CaCO3 equivalent

Why equivalents of $CaCO_3$?

- The choice of $CaCO_3$

Molecular wt. is 100

Equivalent wt. is 50

Most soluble salt that can be precipitated in water treatment

Formulae

$$\text{Conversion factor} = \frac{100}{\text{Molar mass of hardness causing substance}}$$

$$\text{Equivalence of } CaCO_3 = \text{Amount of hardness causing substance} \times \text{Conversion factor}$$

Sr. No.	Hardness causing substance	Mole. wt. of hardness causing substance	Conversion factor for Equivalence of C $CaCO_3$
1	$CaCO_3$	100	100/100
2	$MgCO_3$	84	100/84
3	$Ca(HCO_3)_2$	162	100/162
4	$Mg(HCO_3)_2$	146	100/146
5	$CaSO_4$	136	100/136
6	$MgSO_4$	120	100/120
7	$CaCl_2$	111	100/111
8	$MgCl_2$	95	100/95
9	CO_2*	44	*Does not cause any hardness
10	NaCl*	58.5	
11	SiO_2*	60	

$MgCO_3 = 84$?

Mg =24

C =12

O = 16x3

=84

Example: **Calculate temporary, permanent and total hardness of water sample having following data**

$Mg(HCO_3)_2$ = 146 ppm, $Ca(HCO_3)_2$ = 324 ppm, $MgCl_2$ = 190 ppm, $CaCl_2$ = 333 ppm

Substance	Amount in ppm	Mole. Wt. of hardness causing substance	Conversion factor	Equi. Of $CaCO_3$

Equivalence of $CaCO_3$ = Amount of hardness causing substance X Conversion factor

Substance	Amount in ppm	Mole. Wt. of hardness causing substance	Conversion factor	Equi. Of $CaCO_3$
$Mg(HCO_3)_2$	146	146	100/146	100
$Ca(HCO_3)_2$	324	162	100/162	200
$MgCl_2$	190	95	100/95	200
$CaCl_2$	333	111	100/111	300

1:42 79%

Substance	Amount in ppm	Mole. Wt. of hardness causing substance	Conversion factor	Equi. Of $CaCO_3$
$Mg(HCO_3)_2$	146	146	100/146	100
$Ca(HCO_3)_2$	324	162	100/162	200
$MgCl_2$	190	95	100/95	200
$CaCl_2$	333	111	100/111	300

Carbonate Hardness $= Mg(HCO_3)_2 + Ca(HCO_3)_2$

$= 100 + 200$

$= 300$ ppm

View key concept

EDTA Problems

HOW TO SOLVE EDTA PROBLEMS

CONCEPTUAL ENGINEERING

Q- 0.5 g of $CaCO_3$ was dissolved in HCl & the solutions made upto 500 mL with distilled water. 50 ml of sol^n required 48 mL of EDTA sol^n for $titr^n$. 50 mL of H.W sample required 15 mL of EDTA & after Boiling & filtering required 10 mL of EDTA sol^n. Calculate the hardness. (Permanent) (6 Marks)

HOW TO SOLVE EDTA PROBLEMS

CONCEPTUAL ENGINEERING

Q- 0.5 g of $CaCO_3$ was dissolved in HCl & the solutions made upto 500 mL with distilled water. 50 ml of soln required 48 mL of EDTA soln for titrn. 50 mL of H.W sample required 15 mL of EDTA & after Boiling & filtering required 10 mL of EDTA soln. Calculate the hardness. (Permanent) (6 Marks)

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

50 ml S.H.W = 50 mg of $CaCO_3$

50 ml of S.H.W = 48 ml of EDTA = 50 mg $CaCO_3$

48 mL of EDTA = 50 mg $CaCO_3$

1 mL of EDTA = $\frac{50}{48}$ mg $CaCO_3$

HOW TO SOLVE EDTA PROBLEMS

CONCEPTUAL ENGINEERING

Q- 0.5 g of $CaCO_3$ was dissolved in HCl & the Solutions made upto 500 mL with distilled water. 50 ml of soln required 48 mL of EDTA soln for titrn. 50 mL of H.W sample required 15 mL of EDTA & after Boiling & filtering required 10 mL of EDTA soln. Calculate the hardness. (Permanent) (6 Marks)

1 mL of EDTA $= \frac{50}{48}$ mg of $CaCO_3$

50 mL of H.W = 15 mL of EDTA

15 mL of EDTA $= \frac{50}{48} \times 15$ mg $CaCO_3$

50 mL of H.W $= \frac{50}{48} \times 15$ mg $CaCO_3$ eq.

1 mL ——— $= \frac{50}{48} \times \frac{15}{50}$ mg $CaCO_3$ eq

HOW TO SOLVE EDTA PROBLEMS

CONCEPTUAL ENGINEERING

Q - 0.5 g of $CaCO_3$ was dissolved in HCl & the solutions made upto 500 mL with distilled water. 50 ml of soln required 48 mL of EDTA soln for titrn. 50 mL of H.W sample required 15 mL of EDTA & after Boiling & filtering required 10 mL of EDTA soln. Calculate the hardness. (Permanent) (6 Marks)

1 mL of EDTA = $\frac{50}{48}$ mg of $CaCO_3$

50 mL of H.W = 15 mL of EDTA

15 mL of EDTA = $\frac{50}{48} \times 15$ mg $CaCO_3$

50 mL of H.W = $\frac{50}{48} \times 15$ mg $CaCO_3$ eq.

1 mL ——— = $\frac{50}{48} \times \frac{15}{50}$ mg $CaCO_3$ eq

1000 mL ——— = $\frac{50}{48} \times \frac{15}{50} \times 1000$ mg $CaCO_3$ eq

mg/L or ppm

HOW TO SOLVE EDTA PROBLEMS

CONCEPTUAL ENGINEERING

Q- 0.5 g of $CaCO_3$ was dissolved in HCl & the solutions made upto 500 mL with distilled water. 50 ml of sol^n required 48 mL of EDTA sol^n for $titr^n$. 50 mL of H.W sample required 15 mL of EDTA & after Boiling & filtering required 10 mL of EDTA sol^n. Calculate the Hardness (Permanent) (6 Marks)

$$\text{Total Hardness} = \frac{50}{48} \times \frac{15}{50} \times 1000 \text{ mg } CaCO_3 = 312.5 \text{ mg/L}$$

or

312.5 ppm

HOW TO SOLVE EDTA PROBLEMS

CONCEPTUAL ENGINEERING

Q- 0.5 g of $CaCO_3$ was dissolved in HCl & the solutions made upto 500 mL with distilled water. 50 ml of soln required 48 mL of EDTA soln for titrn. 50 mL of H.W sample required 15 mL of EDTA & after Boiling & filtering required 10 mL of EDTA soln. Calculate the hardness (permanent) (6 Marks)

$$\text{Total Hardness} = \frac{50}{48} \times \frac{15}{50} \times 1000 \text{ mg } CaCO_3 = 312.5 \text{ mg/L or } 312.5 \text{ ppm}$$

50 mL of H.W = 10 mL of EDTA

1 mL of EDTA = 50/48 mg of $CaCO_3$

$$50 \text{ mL of H.W} = \frac{50}{48} \times 10 \text{ mg of } CaCO_3$$

$$1 \text{ ——— } = \frac{50}{48} \times \frac{10}{50} \text{ mg of } CaCO_3$$

$$1000 \text{ ml ——— } = \frac{50}{48} \times \frac{10}{50} \times 1000 \text{ mg of } CaCO_3$$

HOW TO SOLVE EDTA PROBLEMS

CONCEPTUAL ENGINEERING

Q- 0.5 g of $CaCO_3$ was dissolved in HCl & the solutions made upto 500 mL with distilled water. 50 ml of soln required 48 mL of EDTA soln for titrn. 50 mL of H.W sample required 15 mL of EDTA & after Boiling & filtering required 10 mL of EDTA soln. Calculate the hardness (Permanent) (6 Marks)

$$\text{Total Hardness} = \frac{50}{48} \times \frac{15}{50} \times 1000 \text{ mg } CaCO_3 = 312.5 \text{ mg/L or } 312.5 \text{ ppm}$$

Permanent Hardness = 208.3 mg/L or ppm

Temp. Hardness = Total - Permanent

$= (312.5 - 208.3)$ mg/L

$= 104.2$ ppm

CHEMISTRY
with
Panda Sir

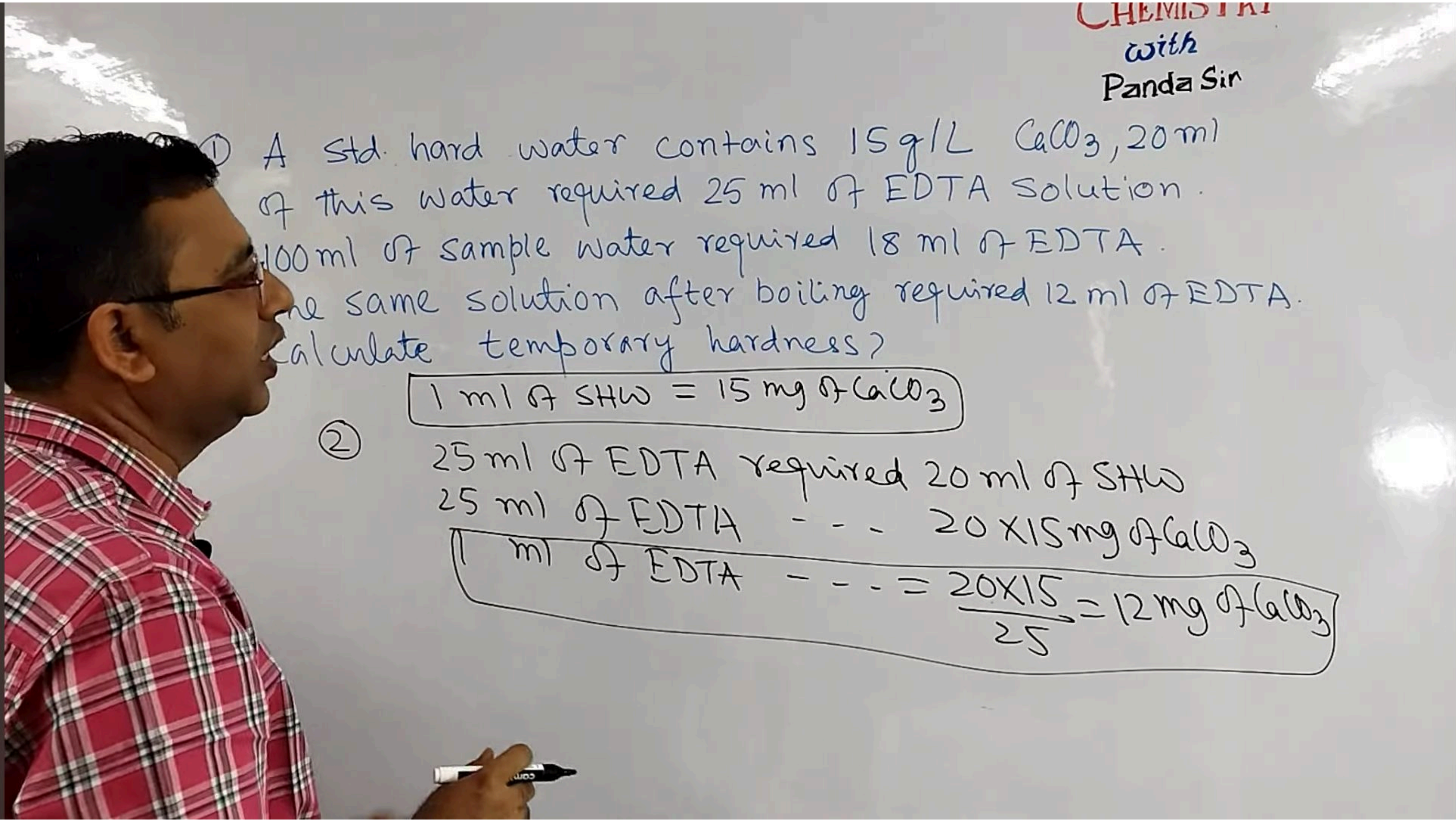
① A std. hard water contains 15 g/L $CaCO_3$, 20 ml of this water required 25 ml of EDTA solution. 100 ml of sample water required 18 ml of EDTA. The same solution after boiling required 12 ml of EDTA. Calculate temporary hardness?

Temp. hardness = Total hardness - Perm. hardness

① 1 lit of SHW contains 15 gm $= 15 \times 10^3$ mg of $CaCO_3$

1000 ml of ------------ $= 15 \times 10^3$ mg of $CaCO_3$

$$\boxed{1 \text{ ml of SHW} ---- = \frac{15 \times 10^3}{10^3} = 15 \text{ mg of } CaCO_3}$$


CHEMISTRY
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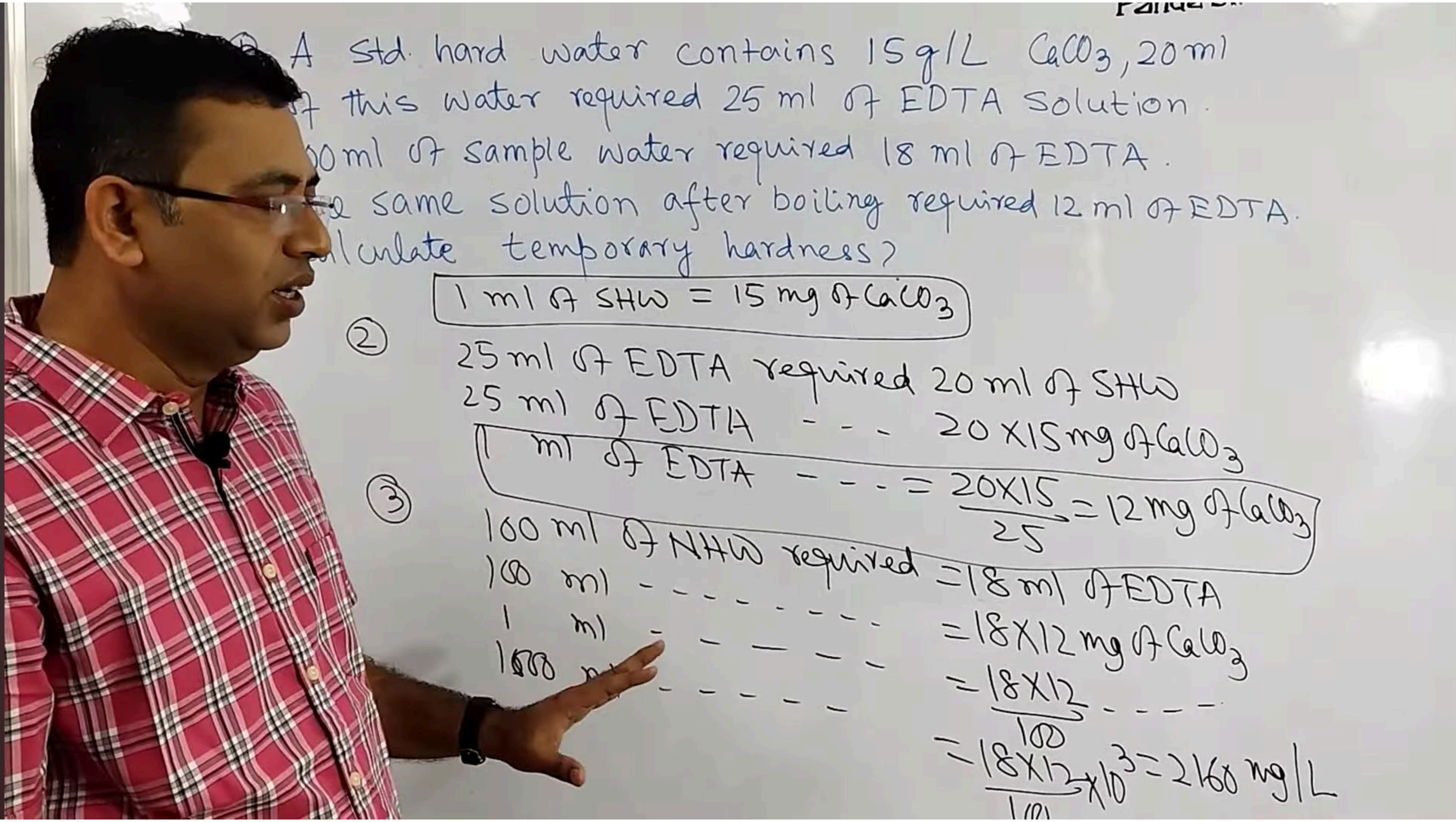
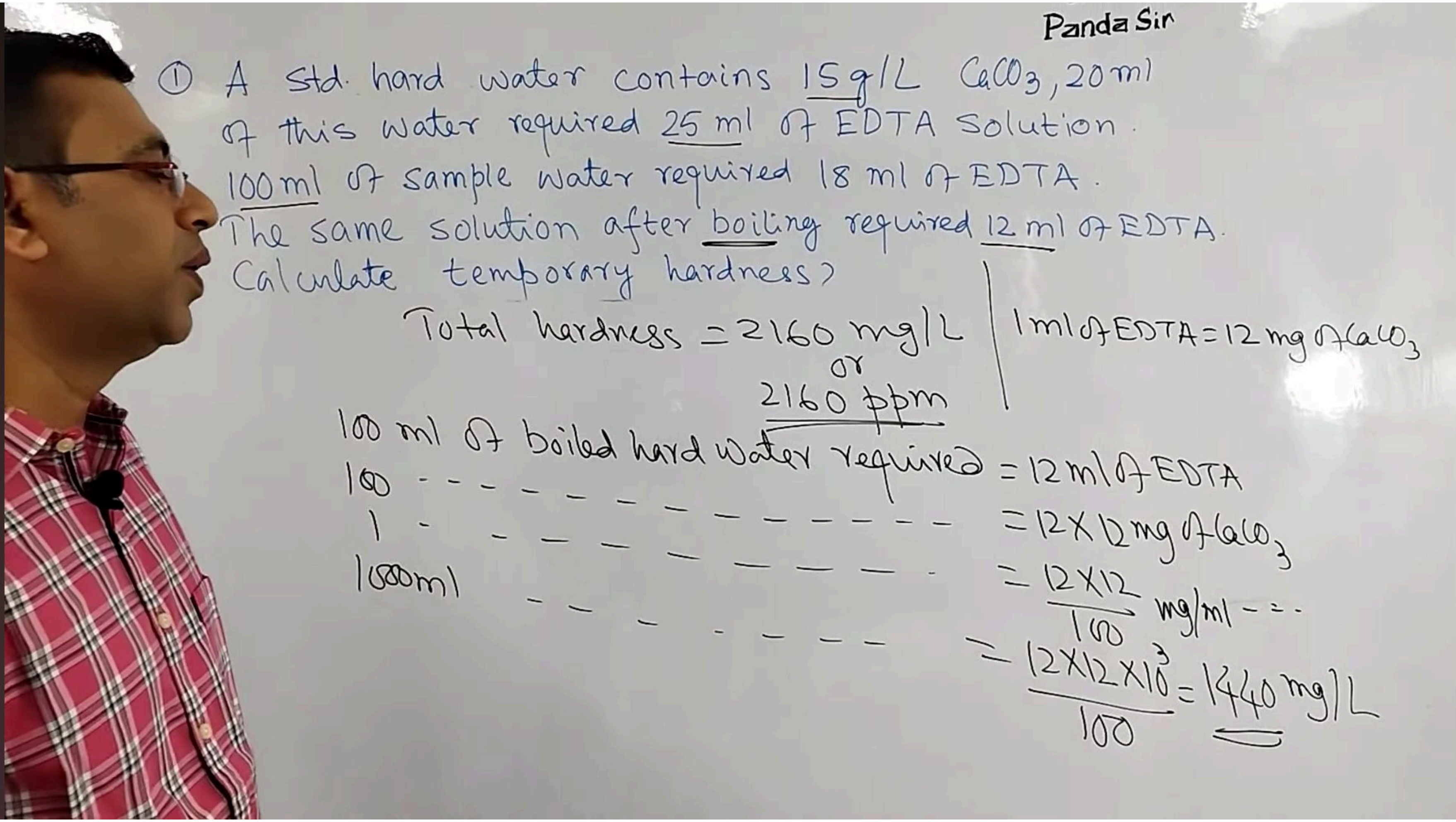
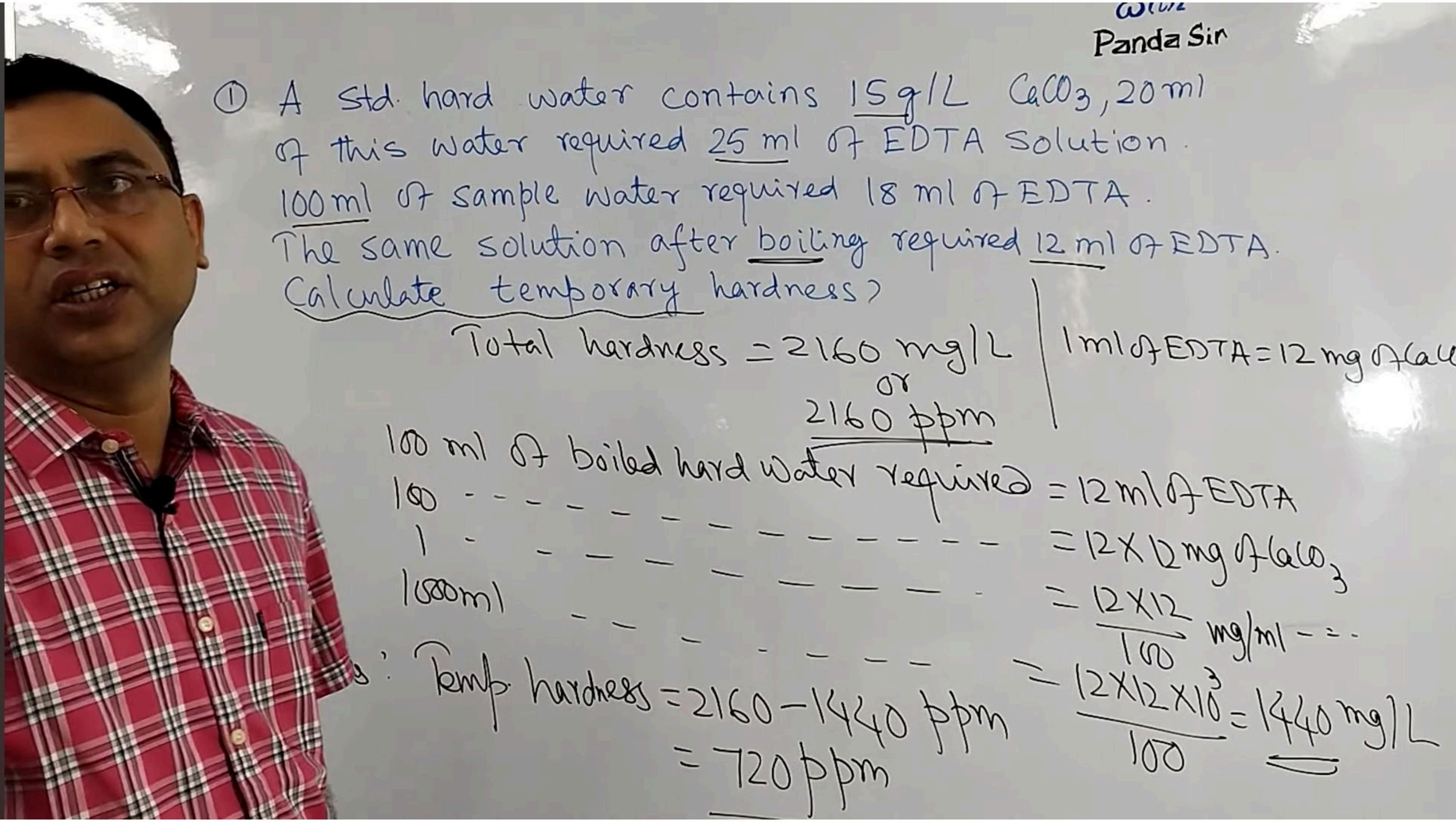
of this water required 25 ml of EDTA solution.
100 ml of sample water required 18 ml of EDTA.
e same solution after boiling required 12 ml of EDTA.
alculate temporary hardness?
1 ml of SHW = 15 mg of $CaCO_3$
② 25 ml of EDTA required 20 ml of SHW
25 ml of EDTA --- 20 × 15 mg of $CaCO_3$
1 ml of EDTA --- = $\frac{20 \times 15}{25}$ = 12 mg of $CaCO_3$


A std. hard water contains 15 g/L CaCO3, 20 ml
f this water required 25 ml of EDTA solution.
0 ml of sample water required 18 ml of EDTA.
e same solution after boiling required 12 ml of EDTA.
lculate temporary hardness?
1 ml of SHW = 15 mg of CaCO3
2
25 ml of EDTA required 20 ml of SHW
25 ml of EDTA - - - 20 X 15 mg of CaCO3
1 ml of EDTA - - - = 20X15/25 = 12 mg of CaCO3
3
100 ml of NHW required
100 ml - - - - - - - - = 18 ml of EDTA
1 ml - - - - - - - = 18X12 mg of CaCO3
= 18X12/100 - - - -
= 18X12/100 x 10^3 = 2160 mg/L



Panda Sir
① A Std. hard water contains 15 g/L CaCO3, 20 ml of this water required 25 ml of EDTA Solution.
100 ml of sample water required 18 ml of EDTA.
The same solution after boiling required 12 ml of EDTA.
Calculate temporary hardness?
Total hardness = 2160 mg/L or 2160 ppm
1 ml of EDTA = 12 mg of CaCO3
100 ml of boiled hard water required = 12 ml of EDTA
100 - - - - - = 12 × 12 mg of CaCO3
1 - - - - - = 12×12/100 mg/ml
1000 ml - - - - - = 12×12×10^3/100 = 1440 mg/L


Panda Sir
① A std. hard water contains 15 g/L CaCO3, 20 ml
of this water required 25 ml of EDTA solution.
100 ml of sample water required 18 ml of EDTA.
The same solution after boiling required 12 ml of EDTA.
Calculate temporary hardness?
Total hardness = 2160 mg/L
or
2160 ppm
1 ml of EDTA = 12 mg of CaC
100 ml of boiled hard water required
100 - - - - - - = 12 ml of EDTA
1 - - - - - - = 12 X 12 mg of CaCO3
1000 ml - - - - - - = 12 X 12 / 100 mg/ml
- - - - - - = 12 X 12 X 10^3 / 100 = 1440 mg/L
∴ Temp. hardness = 2160 − 1440 ppm
= 720 ppm

NUMERICAL BASED ON L-S METHOD

FORMULA FOR LIME REQUIRMENT

$$LR = \frac{74}{100}\left[\begin{array}{l} \text{Temp. } Ca^{+2} + 2\times \text{Temp. } Mg^{+2} + \\ \text{Perm. } (Mg^{+2} + Fe^{+2} + Al^{+3}) + CO_2 \\ + H^{+} + HCl + H_2SO_4 + HCO_3^{-} + NaHCO_3 \\ - NaAlO_2 + O\bar{H} \\ \text{All in terms of } CaCO_3 \text{ equivalent} \end{array}\right]$$

$$\times \text{ Volume of water} \times \frac{100}{\%\text{ purity}} \times \frac{1}{10^6} \text{ Kg}$$

FORMULA FOR SODA REQUIRMENT

$$\left[\text{Perm. } (Ca^{+2} + Mg^{+2} + Fe^{+2} + Al^{+3}) \right.$$

FORMULA FOR SODA REQUIRMENT

$$SR = \frac{106}{100}\left[\begin{array}{l}\text{Perm.}(Ca^{+2} + Mg^{+2} + Fe^{+2} + Al^{+3}) \\ + H^{+} + HCl + H_2SO_4 - HCO_3^{-} + OH^{-} + CO_3^{2-} \\ \text{All in terms of } CaCO_3 \text{ equivalents}\end{array}\right]$$

$$\times \text{volume of water} \times \frac{100}{\%\,\text{purity}} \times \frac{1}{10^6}\ \text{Kg}$$

- Temp. Ca^{+2} — $Ca(HCO_3)_2$, $CaCO_3$, Temp. Ca^{+2} Hard
- Temp. Mg^{+2} — $Mg(HCO_3)_2$, $MgCO_3$, Temp. Mg^{+2} Hardness
- Perm. Ca^{+2} — $CaCl_2$, $CaSO_4$, $Ca(NO_3)_2$, Ca^{+2}
- Perm. Mg^{+2} — $MgCl_2$, $MgSO_4$, $Mg(NO_3)_2$, Mg^{+2}
- Perm Fe^{+2} — $FeSO_4$, $FeSO_4 \cdot 7H_2O$, Fe^{+2}

$\times$ volume of water $\times \frac{100}{\%\,purity} \times \frac{1}{10^6}$ Kg

- Temp. Ca^{+2} — $Ca(HCO_3)_2$, $CaCO_3$, Temp. Ca^{+2} Hard
- Temp. Mg^{+2} — $Mg(HCO_3)_2$, $MgCO_3$, Temp. Mg^{+2} Hardness
- Perm. Ca^{+2} — $CaCl_2$, $CaSO_4$, $Ca(NO_3)_2$, Ca^{+2}
- Perm. Mg^{+2} — $MgCl_2$, $MgSO_4$, $Mg(NO_3)_2$, Mg^{+2}
- Perm Fe^{+2} — $FeSO_4$, $FeSO_4 \cdot 7H_2O$, Fe^{+2}
- Perm Al^{+3} — $Al_2(SO_4)_3$, Al^{+3}
- HCO_3^- — HCO_3^-, $NaHCO_3$, $KHCO_3$

Date
Page

POINTS TO REMEMBER

If the impurities are given as $CaCO_3$ and/or $MgCO_3$, these should be considered as temporary Ca and temporary Mg hardness respectively.

Substances like KCl, $NaCl$, K_2SO_4, Na_2SO_4, SiO_2, Fe_2O_3, organic matter do not impart any hardness to water and do not consume any lime or soda.

If only word temporary hardness is given it means calcium bicarbonate.

..., these should be considered as temporary Ca and temporary Mg hardness respectively.

Substances like KCl, $NaCl$, K_2SO_4, Na_2SO_4, SiO_2, Fe_2O_3, organic matter do not impart any hardness to water and do not consume any lime or soda.

If only word temporary hardness is given it means Calcium bicarbonate.

Co-agulants like $FeSO_4$ [illegible] H_2O, $Al_2(SO_4)_3$ when also used, should be [illegible]ted as dissolved Iron and Aluminiu[illegible]ts and their amounts added mu[illegible] taken into consi- -deration for [illegible]lime and soda

Co-agulants like $FeSO_4 \cdot 7H_2O$, $Al_2(SO_4)_3$ when also used, should be treated as dissolved Iron and Aluminium salts and their amounts added must be taken into consideration for calculating lime and soda requirement.

If Lime and soda used in excess quantity then treated water contains OH^- and CO_3^{2-} ions, so ~~these~~ this excess amount should be added to the calculations.

Excess Lime

$$Ca(OH)_2 \longrightarrow Ca^{+2} + 2OH^-$$

$$Ca^{+2} + Na_2CO_3 \longrightarrow CaCO_3 + 2Na^+$$

Excess soda

$$Na_2CO_3^{2-} \longrightarrow 2Na^+ + CO_3^{2-}$$

1. Calculate the amount of lime (84% pure) and soda (92% pure) required for the treatment of 20,000 L of water whose analysis is as follows in ppm

$Ca(HCO_3)_2 = 40.5$, $Mg(HCO_3)_2 = 36.5$, $MgSO_4 = 30.0$
$CaSO_4 = 34.0$, $CaCl_2 = 27.75$, $NaCl = 10.0$

Given : Volume of water = 20,000 L
% purity for Lime = 84%
% Purity for Soda = 92%

Impurities	Amount (ppm)	Multiplication F[illegible]	[illegible]O_3 eq
$Ca(HCO_3)_2$	40.5	100/162	

$Ca(HCO_3)_2 = 40.5$, $Mg(HCO_3)_2 = 36.5$, $MgSO_4 = 30.0$
$CaSO_4 = 34.0$, $CaCl_2 = 27.75$, $NaCl = 10.0$

Given : Volume of water = 20,000 L
% purity for Lime = 84%.
% Purity for Soda = 92%.

Impurities	Amount (ppm)	Multiplication F.	$CaCO_3$ eq
$Ca(HCO_3)_2$	40.5	100/162 × 40.5	25
$Mg(HCO_3)_2$	36.5	100/146 × 36.5	25
$MgSO_4$	30.0	100/120 × 30	25
$CaSO_4$	34.0	100/136 × 34	25
$CaCl_2$	27.75	100/111 × 27.75	25
$NaCl$	10.0	—x—	

	(ppm)	Multiplication F.	$CaCO_3$ eq
$Ca(HCO_3)_2$	40.5	100/162 × 40.5	25
$Mg(HCO_3)_2$	36.5	100/146 × 36.5	25
$MgSO_4$	30.0	100/120 × 30	25
$CaSO_4$	34.0	100/136 × 34	25
$CaCl_2$	27.75	100/111 × 27.75	25
NaCl	10.0	—×—	—

$$LR = \frac{74}{100}\left[25 + 2\times 25 + 25\right] \times 20{,}000 \times \frac{100}{84} \times \frac{1}{10^6}\ \text{kg}$$

$$= 1.761\ \text{kg}$$

$$SR = \frac{106}{100}\left[\overset{CaSO_4}{25} + \overset{CaCl_2}{25} + \overset{MgSO_4}{25}\right] \times 20{,}000 \times \frac{100}{92} \times \frac{1}{10^6}\ \text{kg}$$

$$= 1.728\ \text{kg}$$

Numericals Based on Zeolite Process

Zeolite process is based on principle of Ion exchange.

Softening Cycle

$Na_2Ze + Ca^{+2} \longrightarrow CaZe + 2Na^+$

$Na_2Ze + Mg^{+2} \longrightarrow MgZe + 2Na^+$

Zeolite	Hard water	Exhausted Zeolite	soft water

Regeneration cycle

$CaZe + 2NaCl \longrightarrow {}_2Ze + CaCl_2$

Zeolite Hard water Exhausted Zeolite soft water

Regeneration cycle

$$CaZe + 2NaCl \longrightarrow Na_2Ze + CaCl_2$$

$$MgZe + 2NaCl \longrightarrow Na_2Ze + MgCl_2$$

Exhausted zeolite Brine solⁿ Regenerated zeolite washing into sink

From above reactions we can conclude that total amount of hard water softened by zeolite process is equivalent to total amount of NaCl sol^n of given concentration, required for regeneration of exhausted Zeolite.

Information from given exercise

Regenerating NaCl sol^n

Hard water

- Concentration of NaCl

Strength Normality W/v %

- Volume of NaCl sol^n

- Hardness
- Volume of water

Q.1 Determination of Hardness

Q.2 Determin[illegible] volume of water

Q.1 Determination of Hardness

Q.2 Determine volume of water

Q.3 Determine volume of NaCl solⁿ required for regeneration.

Q.4 Determine conc. of NaCl solⁿ

Remember

Hardness is no. of mg of $CaCO_3$ equivalent present in 1 L of water.

Q.1 The hardness of 10,000 litres of a sample of water was removed by passing it through a zeolite softener. The zeolite softener then required 200 L of sodium chloride (NaCl) solution containing 150 g/L of NaCl for regeneration. Find the hardness of water sample.

Sol. Given: Volume of water = 10,000 L
Volume of NaCl soln = 200 L
Strength of NaCl soln = 150 g/L
Hardness = ?

Step-1 Total amount of NaCl in m

1 L NaCl soln contains 150 NaCl

containing 150 g/L of NaCl for regeneration. Find the hardness of water sample.

Sol. Given: Volume of water = 10,000 L
Volume of NaCl solⁿ = 200 L
Strength of NaCl solⁿ = 150 g/L
Hardness = ?

Step-1 Total amount of NaCl in mg
1 L NaCl solⁿ contains 150 g NaCl
200 L NaCl solⁿ contains 150 × 200 g NaCl
150 × 200 × 1000 mg NaCl
3×10^7 mg of NaCl.

Step-2 $CaCO_3$ equivalent for total NaCl (mg)
Weight of NaCl in mg × Multiplication Factor

Step-1 Total amount of NaCl in mg

1 L NaCl solⁿ contains 150 g NaCl

200 L NaCl solⁿ contains 150×200 g NaCl

$150 \times 200 \times 1000$ mg NaCl

3×10^7 mg of NaCl.

Step-2 $CaCO_3$ equivalent for total NaCl (mg)

Weight of NaCl in mg × Multiplication Factor

$$3 \times 10^7 \text{mg} \times \frac{100}{117} \qquad \left[\frac{50}{58.5}\right]$$

25641025.64 mg of $CaCO_3$ eq.

Step-3 Determination of Hardness of W.S.

10,000 L of water contains 25641025.64 mg of $CaCO_3$ eq.

1 L of water contains $\frac{25641025.64}{10,000}$

1 L of water contains = 2564.10 mg of $CaCO_3$

= 2564.10 mg/L

Short trick to solve zeolite Numerical

Hard Water   NaCl soln

$$H_{(mg/L)} \times V_{(L)} = W_{(mg)} \times v_{(L)} \times \frac{100}{117}$$

$H_{(mg/L)}$ = Hardness of water in mg/L

$V_{(L)}$ = Volume of water in Litres

$W_{(mg)}$ = Weight of NaCl in mg

$v_{(L)}$ = Volume of NaCl in Litres.

Q. A zeolite softener is 90% exhausted by removing the hardness completely when 10,000 L of hard water sample was passed through it. The exhausted zeolite required 200L of 3% NaCl for its complete regeneration. Calculate hardness of water.

Given

Conc. of NaCl = 3%
Volume of NaCl = 200L
Volume of water = 10,000
Hardnes of water = ?

Concentration of NaCl is giv[illegible] in $\frac{\text{weight}}{\text{Volume}}$ %

$\frac{\text{weight}}{\text{Volume}}$ % means amount [illegible] solute in g per 100 mL [illegible]ution

Given Conc. of $NaCl$ = 3%
Volume of $NaCl$ = 200L
Volume of water = 10,000
Hardnes of water = ?

Concentration of $NaCl$ is given in $\frac{\text{weight}}{\text{volume}}$ %

$\frac{\text{weight}}{\text{volume}}$ % means amount of solute in g per 100 mL of solution.

So 3% $NaCl$ means 3 g $NaCl$ dissolved in 100 mL solution.

Numerical Ion Exchange Column Chromatography

After treating 10^4 litres of water by ion-exchanger, the cationic resin required 200 litres of 0.1 N HCl and anionic resin required 200 litres of 0.1 N NaOH solutions. Find the hardness of water.

Solution :

In an ion-exchanger all hardness causing cations are removed by cation-exchanger. Hence, the amount of acid used for regeneration of cation resin refers to the hardness of water.

Hardness in 10^4 litres of water

$$\equiv 200 \text{ litres of } 0.1 \text{ N HCl}$$

$$\equiv 200\ l \text{ of } 001 \text{ NCaCO}_3 \text{ eq.}$$

$$= 200 \times 0.1\ l \text{ of } 1 \text{ N CaCO}_3 \text{ eq.}$$

$$= 20\ l \text{ of } 1 \text{ N CaCO}_3 \text{ eq.}$$

$$= 20 \times 50 \text{ g of CaCO}_3 \text{ eq.}$$

$$= 1000 \text{ gms of CaCO}_3 \text{ eq.}$$

$\therefore$ Hardness in 1 litre of water

$$= \frac{1000}{10^4} \text{ gms of CaCO}_3 \text{ eq.}$$

$$= 100 \text{ mgms of CaCO}_3 \text{ eq.}$$

$\therefore$ Hardness of water sample = 100 mg/L

$$= 100 \text{ ppm}$$

25 ml of sewage water is refluxed with 0.1 N $K_2Cr_2O_7$ solution in the presence of H_2SO_4 and $AgSO_4$. The unreacted dichromate required 5.5 ml of 0.1 N FAS solution. Blank titration consumed 15 ml of 0.1 N FAS solution. Calculate COD of the effluent.

SOLUTION:

$$COD = \frac{(V1 - V2) * \text{Normality of FAS solution} * 8000}{\text{Volume of water sample taken}}$$

$$= \frac{(15 - 5.5) * 0.1 * 8 * 1000}{25}$$

$$COD = 304 \text{ ppm}$$

A 10 ml sample of waste water was refluxed with 20 ml of potassium dichromate solution and after refluxing the excess unreacted dichromate required 26.2 ml of 0.1 M FAS solution. A blank of 10 ml of distilled water on refluxing with 20 ml of dichromate solution required 36 ml of 0.1 M FAS solution. Calculate the COD value of the wastewater.

Solution:

$$\text{COD} = \frac{(V1 - V2) * \text{Normality of FAS solution} * 8000}{\text{Volume of water sample taken}}$$

$$= \{(36 - 26.2) * 0.1 * 8000\} / 10$$

$$= 784 \text{ ppm}$$

20 ml of sample of water contains 454 ppm of dissolved oxygen. After five days the dissolved oxygen value is 300 ppm, after sample was diluted to 100 ml. Calculate the BOD of water.

SOLUTION:

Dissolved Oxygen before incubation (DO_b) = 454 ppm

Dissolved Oxygen after incubation (DO_i) = 300 ppm

$$BOD = (DO_b - DO_i) * \text{Dilution Factor}$$

$$= (DO_b - DO_i) * \frac{\text{ml of sample after dilution}}{\text{ml of sample before dilution}}$$

$$= (454 - 300) * 100/20$$

BOD = 770 ppm