Q5

→ Strength of SHW,

Standard Hardwater contains 1·2 g $CaCO_3$ per 1000 mL

= 1200 mg $CaCO_3$ per 1000 mL

1 mL SHW = 1·2 mg $CaCO_3$

(i) Standardization of EDTA,

38 mL of EDTA solution = 100 mL SHW

= (100 × 1·2) mg $CaCO_3$ equivalent

1 mL EDTA = $120 \times \frac{1}{38}$ = 3.158 mg $CaCO_3$ equivalent

(ii) To calculate total hardness of Water,

120 mL sample water = 18 mL EDTA

= (18 × 3·158) mg $CaCO_3$ equivalent

1000 mL water = (18 × 3·158 × 1000/120)

= 473.70 mg $CaCO_3$ equivalent

Total Hardness = 800 ppm

(iii) To calculate permanent hardness of water,

150 mL of boiled & filtered sample water = 12 mL EDTA

= (12 × 3·158) mg $CaCO_3$ equivalent

1000 mL boiled water = (12 × 3·158 × 1000/150)

= 252·64 mg $CaCO_3$ equivalent

∴ Permanent Hardness = 252.64 ppm

(iv) To Calculate temporary hardness of water,

Temp Hardness = (Total - Permanent) Hardness

= 473.70 - 252.64

Temporary Hardness = 221.06 ppm.

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$Ca(HCO_3)_2$ = 24.3 ppm = (24.3 x100) / 162 = 15 ppm $CaCO_3$

$CaCl_2$ = 55.5 ppm = (55.5x100) / 111 = 50 ppm $CaCO_3$

$MgCl_2$ = 38 ppm = (38x100) / 95 = 40 ppm $CaCO_3$

- NaCl = 58 ppm = —

- SiO_2 = 15 ppm = —

$FeSO_4$ = 75.9 = $\frac{75.9 \times 100}{152}$ = 49.93 ≈ 50 ppm

$$\text{Lime} = \frac{74}{100}\left[15 + 50 + 40\right] \times \frac{3 \times 10^4}{10^6} \times \frac{100}{80}$$

Lime = 2913.75

$$\text{Soda} = \frac{106}{100}\left[50 + 40 + 50\right] \times \frac{30000}{10^4} \times \frac{100}{80}$$

Soda = 5565

Q] **Problem-1:**
The hardness of 10,000 Lit of hard water was completely removed by passing it through a zeolite softner. The zeolite softner required 5000Lit of NaCl solution containing 1170mg/Lit. Determine the hardness of water sample.

→ 5000 L of NaCl soluⁿ = 5000 × 1170 mg/L

= 5850000 mg

= $5850000 \times \frac{50}{58.5}$ mg $CaCO_3$ eq.

= 5000000 mg

Hardness of 10000 L water = 5000000 mg

Thus hardness for 1L = $\frac{5000000}{10000}$ = 500 mg $CaCO_3$ eq.

Hence, Hardness = 500 ppm.

2023 Q] Calculate Temporary, permanent and total hardness of water sample from the following data: $Mg(HCO_3)_2$ = 14.6 mg/L, $MgCl_2$ = 9.5mg/L, $MgSO_4$ = 18mg/L, $Mg(NO_3)_2$ = 29.6mg/L, Na_2SO_4 = 24mg/L $CaCO_3$ = 8mg/L, $MgCO_3$ = 20mg/L.

→

Ion	Quantity	Conversion factor	$CaCO_3$ eq.	Types of Hardness
$Mg(HCO_3)_2$	14.6	$\frac{14.6 \times 100}{146}$	10 ppm	T
$MgCl_2$	9.5	$\frac{9.5 \times 100}{95}$	10 ppm	P
$MgSO_4$	18	$\frac{18 \times 100}{120}$	15 ppm	P
$Mg(NO_3)_2$	29.6	$\frac{29.6 \times 100}{148}$	20 ppm	P
Na_2SO_4	24	—	—	—

$CaCO_3$	8	$\frac{8 \times 100}{100}$	8 ppm	T
$MgCO_3$	20	$\frac{20 \times 100}{84}$	23.8 ppm	T

$\therefore$ T.H = 10 + 8 + 23.8 = 41.8 ppm

$\therefore$ P.H = 10 + 15 + 20 = 45 ppm

$\therefore$ Total = T.H + P.H. = 86.8 ppm

Q) *Two BOD bottles contained each of 5 ml of sewage sample and water diluted with distilled water to 300 ml. One 100 ml portion of the blaenk consumed 6.4 ml of 0.05 N thiosulphate in the Winkler's method for the determination of dissolved oxygen while 100 ml of the second bottle incubated at 20 ℃ for the five days required 1.6 ml of the same thiosulphate solution. Calculate the BOD content of the sample.*

→ 6.4 − 1.6 = 4.8 ml of 0.05 N thiosulphate solution.

1 L of 1N Thiosulphate = 8 gm of O

4.8 ml of 0.05 Thiosulphate = $\frac{8 \times 4.8 \times 0.05}{1000}$ = 1.92×10^{-3} g = 1.92 mg

$\therefore$ 1000 ml of sewage water sample titrated contains = 192 mg/L

BOD = 192 × Dilution Back

= $192 \times \frac{100}{300}$ = 64 ppm

$\therefore$ O_2 req for 100 ml = 0.128 g

BOD = 1285 mg/L

8]

1.5g of $CaCO_3$ was dissolved in HCl and the solution made up to 750mL with distilled water. 20 mL of the above solution required 20 of EDTA solution. 50 mL of hard water sample required 25mL of EDTA solution. 50mL of boiled hard water sample required 8mL of EDTA solution. Calculate each type of hardness.

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1ml S.H.W = 1mg of $CaCO_3$

20 mL of S.H.W = 20 mL of EDTA soln

1 mL of EDTA = $\frac{20}{20}$ mg of $CaCO_3$

50 mL of H.W = 25 mL of EDTA soln

15 mL of EDTA = 1 x 15 mg $CaCO_3$

50 mL of H.W = 15 mg $CaCO_3$