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FACULTY OF ENGINEERING, UNIVERSITY OF LUCKNOW
Assignment 3

Course: B.Tech.   **Session: 2019-20**
Subject: Engineering Chemistry   **Semester: II**
Submission Deadline: **Name of Faculty: Dr. R. P. Singh**

Q1. Which components are responsible for hardness? Define hardness of water also.

Q2. Why soap does not produce lather with hard water? Explain with example.

Q3. Define the types of hard water with suitable examples.

Q4. Explain the disadvantage of water.

Q5. How scales and sludge are form?

Q6. Write short notes on boiler troubles/problems.

Q7. Explain the lime-soda process used for softening of water with suitable examples.

Q8. Why lime does not remove hard water causes by calcium salts?

Q9. Explain zeolite method and also explain what happens when mineral acid pass through zeolite.

Q10. Explain Ion-exchange resins process to remove hardness of water. How these Ion-exchange resins are regenerated?

Q11. Explain the concept used in water purifier.

Q12. Define phase rule, phase, component and degree of freedom with suitable examples.

Q13. Define triple point and metastable equilibrium or super cooled liquid with example.

Q14. Explain application of phase rule to one component water system.

Q15. Write the formula, for the requirement of lime-soda during softening of water.

Q16. Why sea water is hard as compare to river water?

Q17. Define degree of hardness. Explain ppm, mg/l, Clarke's degree and French degree.

Q18. What is the relation between ppm, mg/l, degree Clarke's and degree French.

Q19. How do you remove hardness of sea water? Give your answer with own ideas.

Q20. Explain calgon and phosphate treatment (internal treatment) of hard water.

Q21. Calculate the temporary and permanent hardness of water sample containing Mg(HCO3)2=9.3mg/L, Ca(HCO3)2= 19.2mg/L, MgCl2= 19.5mg/L, CaSO4=17.6mg/L).

$$\text{Equivalent of CaCO}_3 = \frac{\left[strength\ of\ substance\ producing\ hardness\left(\frac{mg}{lit}\right)\right] \times [\ chemical\ equvalent\ of\ \text{CaCO3}] \times 2}{[\ chemical\ equivalent\ of\ hardness\ producing\ substance] \times 2}$$

OR

$$\text{Equivalent of CaCO}_3 = \frac{\left[strength\ of\ substance\ producing\ hardness\left(\frac{mg}{lit}\right)\right] \times 100}{[\ chemical\ equivalent\ of\ hardness\ producing\ substance] \times 2}$$

For every constituent all of you first calculate the CaCO3 equivalents then add the value of constituents producing temporary hardness and permanent hardness.

Q22. Calculate the requirement of lime and soda for removing hardness of a 20,000 liter hard water sample containing Mg(HCO3)2=73mg/L, Ca(HCO3)2= 162mg/L, MgCl2= 95mg/L, CaSO4=136mg/L.
All of you first calculate the CaCO3 equivalents of hardness producing substance then put the value in following formula-

Lime requirement $= \frac{74}{100}$ [temporary hardness of Ca + 2 × temporary hardness of

Mg + permanent hardness of Mg in terms of CaCO3 equivalents] x Volume (lit)

Soda requirement $= \frac{106}{100}$ [permanent hardness of CaCl2 + CaSO4 + MgCl2 + MgSO4

in terms of CaCO3 equivalents] x Volume (lit)

Q23. Calculate the requirement of lime and soda for removing hardness of a 20,000 liter hard water sample containing Mg(HCO3)2=73mg/L, Ca(HCO3)2= 162mg/L, MgCl2= 95mg/L, CaSO4=136mg/L. Assume the purity of lime as 96% and soda as 97%.

Lime requirement $= \frac{74}{100}$ [temporary hardness of Ca + 2 × temporary hardness of

Mg + permanent hardness of Mg in terms of CaCO3 equivalents] x Volume (lit) x purity factor

Soda requirement $= \frac{106}{100}$ [permanent hardness of CaCl2 + CaSO4 + MgCl2 + MgSO4

in terms of CaCO₃ equivalents] x Volume (lit) x purity factor

If purity of lime is 96% then value of purity factor can be written as = 100/96

Q24. The hardness of 1000 liter of a sample of water was removed by passing it through it zeolite softener. The zeolite softener then required 50 liters of sodium chloride solution containing 2.5 gm/lit of NaCl for regeneration. Find the hardness of water sample.