

MSIC - 204
Date - 24.05.22

Numerical Problem

Q1. A sample of water on analysis was found to contain the following impurities.

Impurity	$\text{Ca}(\text{HCO}_3)_2$	$\text{Mg}(\text{HCO}_3)_2$	CaSO_4	MgSO_4
Quantity	4	6	8	10
Mol. wt.	162	146	136	120

Calculate the temporary, permanent and total hardness of water in ppm, $^\circ\text{Fr}$, $^\circ\text{Cl}$.

Solution: Step 1 Conversion into CaCO_3 equivalent

S.No.	Constituent	Amount mg/L [A]	Multiplication factor [M]	CaCO_3 equivalent = [A] x [M]
1.	$\text{Ca}(\text{HCO}_3)_2$	4	$100/162$	$4 \times \frac{100}{162} = 2.47$ mg/L
2.	$\text{Mg}(\text{HCO}_3)_2$	6	$100/146$	$6 \times \frac{100}{146} = 4.11$ mg/L
3.	CaSO_4	8	$100/136$	$8 \times \frac{100}{136} = 5.88$ mg/L
4.	MgSO_4	10	$100/120$	$\frac{10 \times 100}{120} = 8.33$ mg/L

Step-② Determination of Temporary

Hardness.

As temp. hardness is due to ~~bica~~ bicarbonates of Ca & Mg.

$$\therefore \text{Temp. hardness} = 2.47 + 4.11 = 6.58 \text{ mg/L}$$

$$1 \text{ mg/L} = 1 \text{ ppm} = 0.1^\circ \text{Fr} = 0.07^\circ \text{Cl.}$$

$$\therefore \text{Temp. Hardness} = 6.58 \text{ mg/L} \times 0.1$$
$$\text{Temp Hardness} = 0.658^\circ \text{Fr}$$

$$\text{Similarly Temp. hardness} = 6.58 \text{ mg/L} \times 0.07$$
$$= 0.46^\circ \text{Cl}$$

Step-③ Determination of Permanent hardness

As Permanent hardness is due to CaSO_4 & MgSO_4 ,

$$\therefore \text{PH} = 5.88 + 8.33 = 14.21 \text{ mg/L}$$

$$= 14.21 \text{ ppm}$$

$$= 14.21 \times 0.1 = 1.421^\circ \text{Fr}$$

$$= 14.21 \times 0.07 = 0.995^\circ \text{Cl.}$$