TITRATION

Finding the concentration of an acid solution.

The aim of the following experiment is to find the concentration of an acid solution by titrating it against a base with known concentration in an acid-base titration. In this experiment the base used will be Sodium Carbonate (Na_2CO_3) and the acid with unknown concentration will be Sulphuric acid (H_2SO_4).

Hypothesis

I predict that upon titrating the acid against the base, there will be a colour change from deep orange colour to a pale yellow colour.

Background Information

During the extraction of a metal from its sulphide ore, sulphur dioxide is often produced. This is converted and sold as a useful by-product. Sulphur dioxide (SO_2) is a colourless gas, belonging to the family of gases called sulphur oxides (SOx). It reacts on the surface of a variety of airborne solid particles, is soluble in water and can be oxidised within airborne water droplets.

Natural sources of sulphur dioxide include releases from volcanoes, oceans, biological decay and forest fires. The most important man-made sources of sulphur dioxide are fossil fuel combustion, smelting, manufacture of sulphuric acid, conversion of wood pulp to paper, incineration of refuse and production of elemental sulphur. Coal burning is the single largest man-made source of sulphur dioxide accounting for about 50% of annual global emissions, with oil burning accounting for a further 25 to 30%.

The major health concerns associated with exposure to high concentrations of sulphur dioxide include effects on breathing, respiratory illness, alterations in pulmonary defences, and aggravation of existing cardiovascular disease. In the atmosphere, sulphur dioxide mixes with water vapour producing sulphuric acid. This acidic pollution can be transported by wind over many hundreds of miles, and deposited as acid rain. Sulphuric acid, H_2SO_4, corrosive, oily,

colourless liquid, with a relative density of 1.85. It melts at 10.36° C (50.6° F), boils at 340° C (644° F), and is soluble in all proportions in water. When sulphuric acid is mixed with water, considerable heat is released. Unless the mixture is well stirred, the added water may be heated beyond its boiling point and the sudden formation of steam may blow the acid out of its container. The concentrated acid destroys skin and flesh, and can cause blindness if it gets into the eyes. The best treatment is to flush away the acid with large amounts of water. Despite the dangers created by careless handling, sulphuric acid has been commercia lly important for many years. The early alchemists prepared it in large quantities by heating naturally occurring sulphates to a high temperature and dissolving in water the sulphur trioxide thus formed. About the 15th century a method was developed for ob taining the acid by distilling hydrated ferrous sulphate, or iron vitriol, with sand. In 1740 the acid was produced successfully on a commercial scale by burning sulphur and potassium nitrate in a ladle suspended in a large glass globe partially filled with water.

Upon reaction of sulphuric acid and sodium carbonate, it is expected that a neutralisation reaction should occur where a soluble salt, water and carbon (IV) oxide is produced. Methyl orange indicator is used since its colour change makes the compl etion of the reaction more observable. There is a colour change of dark orange to pale yellow. If the end colour is pink this indicates that the reaction has gone beyond the end -point.

The overall experiments can be summarised by the following equation:

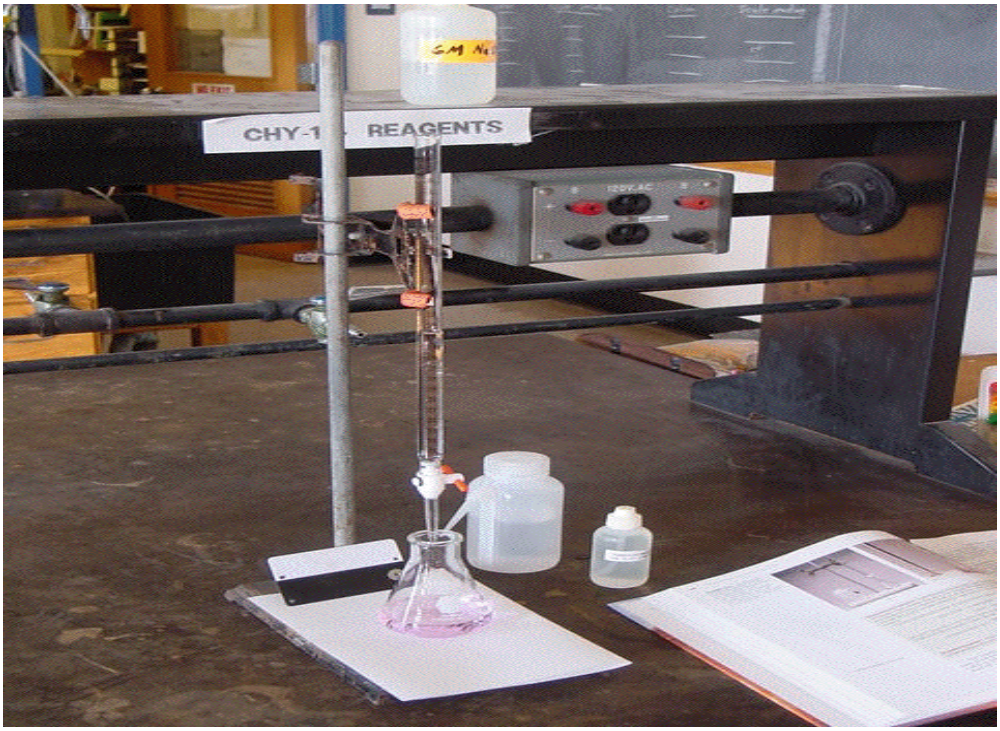
$$Na_2CO_3 + H_2SO_4 \qquad Na_2SO_4 + CO_2 + H_2O$$

APPARATUS

1. Weighing bottle- to contain anhydrous sodium carbonate during weight measurement.
2. Two 250cm3 beakers
3. Stirring rod

4. 250cm3 volumetric flask
5. 250cm3 conical flask
6. Teat pipette
7. Burette
8. 25cm3 pipette and pipette filler
9. white tile
10. access to a balance
11. Sulphuric acid, between 0.05 and 0.15moldm-3(150cm3)
12. methyl orange indicator solution
13. Distlled/dionized water

DIAGRAM



PROCEDURE.

1. Using a weighing bottle, weigh out 2.566g of anhydrous sodium carbonate accurately and transfer it to a 250cm^3 beaker. All the balance readings were recorded, and the exact mass of anhydrous sodium carbonate that has been transferred to the beaker is calculated.
2. Dissolve the sodium carbonate in about 100cm^3 of distilled water in the beaker and carefully pour the solution into a 250cm^3 volumetric flask. Rinse the beaker two or three times with small volumes of distilled water, and transfer the washings to the volumetric flask.
3. Make up the sodium carbonate solution to 250cm^3 with more distilled water. Use a dropper pipette to add the last few drops of water to ensure that the bottom of the meniscus is exactly level with the mark on the neck of the flask. Stopper the flask and invert it several times to make sure that the solution is mixed thoroughly.
4. Set up burette and fill it with the sulphuric acid solution.
5. Transfer your sodium carbonate solution to a clean, dry 250cm^3 beaker. Use a pipette and pipette filler to transfer 25.0cm^3 of this solution to a clean 250cm^3 conical flask.
6. Add 3 drops of methyl orange indicator to the conical flask. Add the acid solution from the burette, swirling the flask, until the indicator changes colour- rough titration allow you to find an approximate value for the volume of acid needed to react with the sodium carbonate solution. The burette readings are recorded in a suitable table. The average of 3 volumes gave me my titre value.
7. In the rough titration you will have gone beyond the end-point and added more acid than needed to react with all the sodium carbonate in the flask. Repeat the titration, but this time, add the acid drop by drop when you get near to the end-point. Repeat your accurate titration until you have three titres that are within 0.1cm3 of each other. Titres like this are said to be concordant. Record al your burette readings and titres in tour table.

CALCULATIONS

For average titre;

$22.90cm^3 + 22.90cm^3 + 22.90cm^3 = 68.70cm^3$

$68.70cm^3/3 = 22.90cm^3$

Therefore average titre is $22.90cm^3$

Mass of sodium Carbonate (Na_2CO_3) = 2.566g

Volume of Na2CO3 solution in volumetric flask = $250cm^3 = 0.25dm^3$

Amount (n) = mass/Molar mass = $2.566g/106gmol^{-1} = 0.0242mol$

Concentration= $0.0242/0.25 = 0.0968moldm^{-3}$

For number of moles of sodium carbonate pipette;

Volume pipetted= $25cm^3 = 0.025dm^3$

Concentration of sodium carbonate= $0.0968moldm^{-3}$

Therefore number of mole= $0.0968moldm^{-3} * 0.025dm^3 = 0.0024mol$

Using the equation;

$$Na_2CO_3 + H_2SO_4 \qquad Na_2SO_4 + CO_2 + H_20$$

Mole ratio $Na_2CO_3 : H_2SO_4 = 1:1$

Therefore amount of sulphuric acid is 0.0024mol that reacted with sodium carbonate solution.

Concentration of sulphuric acid is $0.0024mol/0.02290dm^3 = 0.10moldm^{-3}$

EVALUATION