Anjali Rana

Experiment-6

Experiment: Find out the total alkalinity and chloride content in a water sample

Apparatus: Pipette, burette, beakers, conical flask, burette stand and clamp

Chemicals: Water sample, potassium chromate (K_2CrO_4), silver nitrate ($AgNO_3$), methyl orange and sulphuric acid (H_2SO_4),

Chemical Equations:

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

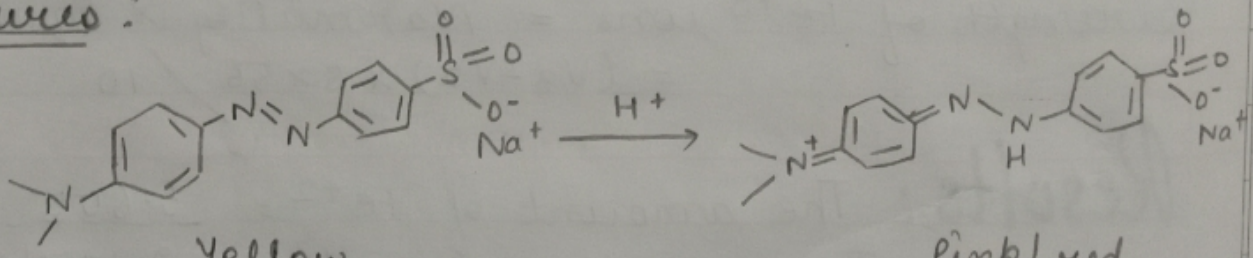
$$HCO_3^- + H^+ \longrightarrow CO_2 + H_2O$$

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

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

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

Structures:



Yellow

Pink/red

Indicator: methyl orange

End point: Yellow to light pink

Procedure:

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Date

EXPERIMENT-6

Experiment : Find out the total alkalinity and chloride content in a 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 and sulphuric acid (H_2SO_4)

Theory : Alkality of water is due to the presence of hydroxides, 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 cations. 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.

$$CO_3^{2-} + 2H^+ \longrightarrow CO_2 + H_2O$$
$$HCO_3^- + H^+ \longrightarrow CO_2 + H_2O$$
$$OH^- + H^+ \longrightarrow H_2O$$

Chloride content is estimated by titrating a

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(i) Determination of total alkalinity of tap water The volume of tap water taken = 50 ml

Sr. no	Burette reading (ml)		Vol. of N/20 H_2SO_4 req. (ml)
	Initial	final	
1	0	6.9	6.9
2.	0	6.9	6.9
3.	0	6.9	6.9

Mean Volume of H_2SO_4 used (V_2) = 6.9 ml

(ii) Determination of chloride contents of water sample Water sample in a titration flask = 10ml

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

Calculations :

(i) Alkalinity

Applying the normality equation

(Tap Water) (H2SO4)

$N_1V_1 = N_2V_2$

50 ml of tap water (of normality N1) = x ml of N/20 H_2SO_4

known volume against a standard silver nitrate solution (N/100) using potassium chromate as an indicator in the neutral medium

$$Cl^- + Ag^+ \longrightarrow AgCl \text{ (white ppt)}$$
$$CrO_4^{2-} + 2Ag^+ \longrightarrow Ag_2CrO_4 \text{ (Brick red ppt)}$$

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 5 times and

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$V_2 = x = 6.9$ 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 × Eq. wt
= 0.0069 × 50 = 0.345

Amount of $CaCO_3$ (mg/1000 ml)
= 0.345 × 1000 ppm
= 345 ppm

(ii) Chloride content

Applying the normality equations,

(Tap water) ($AgNO_3$)

$N_1V_1 = N_2V_2$

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

$y = 12.9$ ml

$$N_1 = \frac{N_2V_2}{V_1} = \frac{y}{1000} = 0.0129$$

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) = $y \times 35.5$ ppm
= 447.3 ppm

take the mean of the closely related 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 the 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 N/20 H_2SO_4

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

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Results

Amount of total alkalinity in water sample 345 ppm of $CaCO_3$

Amount of chloride content in water sample 447.3 ppm

Eq. wt. of $CaCO_3 = 50$; Amount of $CaCO_3$ (gm/L) = Normality x 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 equations.

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

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

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

Eq. wt. of Cl^- = 35.5

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

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

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

Results

Amount of total alkalinity in water sample 345 ppm of $CaCO_3$

Amount of chloride content in a sample 447.3 ppm

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