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Freshman Engineering Department (Chemistry)
I/IV B.Tech A/C Year-2022-23
ENGINEERING CHEMISTRY (R20)
With effect from 2020-21
(Common for all branches)

Course Code - Category: 113/123 Credits: 3
L T P E O Sessional Marks:40
3 0 0 1 4 End Exam Marks:60

UNIT I **12 Periods**

Water Chemistry: Introduction- Impurities in water; Hardness of water – types of Hardness, units and calcium carbonate equivalents, problems, disadvantages of hard water; Boiler troubles- Scale & Sludge formation, prevention- Internal treatment - (Phosphate, Carbonate and Calgon conditioning) , Caustic embrittlement.

Water treatment techniques: Softening of water by ion exchange method- Principle, Process, advantages; Desalination of water – Reverse Osmosis and Eelectrodialysis; WHO standards for drinking water, Municipal water treatment - Sedimentation, Coagulation, Chlorination-Break point chlorination.

Question Bank

Very Short Answers:

1. Define Hardness and mention dissolved impurities responsible for hardness.
2. Distinguish between temporary hardness and permanent hardness.
3. An underground water sample doesn't give lather immediately with soap solution. Give reason.
4. What happens when temporary hard water is boiled? (Give equations)
5. How can you express the hardness of water sample. Give the formula.
6. Mention units of hardness and what do you mean 10ppm, 20mg/L& 15°Fr?
7. List out the various types of impurities in water resources with examples.
8. Sea water has brackish taste. Give reason
9. A water sample collected from Godavari River is highly turbid. Which impurities are responsible for turbidity.
10. Do you suggest a water sample containing 50 ppm hardness for drinking purpose and for high pressure boilers. Mention reason
11. List out various water resources used in and around Visakhapatnam district for industry as well as drinking water purpose.
12. List out major boiler troubles.
13. What is meant by Scale and sludge? Which can be easily removed?
14. Mention the reasons for scale formation.
15. Which chemicals are added during i) carbonate conditioning ii) Phosphate conditioning iii) Calgon conditioning?
16. What is meant by caustic embrittlement?
17. What are the methods available for removal of Scales in boilers?
18. Define i) Softening ii) Desalination iii) Potable water iv) Ion exchange resin
19. Why water must be softened before using in boiler?
20. Among Calgon conditioning and phosphate conditioning which one is advantageous?

21. Mention the reason to express hardness of water in terms of Calcium carbonate equivalent?
22. Among Reverse Osmosis and Electrodialysis which method is preferred for desalination? (Reason)
23. What is meant by Break point chlorination?
24. Name some common coagulants used during coagulation process.
25. How the exhausted resin regenerated in ion exchange method of water softening? Or Mention chemicals used to regenerate ion exchange resins?
26. Do you suggest ion exchange method for water softening of hard water sample before fed into high pressure boilers or not. Give reason.
27. Give the role of Cation exchange resin and Anion exchange resin?

Short answers:

1. Write a brief note on hardness of water with a suitable equation.
   (Or) Why does hard water consume lot of soap.
2. Distinguish between:
   i)hard water and soft water ii) Temporary and Permanent hardness
   iii) Scale and Sludge
3. List out Internal treatment methods to prevent scale formation in boilers? Give the principle involved in this process.
4. What are the disadvantages in scale formation? Explain in detail.
   (Or)
   What are the disadvantages on formation of deposits in steam boilers and heat exchangers?
   (Or)
   Write short notes on (i). Wastage of fuels. (ii). Decrease in efficiency. (iii). Boiler explosion.
5. Why is Phosphate conditioning preferred over Carbonate conditioning?
6. Why is Calgon conditioning preferred to Phosphate conditioning?
7. What is break point chlorination? What is its significance?
8. Write a note on boiler problems (Or) Write a note on Scale and Sludge formation in boilers.
9. Write a short note on caustic embrittlement.
10. What is reverse osmosis? Bring out the methodology behind it.
11. What are Cationic exchange and anionic exchange resins.
12. List out the steps involved in municipal water treatment and mention the significance of each step.
13. Give the principle involved in electrodialysis and Reverse osmosis process. Which one you suggest for desalination among these two processes.

14. Explain coagulation with sedimentation.

15. What is meant by disinfection? Discuss chlorination process in brief.

Essay Questions:

1. What is hardness of water? Mention various units used for its expression and give their relation.

2. List out various methods for scale prevention. Describe Calgon conditioning and Phosphate conditioning.

   (Or)

   Give specifications of boiler-feed water. Discuss methods used for prevention of scales in boilers.

   (Or)

   Give the principle involved in internal treatment process and discuss any two methods to prevent scale formation in boilers.

3. What is meant by demineralization? Describe Ion-exchange or Deionization or Demineralization process of softening of hard water.

   (Or)

   What are ion-exchange resins? Discuss their application in water softening. How are spent resins regenerated?

   (Or)

   What is meant by softening? Suggest a method to soften boiler fed water employed in high pressure boilers. Explain the process with a neat sketch.

4. What is Desalination? Describe desalination of by Reverse Osmosis method with neat Sketch

   (Or)

   Explain the reverse osmosis process for desalination of brackish water in detail.

5. Explain Electro dialysis process to convert brackish water into desalinated water. Give the significance of this process.

6. Give specifications of Potable water. Discuss the treatment of water to be used for drinking purposes.

7. What is meant by disinfection? Discuss break point chlorination.

   (Or)

   Write a note on break point chlorination

8. Write a brief note on: i) Coagulation with sedimentation ii) Desalination iii) Break point Chlorination

Problems:

1. A sample of water is found to contains following dissolving salts in milligrams per litre $Mg(HCO_3)_2$ = 73, $CaCl_2$ = 111, $Ca(HCO_3)_2$ = 81, $MgSO_4$ = 40 and $MgCl_2$ = 95. Calculate temporary and permanent hardness and total hardness.

2. A sample of water is found to contains following dissolving salts in milligrams per litre $Mg(HCO_3)_2$ = 16.8, $MgCl_2$ = 12.0, $MgSO_4$ = 29.6 and NaCl = 5.0. Calculate temporary and permanent hardness of water.

3. A sample of water is found to contains following analytical data in milligrams per litre Mg(HCO3)2 = 14.6, MgCl2 = 9.5, MgSO4 = 6.0 and Ca(HCO3)2 = 16.2. Calculate temporary and permanent hardness of water in parts per million, Degree Clarke's and Degree French.

4. Calculate the amount of temporary and permanent hardness of a water sample in Degree Clarke's, Degree French and Milligrams per Litre which contains following impurities. $Ca(HCO_3)_2$ = 121.5 ppm, $Mg(HCO_3)_2$= 116.8 ppm, $MgCl_2$ = 79.6 ppm and $CaSO_4$ = 102 ppm.

5. Calculate the temporary, permanent and total hardness of water in ppm having the following composition. Ca2+ = 200 ppm, Mg^{2+}= 96 ppm, HCO_3^- = 976 ppm, Cl- = 146 ppm and SO4 2- = 96 ppm, Na+ = 112 ppm?

6. Calculate the temporary, permanent and total hardness of water in ppm having the following composition. Ca(HCO3)2 = 4ppm, Mg(HCO3)2 = 6 ppm, CaSO4 = 8ppm, MgSO4 = 10 ppm and Na HCO3 = 3 ppm?

Activity Topics: (For Advanced Learners)

1.WHO (World health organization) Guidelines to drinking water Quality (GDWQ)

2. Municipal Water treatment plants in India.

3. Advanced Technologies in water purification

4. Drinking water treatment process

5. Desalination plants in India

6. Drinking water quality in rural India: Issues & problems- A case study

7. Boiler Feed Water treatment for Industrial Boilers and Power Plants

8. The disinfection of drinking water

9. Water treatment in Remote and Rural areas: a conceptual screening protocol for appropriate Point of Use (POU) / Point of Entry (POE) technologies

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