KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

COLLEGE OF ENGINEERING
DEPARTMENT OF CHEMICAL ENGINEERING

TITLE: DETERMINATION OF Cl^- WITH $AgNO_3$ (MOHR'S METHOD)

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Aims and Objectives:

- To determine chloride ions in a sample
- To gain understanding of the concept of Mohr's method
- To gain experience in the titration process

INTRODUCTION/THEORY

Chlorine, although less abundant than fluorine in the earth's crust, is more found in both the laboratory and industry. These compounds are quite often used in the laboratory as a source of positive metal ions bound with the chloride ions.
Chlorine is produced primarily to make other chemicals but some is consumed in paper manufacture. Hydrochloric acid is a by-product of many industrial processes. Its uses include steel manufacture, dye production, food processing and oil well drilling.
Chloride ions are the principle inorganic anions of living systems, where they help maintain the ionic or electrolytic balance. This balance is necessary for maintenance of proper osmotic activity between cellular fluids and other body fluids. Most chlorides are water soluble, except mercurous chloride and silver chloride.
In qualitative analysis, anions are determined by using aqueous silver nitrate solution. When chloride ions are present, a white precipitate is formed.
The titration method of titrating silver nitrate against a solution of chloride ions using potassium chromate as the indicator is called Mohr's method and is based on formation of a red precipitate of silver chromate at end point after the chloride ions has been precipitated as white chloride.
The Mohr's method must also be performed in pH of 6.5 to 9. If the pH is too high, the brownish silver hydroxide formed and masks the end point. If the pH is too low, the chromate is converted into dichromate and the end point comes too late or cannot be perceived at all.
The following reactions are used

$$\mathbf{Ag^+ + Cl^- \leftrightarrow AgCl\ (ppt.)}$$
$$\mathbf{2Ag^+ + CrO_4^{2-} \leftrightarrow Ag_2CrO_4 (red\text{-}brown\ ppt.)}$$

Chemicals Used

Silver Nitrate Solution
Potassium Chromate Solution
Sample containing Chloride (Unknown)
Distilled water

Apparatus Used

Wash bottle	Burette
50ml pipette	250 ml volumetric flasks
250ml titration flask	10ml measuring cylinder
Retort stands	Beaker
Analytical Balance	Spatula

PROCEDURE

- 0.1g of the unknown was accurately weighed

- It was then quantitatively transferred into a 250ml volumetric flask
- It was dissolved and diluted to the mark
- 50ml of the solution was pipetted into a 250ml titration flask
- 2ml of 5% Potassium Chromate was added and titrated with standard 0.1M $AgNO_3$ Solution from the burette
- Two more duplicate titrations for concordant values of the end point was performed

TABLE OF RESULTS

Experiment	**1**	**2**	**3**
Final Reading	4.35	8.85	13.35
Initial Reading	0.00	4.35	8.85
Volume Used	4.35	4.50	4.50

Average titre $= \frac{4.5+4.5}{2}$

$\mathbf{=4.50cm^3}$

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POST LAB CALCULATIONS

The reaction equation for the titration is

$\mathbf{AgNO_3}(aq) + \mathbf{Cl^-} \leftrightarrow \mathbf{AgCl}(s) + \mathbf{NO_3^-}(aq)$

First Titration

$\frac{nCl^-}{nAgNO3} = \frac{1}{1}$

$nCl^- = nAgNO_3$

But $n=c\times v$

$nCl^- = CAgNO_3 \times VAgNO_3$

$CAgNO_3 = 0.1M = 0.1moldm^{-3}$

$VAgNO_3 = 4.50cm^3 = 4.5\times10^{-3}dm^3$

$nCl- = 0.1moldm^{-3}\times4.5\times10^{-3}dm^3$

$=4.5\times10^{-4}mol$

$mCl^- = nCl^-\times MCl^-$

$MCl^- = 35.5gmol^{-1}$

$mCl^- = 4.5\times10^{-4}dm^3\times35.5g/mol$

$=0.01633g=0.0164g$

$50ml = 0.0163g\ Cl^-$

$250ml = \frac{250ml}{50ml}\times 0.0163g\ Cl^-$

$=0.082g\ Cl^-$

Percentage Cl^- in the unknown = $\frac{0.082g}{0.1g} \times 100\%$

=**82%**

The unknown cation contains 81% Cl^- ions

PRECAUTIONS

- Lab coat, protective footwear and goggles were worn
- All glassware used were thoroughly washed before starting the experiment
- All reagent bottle were corked after the chemical in it had been used
- All the spills were immediately wiped to prevent accidents
- All the glassware used were thoroughly washed after the experiment

DISCUSSION

From the experiment we calculated the % of Cl- as 82 which shows the chloride solution was not made completely of Chloride ions but had certain impurities in it which comprises about 18% of the solution .On addition of the silver nitrate to a solution of chloride, containing a few drops of potassium chromate, white silver chloride is precipitated initially. As soon as all the chloride ions have precipitated out, even a drop of silver nitrate added in excess gives red precipitate of silver chlorate. The white precipitate is as a result of the formation of white AgCl.

The red colour which appeared when the silver nitrate fell in the solution immediately was due to the presence of Cl^- in the solution. This is because no red Ag_2CrO_4 is formed until the addition of $AgNO_3$ has precipitated most, if not all of the Cl^- as silver chloride. And this makes potassium chromate a suitable indicator for such a titration.

The salt formed can b inferred to be a group (1) salt.

CONCLUSION

The experiment was feasible since the main aims that was knowing the amount of Cl^- ions and also understanding the Morh's method was achieved.

At the end of the experiment 82% of the unknown sample contained Cl^- ions

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