Experiment - 6

**Experiment** - Find out the total alkalinity and chloride content in water sample

**Apparatus** - Pipette, burette stand, beaker, conical flask, and clamp

**Chemicals** - Water sample, potassium chromate ($K_2CrO_4$), silver nitrate ($AgNO_3$), methyl orange & sulphuric acid ($H_2SO_4$).

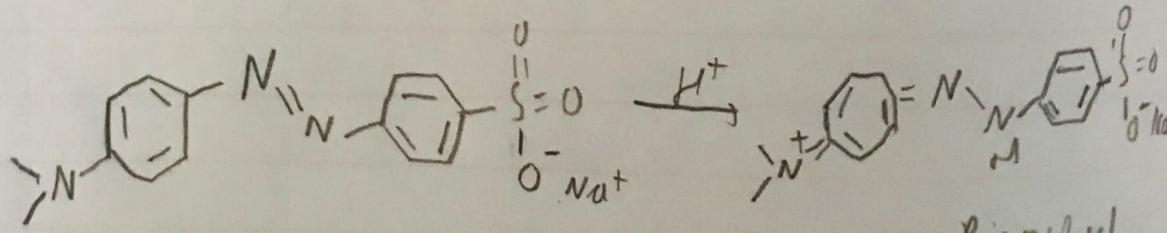
**Chemical Equations** - $CO_3^{2-} + 2H^+ \rightarrow CO_2 + H_2O$

$HCO_3^- + H^+ \rightarrow CO_2 + H_2O$

$Cl^- + Ag^+ \rightarrow AgCl$ (white ppt)

$CrO_4^{2-} + 2Ag^+ \rightarrow Ag_2CrO_4$ (Brick red ppt)

**Structure** -




yellow

Pink/red

**Indicator** - Methyl orange

**End Point** - yellow to light pink

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# Experiment-6.

**Experiment** - Find out the total alkalinity and chloride content in water sample.

**Apparatus** - Pipette, burette, beakers, conical flask, burette, Stand and clamp.

**Chemicals** - Water samples, potassium chromate ($K_2CrO_4$), Silver nitrate ($AgNO_3$), methyl orange & Sulphuric acid ($H_2SO_4$).

**Theory** - Alkalinity of water is due to the presence of hydroxide, carbonates and bicarbonates of the salts of calcium, magnesium, sodium and potassium. Similarly, the chloride content of water is due to the presence of chloride ions of these salts. Total alkalinity is estimated by titrating a known volume of water against a standard acid. ($N/20\ H_2SO_4$) using methyl Orange as indicator in the neutral medium.

$$CO_3^{2-} + 2H^+ \rightarrow CO_2 + H_2O$$

$$HCO_3^- + H^+ \rightarrow CO_2 + H_2O$$

$$OH^- + H^+ \rightarrow H_2O$$

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Procedure - (i) Determination of total alkalinity of tap water

The volume of tap water taken = 50 ml.

| Sr No | Burette Reading (ml) | | Volume of N/20 $H_2SO_4$ avg (ml) |
|---|---|---|---|
| | Initial | final | |
| 1 | 0 | 6.9 | 6.9 |
| 2 | 0 | 6.9 | 6.9 |
| 3 | 0 | 6.9 | 6.9 |

Mean value of $H_2SO_4$ used ($V_2$) = 6.9 ml

(ii) Determination of chloride contents of water sample

Water sample in a titration flask = 10 ml.

| Sr. NO | Burette Reading (ml) | | Vol. of N/100 $AgNO_3$ |
|---|---|---|---|
| | Initial | final | |
| 1 | 0 | 12.9 | 12.9 |
| 2 | 0 | 12.9 | 12.9 |
| 3 | 0 | 12.9 | 12.9 |

Mean volume of $AgNO_3$ used $V_3$ = 12.9 ml

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Chloride content is estimated by titrating a known volume against a standard silver nitrate solution (N/100) using potassium chromate as an indicator in the neutral medium.

$$Cl^- + Ag^+ \rightarrow AgCl \text{ (white ppt)}$$

$$CrO_4^{2-} + 2Ag^+ \rightarrow Ag_2CrO_4 \text{ (Brick red ppt)}$$

If water is found to be acidic, it is made neutral by adding solid calcium carbonate. In this case, some calcium carbonate must remain settled at the bottom. The results are expressed in parts per million (ppm)

Procedure - (i) Determination of total alkalinity of tap water.

1. Wash, rinse and fill the burette with N/20 $H_2SO_4$
2. Transfer 50 ml of tap water in the titration flask. Add 2-3 drops of methyl orange and titrate it against N/20 $H_2SO_4$ till the colour changes from yellow to light pink as an end point.
3. Note the volume of the solution used and repeat the titration at least 3 times and

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Calculations - (1) Alkalinity

Applying the normality eqn

| Tap water | | $H_2SO_4$ |
|---|---|---|
| $N_1V_1$ | = | $N_2V_2$ |

50 ml of tap water (of Normality $N_1$) = x ml of $\frac{N}{20}$ $H_2SO_4$

$V_2 = x = 6.9$ ml

$$N_1 = \frac{N_2V_2}{V_1} = \frac{0.05x}{50} = \frac{0.05 \times 6.9}{50} = 0.0069$$

Eq wt of $CaCO_3 = 50$

Amount of $CaCO_3$ (gm/L)

= Normality x Eq wt

= $0.0069 \times 50 = 0.345$

Amount of $CaCO_3$ (mg/1000 ml)

= $0.345 \times 1000$ ppm

= 345 ppm

take the mean of the closely agreed reading (x ml)

(ii) Determination of chloride of water sample.

1. Take 10 ml of water sample in a titration flask.
2. Add 3-4 drops of $K_2CrO_4$ and titrate against N/100 $AgNO_3$ from the burette till the appearance of light brick red color.
3. Note the volume of it used and repeat the titration at least 5 times and take the mean of the closely readings (y ml)

Observations - Let the volume of N/20 $H_2SO_4$ used = x ml.
Let the volume of N/100 $AgNO_3$ used = y ml.

General calculations - (i) Alkalinity -

Applying the normality equation.

| Tap water | $H_2SO_4$ |
|---|---|
| $N_1V_1$ | $= N_2V_2$ |

100 ml of tap water (of normality $N_1$) = x ml of $\frac{N}{20}$ $H_2SO_4$

$$N_1 = \frac{N_2V_2}{V_1} = \frac{0.05x}{100} = \frac{x}{2000}$$

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(iii) Chloride content

Applying the normality eq

$$\underset{N_1 V_1}{\text{Tap water}} = \underset{N_2 V_2}{Ag\,NO_3}$$

10 ml of tap water (eq normality $N_1$) = y ml of N/1000 $Ag\,NO_3$

$y = 12.9$ $\qquad N_1 = \frac{N_2 V_2}{V_1} = \frac{y}{1000} = 0.0129$ $Ag\,NO_3$ Sol

Eq wt of $Cl^-$ = 35.5

Chloride content (gm/L) = Normality × Eq wt

$$= \frac{y}{1000} \times 35.5 = 0.45795$$

Chloride content (mg/1000 ml) = $y_1 \times 35.5$ ppm

$$= 457.95 \text{ ppm}$$

Result - Amount of total alkalinity in water sample
345 ppm. of $CaCO_3$

Amount of chloride content in water sample
457.95 ppm

Eq wt of $CaCO_3 = 50$, Amount of $CaCO_3$ (gm/L) = Normality × Eq wt.

$$= \frac{x}{2000} \times 50 = \frac{x}{40}$$

Amount of $CaCO_3$ (mg / 1000 ml) $= \frac{x}{40} \times 1000$ ppm

(ii) Chloride content -

Applying the normality eq.

| Tap water | | ($AgNO_3$) |
|---|---|---|
| $N_1V_1$ | = | $N_2V_2$ |

10 ml of tap water (of normality $N_1$) = y ml of N/100 $AgNO_3$ Solu

$$N_1 = \frac{N_2V_2}{V_1} = \frac{y}{1000}$$

Eq. wt. of $Cl^-$ = 35.5

Chloride content (gm/L) = Normality × Eq. wt

$$= \frac{y}{1000} \times 35.5$$

Chloride content (mg / 1000 ml) = $y \times 35.5$ ppm

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**Results-** Amount of total alkalinity in water sample 345 ppm of $CaCO_3$

Amount of chloride content in a sample 457.95 ppm.

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