Volumetric Analysis of Chloride Introduction

Volumetric analysis is a method for determining the composition of a substance by precisely measuring the volume of a reacting substance. The amount of a substance present can be determined by finding the volume of a chemical required to react with it. The reactions end-point is usually signified by an indicator.

In this experiment we will determine the composition of an unknown chloride salt (XCl) by reacting chloride and silver ions to produce a silver chloride precipitate.

$$Ag^+ (aq) + Cl^- (aq) \rightarrow AgCl (s)$$

We will begin our experiment by first adding our unknown XCl sample to water. The XCl will disassociate in the water into Cl^- and X^+ ions:

$$XCl (s) + H_2O (aq) \rightarrow X^+ (aq) + Cl^- (aq) + H_2O (aq)$$

We then add a solution of Potassium Chromate (K_2CrO_4) to serve as an indicator. The potassium chromate will change our unknown solution to a yellow color.

A 1M solution of $AgNO_3$ is added to serve as the source for our Ag^+ ions. As $AgNO_3$ is added AgCl will precipitate out of the solution. The initial quantity of Cl^- ions present serves as the limiting agent to our reaction.

The CrO_4^{2-} ion will react with excess Ag+ ions once all the Cl- ion, which has a greater affinity to react with Ag+ ions, is completely consumed. This will trigger a color change in our solution from yellow to reddish-brown as the reddish Ag_2CrO_4 precipitates out.

$$2\ Ag+ (aq) + CrO_4^{2-} (aq) \rightarrow Ag_2CrO_4 (s)$$

The Volume of $AgNO_3$ added is used to determine the moles of AgCl created.

Moles of AgCl = Moles of $AgNO_3$ added = (Volume of $AgNO_3$ added) X (Molarity of $AgNO_3$)

We can determine the % of Cl^- present in are unknown:

Moles of Cl^- = moles of AgCl

Weight of Cl^- in XCl sample = (moles of Cl^-)x(atomic weight of Cl^- = 35.4527)

% Cl^- in sample = (weight of Cl^- in XCl sample / weight of XCl sample) x 100 %