EXPERIMENT NO. 2

Date :

ALKALINITY OF WATER

AIM OF THE EXPERIMENT : To estimate the amount of NaOH and Na_2CO_3 present in a given mixture solution.

APPARATUS REQUIRED

1. Beaker 2. Conical flask 3. Burette 4. Pipette

CHEMICALS REQUIRED

1. Given mixture solution
2. Standard HCl
3. Phenolphthalein indicator
4. Methyl orange indicator

PRINCIPLE

Determination of alkalinity due to different ions is based on the titration of the water sample against a standard acid making selective use of indicators.

In the first step a known volume of the mixture solution is titrated against a standard acid by using phenolphthalein indicator. In this step carbonate is converted to bicarbonate and hydroxide is converted into water. The volume of acid required neutralises half of the sodium carbonate and total amount of sodium hydroxide.

In the second step the same given mixture solution is titrated against the same standard acid by using methyl orange indicator. In this case bicarbonate is converted into carbon dioxide and water. The volume of acid required from beginning to the end of second step neutralises total amount of sodium hydroxide and sodium carbonate.

CHEMICAL REACTION

(1) $Na_2CO_3 + HCl \longrightarrow NaHCO_3 + NaCl$

$NaOH + HCl \longrightarrow NaCl + H_2O$

(2) $NaHCO_3 + HCl \longrightarrow NaCl + H_2O + CO_2$

IONIC EQUATION

(1) $CO_3^{-2} + H^+ \longrightarrow HCO_3^-$] P] M

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

(2) $HCO_3^- + H^+ \longrightarrow CO_2 + H_2O$

If P correspond to phenolphthalein end point and M correspond to methyl orange end point then

$P = 1/2\ Na_2CO_3 + NaOH$

$M = Na_2CO_3 + NaOH$

$\therefore \quad M - P = 1/2\ Na_2CO_3$

$Na_2CO_3 = 2\ (M - P) = x$

$NaOH = M - 2\ (M - P) = y$

x ml of HCl acid is required to neutralise only Na_2CO_3

y ml of HCl acid is required to neutralise only NaOH.

PROCEDURE :

1. Thoroughly wash all the supplied glassware with water.
2. Rinse the burette with the supplied HCl solution and pipette with the given mixture solution.
3. Fill the burette with the supplied HCl solution upto a convenient mark. Remove any air gap and note initial burette reading.
4. Pipette out 10 ml of mixture solution into a conical flask and add 3-4 drops of phenolph thalein indicator into it.
5. Carry out the titration by adding HCl solution from the burette till the colour changes from pink to colourless. Note the final burette reading for phenolphthalein end point.
6. To this solution add 3-4 drops of methyl orange indicator and carry out the titration by adding HCl solution from the burette till the colour changes from light yellow to light pink. Note the final burette reading for methyl orange end point.
7. Repeat this process to get the concordant reading.

CALCULATION :

M = Volume of HCl required to neutralise both NaOH and Na_2CO_3.
P = Volume of HCl required to neutralise total NaOH and half of Na_2CO_3.
So M-P = Volume of HCl required to neutralise 1/2 of Na_2CO_3.
2(M-P) Volume of HCl required to neutralise only Na_2CO_3.
M-2(M-P) = Volume of HCl required to neutralise only NaOH.

***Estimation of* Na_2CO_3**

At the neutralisation point : $N_1V_1 = N_2V_2$
Let N_1 = Normality of supplied HCl.
V_1 = Volume of HCl required to neutralise only Na_2CO_3.
N_2 = Normality of mixture solution due to Na_2CO_3 only.
V_2 = Volume of mixture solution required for titration.

$$N_2 = \frac{N_1V_1}{V_2}$$

Strength of mixture solution due to Na_2CO_3 only = Eq. wt. of Na_2CO_3 x N_2
= 53 x N_2 = ... g/litre

Alkalinity due to Na_2CO_3 = 50 × N_2 = ... g/litre in terms of $CaCO_3$ equvalent.

***Estimation of* NaOH**

At the neutralisation point $N_1V_1 = N_2V_2$
Let N_1 = Normality of supplied HCl.
V_1 = Volume of HCl rquired to neutralise only NaOH.
N_2 = Normality of mixture solution due to NaOH only.
V_2 = Volume of mixture solution.

So $$N_2 = \frac{N_1V_1}{V_2}$$

Strength of mixture solution due to NaOH only = Eq. wt. of NaOH x N_2
= 40 x N_2 = ... g/litre

Alkalinity due to NaOH = 50 × N_2
= ..... g/litre in terms of $CaCO_3$ equvalent.

Questions for Discussion.

1. What is acidimetry and alkalimetry ?
2. What are acid and base ?
3. How do you choose the indicator in acid - base titration ?
4. What are the constituents responsible for the alkalinity of water ?
5. Can hydroxides and bicarbonates be present together in the water ?
6. Write the reaction taking place in phenolphthalein end point ?
7. Write the reaction, which takes place in methyl orange end point.
8. What are the disadvantages of the highly alkaline water ?
9. Why aqueous Na_2CO_3 solution is basic in nature ?
10. Na_2CO_3 is a salt of which acid ?

Rough Work

DEPARTMENT OF CHEMISTRY

Roll No. :

Branch :

Date :

AIM OF THE EXPERIMENT :

OBSERVATION TABLE

No. of obs.	Volume of mixture solution (ml)	Initial (i)	Final Burette Reading (ml)		Difference (ml)		Remark
			Phenolphthalein (p)	Methyl Orange (m)	Phenolphthalein end point. (P) (p-i)	Methyl Orange end point. (M) (m-i)	

CALCULATION :

CONCLUSION :