**Experiment – 3**

**OBJECT:** To determine the constituents and amount of alkalinity of the supplied water sample.

**CHEMICALS REQUIRED:** 0.2N HCl solution, phenolphthalein indicator, methyl orange indicator.

**APPARATUS REQUIRED:** Conical flask, Burette, Pipette, Beaker, Measuring flask.

**PRINCIPLE/THEORY:** The alkalinity in water is due to the presence of hydroxyl ion (**OH-**), carbonate ion (**CO32**-) and bicarbonate ion (**HCO3-**) present in the given sample of water. These can be estimated separately by titration against standard acid, using phenolphthalein and methyl orange indicator. The chemical reaction involved can be shown by the equations given below:

1. **OH- + H+ H2O (a)**
2. **CO32- + H+ HCO3- (b)**
3. **HCO3- + H H2O+CO2 (c)**

The phenolphthalein end point [P] corresponds to the completion of equation (a) and (b) while methyl orange end point [M] corresponds to the completion of equation(c). The result may be summarized as in the following table:

|  |  |  |  |
| --- | --- | --- | --- |
| Result of titration to phenolphthalein end point [P]and Methyl orange end point [M] | Hydroxide  (OH-) | Carbonate  (CO32-) | Bicarbonate  (HCO3-) |
| [P] =0  [P]= [M]  [P]=1/2[M]  [P]> 1/2[M]  [P]<1/2[M] | NIL  [M] [P]  NIL  2[P] - [M]  NIL | NIL  NIL  [P] [M]  2[M] - [P]  2[P] | [M]  NIL  NIL  NIL  [M] - 2[P] |

**INDICATOR**: Phenolphthalein[**P**]and Methyl orange [**M**].

**PROCEDURE/METHOD:** Take 20ml of the solution in conical flask and add 2-3 drops of phenolphthalein indicator. Titrate this sample against HCl solution until the pink colour caused by phenolphthalein just disappears. Note down this reading as Phenolphthalein shows the end point. Now add 2-3 drops of methyl orange indicator in the same solution. Continue the titration until yellow color change into orange. Note the volume of acid used. This is methyl orange end point.

**OBSERVATIONS:** Titration with given water sample:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| S.No. | Vol. of water taken | Vol. of HCl with phenolphthalein (P) | Vol. of HCl with methyl orange (M) | Vol. of used HCl |
| **1.**  **2.**  **3.** | *20ml*  *20ml*  *20ml* |  |  |  |

**CALCULATION:**

According to experiments P=X ml M= Y ml

According to the Table:

We find, P>1/2M, then solution contain OH- and CO32-- only.

Now, 2(M-P) should correspond to CO32-- and (2P-M) correspond to OH-.

Thus, Volume N/10 acid equivalent to CO32-- = 2(M-P) = 2(Y-X) = Z ml

Volume N/10 acid equivalent to OH- = (2P-M) = (2X-Y) = t ml

**(a)Normality of water sample with respect to** CO32--

N1 V1  = N2 V2

(Sample) (Acid sol.)

N1 =Zx1/10x1/20

Strength of CO32--= N1 =Zx1/10x1/20x30 Equivalent weight of CO32-- = 30]

=b gm/ltr

Strength of CO2-3 in terms of CaCO3 = b x 50/30 gm/ltr.

=d gm/ltr =dx1000 mg/ltr

**(b)** **Normality of water sample with respect to** OH-

N1 V1  = N2 V2

(Sample sol.) (Acid sol.)

N1 =tx1/10x1/20

Strength of CO32--= N1 =tx1/10x1/20x17 [Equivalent weight of CO32-- = 17]

=R gm/ltr

Strength of CO2-3 in terms of CaCO3 = R x 50/30 gm/ltr.

=Q gm/ltr =Qx1000 mg/ltr

**RESULT:** The given water sample has:

Alkalinity due to **CO2-3**  = ……………mg/Ltr.

Alkalinity due to **HCO2-3** =……………mg/Ltr.

**Total constituent CO2-3 + HCO2-3 =……………ppm.**