Titration of Determination of Alkalinity

1. Alkalinity of natural water is due the presence of salts of Calcium and Magnesium such as bicarbonates, phosphates, silicates and borates which resist lowering of pH.

2. Alkalinity of water can be considered mainly due to : a. Hydroxides only (OH-). b. Carbonates only (CO_3^{2-}). c. Bicarbonates only (HCO_3^-). d. Hydroxides and carbonates together. e. Carbonates and Bicarbonates together.

3. Highly alkaline water may lead to caustic embrittlement and may cause deposition of precipitate and sludge in the boiler pipes.

4. The type and extent of alkalinity present in the water sample is determined by titrating the water sample with standard acid using phenolphthalein indicator to give end point ‘P’.

5. ‘P’ end point is the Phenolphthalein end point.

6. The titration is then continued by adding Methyl – Orange indicator to give end point ‘M ‘.

7. ‘M ‘end point is the Methyl – Orange end point.

8. Phenolphthalein end point marks the reaction as follows:- a. [OH^-] + [H^+] = H_2O b. [CO_3^{2-}] + [H^+] = [HCO_3^-]

9. Methyl – Orange end point marks the completion of titration as follows:- a. [OH^-] + [H^+] = [H_2O] b. [CO_3^-] + [H^+] = [HCO_3^-] c. [HCO_3^-] + [H^+] = $H_2O + CO_2$

10. The amount of acid used up to ‘ P ‘ end point corresponds to OH- ions and half of the normal CO_3^{2-} ions .

11. While the amount of acid used after ‘P’ end point corresponds to half of the normal CO_3^{2-} and HCO^{3-} ions.

12. While the total amount of acid used represents the total alkalinity.

13. From this experiment we get ‘P ‘and ‘M ‘values.

14. Alkalinity is generally expressed as ppm in terms of $CaCO_3$.

The alkalinity is calculated according to the table:-

Alkalinity	OH^-	CO_3^{2-}	HCO_3^-
P = 0	-	-	M
P = ½ M	-	2P	-
P = M	P = M	-	-
P > ½ M	2P - M	2(M – P)	-
P < ½ M	-	2P	M – 2P

On the basis of both strengths we can decide the suitable combination for Alkalinity

1. If P = 0 ,alkalinity is due to HCO_3^-

2. If P = 1/2 ,alkalinity is due to CO_3^{2-}

3. If P = M ,alkalinity is due to OH^-

4. If P > ½ M ,alkalinity is due to OH^- & CO_3^{2-}

5. If P < ½ M ,alkalinity is due to CO_3^{2-} and HCO_3^-