CHEMISTRY

Lab 3: Determination of the concentration of chlorine ions in tap and pool water

Background:

Tap water contains a variety of dissolved ions such as Ca^{2+}, Mg^{2+}, Na^{+}, HCO^{3-} and Cl^{-}. In this experiment we will determine the concentration of the Cl^{-} ions. The method used is the standard one for determining the concentration of chloride ions: titration with silver nitrate solution of known concentration. Silver ions form insoluble silver chloride when added to a solution containing chloride ions:

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

By adding silver ions until silver chloride is no longer precipitated, the amount of chloride in a solution can be found.

Potassium chromate (VI), K_2CrO_4, can be used to indicate the end-point of the titration, the point at which all chloride ions have been precipitated. Silver ions combine with chromate (VI) ions to form a red precipitate of silver chromate (VI):

$$2Ag^{+}_{(aq)} + CrO^{2-}_{4(aq)} \rightarrow Ag_2CrO_{4(s)}$$

When both chloride ions and chromate (VI) ions are present, however, no silver chromate (VI) is precipitated until all the chloride ions have been removed. The sudden appearance of red silver chromate (VI) therefore indicates the end-point of the titration.

Procedure:

NOTE: It is particularly important in this practical to rinse all glassware with distilled water before use and wear gloves all the time.

Part 1

Silver nitrate is expensive and is normally used in fairly low concentration. In this titration you will use pre-prepared 0.05 mol dm^{-3} $AgNO_{3(aq)}$.

Pipette 10 cm^3 of tap water into a conical flask and add about 10 drops of potassium chromate (VI) indicator.

Rinse a burette with silver nitrate solution, then fill it with the solution. Titrate the tap water in the conical flask against the silver nitrate solution from the burette until a reddish color just begins to appear. You may find the end-point a little difficult to detect, so it is best to carry out a rough titration first and keep the result to remind you of the end-point color when carrying out accurate titrations later.

Repeat the titration until two consistent results are obtained.

Part 2

Pipette 10 cm^3 of pool water into a 100 cm^3 volumetric flask. Make up to the mark with distilled water. Put a stopper and mix well.

Pipette 10 cm^3 of the diluted sea water into a conical flask and add 10 drops of potassium chromate (VI) indicator.

Rinse a burette with a silver nitrate solution of concentration 0.05 mol dm^{-3}, then fill it with the solution. Titrate the pool water in the conical flask against the silver nitrate solution from the burette until a reddish color just begins to appear. You may find the end-point a little difficult to detect, so it is best to carry out a rough titration first and keep the result to remind you of the end-point color when carrying out accurate titrations later.

Repeat the titration until two consistent results are obtained.

Calculations and points for discussion:

Calculate the concentration of chloride ions in mol dm^{-3} and in g dm^{-3} in tap and pool water.

How does this value for tap water compare to the Greek legal limit of 300 mg dm^{-3}?

What are the major sources of errors in this experiment?