JECRC Foundation

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE

Year & Sem. – B. Tech I year, Sem.-I

Subject –Engineering Chemistry

Unit – I (Numerical problems based on Lime Soda Method)

Presented by – Dr. Barkha Shrivastava

Designation - Associate Professor & Head

Department - Chemistry

Numerical problems based on Lime Soda Method

Lime required for softening:

$$= \frac{74}{100} [\text{Temp. } Ca^{2+} + 2\times\text{Temp. } Mg^{2+} + \text{Perm. } (Mg^{2+} + Fe^{2+} + Al^{3+} + CO_2 + H^+ (HCl \text{ or } H_2SO_4) + HCO_3^-]$$

Soda required for softening:

$$= \frac{106}{100} [\text{Perm. } (Ca^{2+} + Mg^{2+} + Fe^{2+} + Al^{3+}) + H^+ (HCl \text{ or } H_2SO_4) - HCO_3^-]$$

Example 2. Calculate the quantity of hydrated lime and soda required for soften 20,000 litre of water containing the following salts:

$CaCO_3$ = 10.0 mg/litre, $MgCO_3$ = 8.4 mg/litre

$CaCl_2$ = 11.1 mg/litre, $MgSO_4$ = 6.0 mg/litre

SiO_2 = 1.2 mg/litre.

Assuming the purity of lime as 90 percent and that of sodium carbonate 95 percent.

[Raj. Univ. 1996]

Solution: Conversion to $CaCO_3$ equivalent.

S.No.	Substances	Amount	Multiplication factor	$CaCO_3$ equivalent
1.	$CaCO_3$	10 mg/litre	$\frac{100}{100}$	$10 \times \frac{100}{100} = 10$mg/litre
2.	$MgCO_3$	8.4 mg/litre	$\frac{100}{84}$	$8.4 \times \frac{100}{84} = 10$mg/litre
3.	$CaCl_2$	11.1 mg/litre	$\frac{100}{111}$	$11.1 \times \frac{100}{111} = 10$mg/litre
4.	$MgSO_4$	6.0 mg/litre	$\frac{100}{120}$	$6.0 \times \frac{100}{120} = 5$mg/litre
5.	SiO_2	1.2 mg/litre	Does not impart hardness	

$\therefore$ Lime requirement

$$= \frac{74}{100}[(2 \times MgCO_3) + CaCO_3 + MgSO_4 \text{ as } CaCO_3 \text{ equivalent}]$$

$$= \frac{74}{100}[2 \times 10 + 10 + 5]\text{mg/litre}$$

$$= \frac{74}{100}[35]\text{mg/litre} = 25.90\text{mg/litre}$$

or, lime required of given quality (i.e,, 90% of purity)

$$= 25.90 \text{ mg/litre} \times \frac{100}{90} = 28.778 \text{ mg/litre}$$

or, 20000 litre of water require

$$= 28.778 \times 20000 \times \frac{1\text{kg}}{10^6\text{mg}} = 0.5755 \text{ kg of lime}$$

$\therefore$ Soda required $= \frac{106}{100}[CaCl_2 + MgSO_4 \text{ as } CaCO_3, \text{equivalent}]$

$$= \frac{106}{100}[10 + 5]\text{mg/litre}$$

$$= \frac{106}{100}[15]\text{mg/litre}$$

$$= \frac{106}{100}[15]\text{mg/litre} = 15.90\text{mg/litre}$$

$\therefore$ Sodium Carbonate required of given quantity (i.e., 95% of purity)

$$= 15.90\text{mg/litre} \times \frac{100}{95} = 16.737\text{mg/litre}$$

20,000 litre of water required $= 16.737$ mg/litre $\times$ 20,000 litre $\times \frac{1\text{kg}}{10^6\text{mg}}$

$$= 0.3347 \text{ Kg of soda.}$$

If Percentage of purity is given for Lime & Soda

Amount of Lime required = Calculated Lime x 100/ Purity %

Amount of Soda required = Calculated Soda x 100/ Purity %

JECRC Foundation

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE

Thank you!