EXPERIMENT NO. 1

Date :

HARDNESS OF WATER SAMPLE

AIM OF THE EXPERIMENT : To estimate total hardness in a given water sample in terms of calcium and magnesium hardness by EDTA method.

APPARATUS REQUIRED :

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

CHEMICALS REQUIRED :

1. 0.01M EDTA solution
2. Buffer solution of pH 10.
3. 2(M) NaOH solution
4. Eriochrome Black-T or Solochrome Black Indicator
5. Patton & Reeder indicator
6. Supplied Water Sample

PRINCIPLE :

Estimation of total hardness in a given water sample is carried out by titrating it against EDTA solution using suitable indicators in different mediums. Both calcium and magnesium content is determined by titrating it against EDTA solution using Eriochrome Black-T indicator in presence of buffer solution of pH 10. In this case both calcium and magnesium indicator complexes are formed which are unstable. When EDTA solution is added, it forms both calcium and magnesium EDTA complexes which are comparatively stable.

Only calcium content is determined by titrating the given water sample against EDTA solution using Patton & Reeder indicator in presence of 2M NaOH solution. In this case only calcium metal indicator complex is formed. When EDTA solution is added only calcium EDTA complex is formed which is comparatively stable.

CHEMICAL REACTION :

I. $$\begin{bmatrix} Ca^{2+} \\ Mg^{2+} \end{bmatrix} + 2\ \text{Eriochrome Black - T} \xrightarrow[\text{pH-10}]{\text{Buffer Sol}^{n}} \begin{bmatrix} \text{Ca - EBT} \\ \text{Mg - EBT} \end{bmatrix}_{\text{Unstable}}$$

(Colourless) (Wine red)

$$\begin{bmatrix} \text{Ca - EBT} \\ \text{Mg - EBT} \end{bmatrix} + 2\ \text{EDTA} \longrightarrow \begin{bmatrix} \text{Ca - EDTA} \\ \text{Mg - EDTA} \end{bmatrix}_{\text{Stable}} + 2\ \text{E.B.T.}$$

(Wine red) (Light Blue)

II. $\begin{bmatrix} Ca^{2+} \\ Mg^{2+} \end{bmatrix} + P.R \xrightarrow{2M\ NaOH} [Ca - P.R]_{Unstable} + Mg(OH)_2$

(Colourless) (Pink)

$[Ca - P.R] + E.D.T.A \longrightarrow [Ca - EDTA]_{Stable} + P.R.$

(Pink) (Light blue)

PROCEDURE :

1. Thoroughly wash the glassware with water.
2. Rinse the burette with supplied EDTA solution and pipette with the given water sample.
3. Fill the burette with the supplied standard 0.01M EDTA solution upto a convenient mark. Remove any air gap and note initial burette reading.
4. Pipette out 10 ml of water sample into a conical flask. Then add 3-4 ml of pH-10 buffer, followed by 4-5 drops of Eriochrome Black-T indicator.
5. Carry out the titration by adding EDTA solution from burette till the colour changes from wine red to light blue. Note the final burette reading.
6. Repeat the process to get the concordant reading.
7. For observation table-II repeat the titration by using 3-4 ml of 2M NaOH and 4-5 drops of Patton and Reeder indicator. End point is that in which colour changes from pink to light blue.

CALCULATION :

1. **Hardness due to Magnesium**

   1 ml of 0.01M EDTA Solution ≡ 1 mg of $CaCO_3$ equivalent hardness

   (x-y) ml of 0.01M EDTA solution ≡ (x-y) mg of $CaCO_3$ equivalent hardness

   10 ml of water sample contains (x-y) mg of $CaCO_3$ equivalent hardness

   1000 ml of water sample contains = (x-y) 100 mg of $CaCO_3$ equivalent hardness or ppm

2. **Hardness due to Calcium**

   1 ml of 0.01M EDTA ≡ 1 mg of $CaCO_3$ equivalent hardness

   y ml of 0.01M EDTA ≡ y mg of $CaCO_3$ equivalent hardness

   10 ml of water sample contains y mg of $CaCO_3$ equivalent hardness

   1000 ml of water sample contains = y x 100 mg of $CaCO_3$ equivalent hardness or ppm

   Total Hardness = Hardness due to Magnesium + Hardness due to Calcium

DEPARTMENT OF CHEMISTRY

Roll No. :

Branch :

Date :

AIM OF THE EXPERIMENT :

OBSERVATION TABLE - I

When Eriochrome Black - T indicator is used (for both Magnesium & Calcium)

No.of Obs.	Vol. of water sample (ml.)	Burette Reading (ml)		Difference (ml) (x)	Remark
		Initial	Final		

OBSERVATION TABLE - II

When Patton & Reeder indicator is used (for only Calcium)

No.of Obs.	Vol. of water sample (ml.)	Burette Reading (ml)		Difference (ml) (y)	Remark
		Initial	Final		

CALCULATION :

CONCLUSION :

Questions for Discussion.

1. What is hardness of water ?
2. What are temporary and permanent hardness ?
3. Does hardness cause any problem in domestic and industrial front ?
4. What methods are available for determination of hardness ?
5. Discuss the different units of hardness.
6. Why hard water does not lather with soap ?
7. What are the names of the other ions that cause hardness besides calcium and magnesium ?
8. Why hardness is generally expressed as calcium carbonate equivalent ?
9. What is the name of the complexing agent used to determine the total hardness?
10. What is full form of EDTA ? Write its structure ?

Rough Work