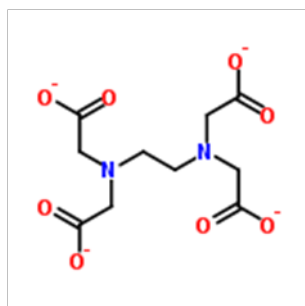


EDTA⁴⁻ is a hexadentate ligand. It forms complexes with many aqueous metal ions. Four oxygen atoms and two nitrogen atoms bond to the metal ion in an octahedral arrangement. These complexes are often called chelates.

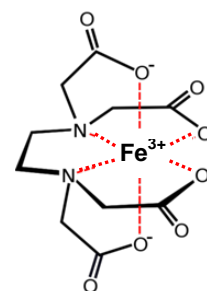
The following reaction takes place when solutions of [Fe(H₂O)₆]³⁺ and EDTA⁴⁻ are mixed:



EDTA



EDTA⁴⁻



[Fe(EDTA)]⁻

The complex may be precipitated as a yellow solid with the formula Na[Fe(EDTA)].3H₂O.

Equipment and materials

- Electronic balance
- 100 cm³ beaker
- 25 cm³ measuring cylinder
- Bunsen burner, tripod and gauze
- Heat resistant mat
- Boiling tube
- Suction filtration apparatus
- Deionised water wash bottle
- Ice bath or a refrigerator
- Watch glass
- Filter funnel
- Na₂H₂EDTA.2H₂O
- 1 mol dm⁻³ sulfuric acid
- Iron(III) chloride-6-water
- Ethanol

Method

- **Care:** Wear goggles. Ethanol is flammable. 1 mol dm^{-3} sulfuric acid is an irritant. Iron(III) chloride-6-water is harmful, corrosive and there is a risk of serious damage to eyes. Avoid raising dust from $\text{Na}_2\text{H}_2\text{EDTA}\cdot 2\text{H}_2\text{O}$ as it is a category 4 respiratory toxin and harmful if inhaled.
1. Stand a deionised water wash bottle in an ice bath or in a refrigerator.
 2. Weigh out 3.8 g (0.01 mol) of $\text{Na}_2\text{H}_2\text{EDTA}\cdot 2\text{H}_2\text{O}$ into a 100 cm^3 beaker. Use a measuring cylinder to add 10 cm^3 of 1 mol dm^{-3} sodium hydroxide solution to the beaker. Heat the mixture gently until the solid dissolves.
 3. Weigh out 2.5 g (0.009 mol) of iron(III) chloride-6-water into a boiling tube and add 5 cm^3 of water. Shake the tube gently to dissolve the solid. Warming gently will help to dissolve the solid).
 4. Pour the iron(III) chloride solution into the beaker and stir the mixture.
 5. Warm the mixture gently to evaporate some of the water until a yellow powder precipitates. This may take about five minutes. Let the mixture cool.
 6. Collect the precipitate by suction filtration, washing it well with ice-cold water. Wash the product twice with 2 cm^3 ethanol.
 7. Lay the filter paper on a watch glass. Cover the solid product with a piece of clean filter paper and leave it to dry in a fume cupboard at room temperature.
 8. Label a sample tube with the name of the product, your name and the date. Weigh the labelled sample tube and record its mass.
 9. Scrape the dried solid into the weighed sample tube. Weigh the tube again. Record its mass.

Calculation

Calculate the theoretical yield and the percentage yield of $\text{Na}[\text{Fe}(\text{EDTA})\cdot 3\text{H}_2\text{O}]$.