Investigating the formulae of chlorides

Background

There are several ways to determine the formulae of chemical compounds. For example the formula of a chloride may be determined by reacting the particular compound with silver ions to precipitate out the chloride as silver chloride.

$$Ag^{+}_{(aq)} + Cl^{-}_{(aq)} \quad AgCl_{(s)}$$

The precipitate would then be accurately weighed. The mass of silver chloride can therefore be determined, which can in turn be used to find the amount of chloride ion that was present in the original chloride. Hence the formula of the original chloride can be determined. This method is known as the gravimetric method.

Where to start

Find out about the technique of gravimetric analysis and plan an experiment to find the formula of sodium chloride.

Practical Techniques

You need to find out about making accurate solutions.

Possible Investigations

- Investigate the accuracy of this technique for determining the formulae of other chlorides

- Investigate other methods of determining the formulae of chlorides such as
    - Using continuous variation as a method for determining the maximum amount of precipitate produced
    - Measuring the change in conductance as the precipitate is formed
    - Silver nitrate titration

How does the accuracy of these methods compare to the gravimetric method?

Sources of Information

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Teachers' Notes

General

Gravimetric analysis experiments can often be found in some older practical chemistry books.
Each run of the starter experiment will probably be take about 2-3 hours (approx 2 hours would be the drying process).

The use of a silver nitrate titration to find the amount of chloride ion in solution is a more familiar method than the gravimetric method and details can be found in many modern textbooks.

The method of continuous variation may be used to determine the stoichiometry of the reaction by measuring the change in a property associated with the reaction i.e. heat evolved, electrical conductance, amount of product precipitated. Various mixtures of silver ions and chloride ions would need to be reacted and the change in property could be measured. A graph of property varied against mole ratio can be drawn and used to find the optimum mole ratio needed. Hence the amount of chloride ion used can be determined.

Chemical Principles

Inorganic chemistry, chlorides, quantitative chemistry

Essential Equipment

Sintered glass funnel, dessicator

Essential Chemicals

Silver nitrate, nitric acid,

Safety

No risk assessment has been given. It is essential that students prepare a detailed risk assessment before they start. Teachers must be satisfied that this is suitable for the proposed investigation.

Starter Experiment Sheet – Investigating the formulae of chlorides

You should prepare the following solution.

- 1 mol dm^{-3} silver nitrate solution

You need to decide how much of this to prepare when you have decided how many experiments you plan to carry out.

You will probably choose a chloride whose formula that you already know and use the method to check the accuracy of the technique.

Weigh accurately about 0.75g of the chloride in a stoppered bottle. Dissolve it in about 150cm^3 of water in a conical flask. Add a few drops of concentrated nitric acid. Now add the silver nitrate solution until all the chloride has precipitated out. Boil the mixture to coagulate the precipitate. Filter the precipitate through a sintered glass funnel that has been previously weighed. Wash the precipitate with distilled water and then twice with ethoxyethane. Dry in an oven at about 120^{o}C for about two hours. Allow to cool in a dessicator and reweigh. Repeat the drying process until a constant mass is obtained.

You can now calculate

a) the mass of the silver chloride produced and hence the amount of silver chloride in moles
b) the amount of chloride ion in moles and hence the mass of the chloride ion in the precipitate
c) the mass of chlorine in the original chloride
d) the mass of the other element in the original chloride
e) the mole composition of the original chloride