WATER TECHNOLOGY

Hardness of water: TUTORIAL-I

1. The maximum desirable limits (as per BIS) of total hardness (as $CaCO_3$) in drinking water is
   a. **600 ppm** b. 300 ppm c. 500 ppm d. 1000 ppm
2. Temporary hardness of water is caused by the presence of
   a. Chlorides of calcium and magnesium b. Sulfates of calcium and magnesium
   c. **Bicarbonates of calcium and magnesium** d. Carbonates of calcium and magnesium.
3. Permanent hardness in water is caused by the presence of
   a. Bicarbonates of calcium and magnesium
   b. Carbonates of sodium and potassium
   c. Chlorides of sulfates and calcium and magnesium
   d. Phosphates of sodium and potassium
4. Hardness in water is caused due to the presence of
   a. Undissolved salts of Ca^{2+} and Mg^{2+}
   b. Dissolved sulfates of Potassium
   c. Dissolved salts of Ca^{2+} and Mg^{2+}
   d. Undissolved $CaCO_3$
5. Hardness of water is expressed in equivalents of
   a. **$CaCO_3$** b. $MgCO_3$ c. $Ca(HCO_3)_2$ d. $Mg(HCO_3)_2$
6. Estimation of hardness of water by EDTA method is used to determine
   a. Alkaline hardness b. temporary hardness only
   c. Permanent hardness only d. **all the above**
7. One part of $CaCO_3$ equivalent hardness per 10^5 parts of water is called
   a. Degree Clarke b. ppm c. **degree French** d. mg /L
8. A water sample found to possess 16.2 mg/L of $Ca(HCO_3)_2$. Its hardness in terms of $CaCO_3$ equivalents is
   a. 100 b. **10** c. 16.2 d. 1000
9. The hardness of water sample is 10 ppm, which can be expressed as _____ degree Clarke. **ANS: 0.7**
10. The hardness of water in $CaCO_3$ equivalents containing $MgSO_4$ (Mol. Wt = 120) with concentration of 12 mg/ L is _____. **ANS: 10 mg/L**
11. Hardness of water is measured in _____. **ANS: ppm**
12. A of sample water contains 11.1 mg/L of $CaCl_2$. Its hardness in $CaCO_3$ equivalents is _____. **ANS: 10 ppm**
13. _____ is used as an indicator in the determination of hardness of water by EDTA method is. ANS: **Erio Chrome Black – T**

14. To maintain the pH between 9 – 10 during complexometric titration, estimation of hardness of water is _____. **ANS: NH_4OH, NH_4Cl.**
15. Which of the following salts cause least hardness to water when converted to CaCO3 equivalents?
    a. 10 mg of $CaCO_3$ **b. 19 mg of $CaSO_4$** c. 10 mg of $MgCl_2$ d. 10 mg of $CaCl_2$
16. Hardness of water does not
    a. Have any bad effect in boiler b. make cooking of food difficult
    c. **Make it unfit for drinking** d. cause difficulty in washing clothes with soaps.
17. Hard water is unfit for use in boilers for generating steam because
    a. Its boiling point is high
    b. Hard water does not produce lather inside boiler
    c. Water decomposes into O_2 and H_2
    d. **It produces scales inside the boiler**
18. **T**he soft, loose and slimy precipitate formed within the boiler is called
    a. Scale **b. sludge** c. embrittlement d. coagulation
19. **Solubility** of calcium sulphate in water is
    a. Increase with rise of temperature
    b. Decreases with rise of temperature
    c. Remains unaltered with rise of temperature
    d. Does not adopt any definite pattern with rise of temperature.
20. Blow – down operation cause the removal of
    a. **Scales** b. sludges c. acidity d. sodium chloride
21. Sodium meta aluminate used in internal treatment of boiler water produces flocculant precipitates of
    a. **$Mg(OH)_2$ and $Al(OH)_3$** b. NaOH and $Al(OH)_3$
    b. $Ca(OH)_2$ and $Al(OH)_3$ d. $Mg(OH)_2$ and $Ca(OH)_2$
22. **One** of the following chemical acts as both coagulant and softening agent
    a. Lime b. soda c. soda **d. sodium aluminate**
23. The composition of alum is
    a. **$K_2SO_4.Al_2(SO_4)_3.24H_2O$** b. $K_2(SO_4)_3.Al_2(SO_4)_3.24H_2O$
    c. $K_2SO_4.Al_2(SO_4)_3.20H_2O$ d. $K_2SO_4.Al_2SO_4.24H_2O$
24. Phosphate conditioning of boiler feed is carried out by
    a. **Na_3PO_4** b. $Ca_3(PO_4)_2$ c. $Mg_3(PO_4)_2$ d. H_3PO_4
25. The chemical which removes dissolved oxygen of water without adding hardness is _____.
    ANS: Hydrazine
26. Sodium aluminate is used as _____ during purification of water. **ANS: Coagulant**
27. Calgon treatment is used for the removal of dissolved _____. **ANS: $CaSO_4$.**
28. $Al_2(SO_4)_3$ in alum produce _____ as flocculant precipitates during softening of water.
    ANS: $Al(OH)_3$.
29. Calgon is used for the removal of
    a. Sodium carbonate **b. permanent hardness of water**
    c. Hardness of water d. none of these

30. Permanent hardness can be removed by the addition of
    a. Lime b. soda ash c. potassium permanganate d. sodium bicarbonate
31. Which of the following chemical is sometimes added in the process of coagulation and flocculation.
    a. **Aluminum sulphate** b. Aluminium oxide
    c. Calcium chloride d. none of these
32. Calgon is the trade name given to
    a. Sodium silicate **b. Sodium hexa meta phosphate**
    c. Sodium meta phosphate d. Calcium phosphate
33. Boiler corrosion caused by using high alkaline water in a boiler is called
    a. Corrosion b. boiler corrosion c**. caustic embrittlement** d. erosion
34. Caustic embrittlement is a type of
    a. **Boiler corrosion** b. conditioning c. scale formation d. sludge formation.
35. Caustic embrittlement can be avoided by using
    a. **Sodium phosphate** b. hydrogen c. ammonium hydroxide d. sodium sulphate
36. The process of wet steam formation is called
    a. Foaming **b. priming** c. corrosion d. caustic embrittlement.
37. Mechanical steam purifiers avoid
    a. Corrosion b. Priming c. scale formation d. sludge formation
38. Castor oil is a
    a. Ant skinning agent b. anti-foaming agent c. anti – ageing agent d. anti – corrosive agent
39. The coefficient of thermal expansion of boiler plant is
    a. More than boiler scale b. less than boiler scale
    c. Equal to boiler scale d. no relation between the two.
40. Presence of residual _____ in boiler water causes caustic embrittlement. **ANS: NaOH**
41. Priming and foaming in boiler produce _____ steam. **ANS: wet**
42. Calgon treatment is used for the removal of dissolved _____. **ANS: $CaSO_4$**
43. The presence of even small amounts of MgCl2 will cause _____ of boiler plate to a large extent. **ANS: Corrosion.**
44. **When** temporary hard water is boiled, one of the substance formed is
    a. CaCO3 b. CaSO4 c. HCl d. CO2
45. Temporary hardness in water is removed by
    a. Filtration b. Sedimentation **c. Boiling** d. coagulation.
46. **T**he maximum permissible limit (BIS) of turbidity in drinking water is
    a. 5 NTU b. 10 NTU c. 15 NTU d. 20 NTU.
47. Hard water can be softened by passing it through
    a. Lime stone b. sodium hexa meta phosphate
    c. Ion – exchange resin d. sodium silicate
48. The external treatment of boiler feed water is done by
    a. **Lime – soda process** b. sodium sulphate treatment
    b. Calgon process d. sodium aluminate treatment.
49. The ion – exchange resins used for softening water are

a. Cross linked polymers with micro porous structure

b. Branched polymers with porous structure

c. Cross linked polymers with non-porous structure

d. Branched polymers with non – porous structure

50. One of the following is an example for cation exchanging resin

a. Copolymer of phenol formaldehyde – amine formaldehyde

b. Copolymer of styrene – divinyl benzene

c. Copolymer of phenol formaldehyde and styrene

d. Copolymer of amine formaldehyde and divinely benzene

51. Best method for removing hardness of water is _____ process.

ANS: Ion – exchange Process

52. Anion exchange resins are regenerated by using _____. **ANS: NaOH**

53. In lime soda process the addition of lime cannot remove _____ hardness in water.

ANS: Permanent calcium

54. Cation exchange resin contains _____ mobile ions. **ANS: H^+**

55. The chemical formula of zeolite is _____. **ANS: $Na_2O.\ Al_2O_3.nSiO_2.yH_2O$**

56. Natrolite is a _____ zeolite. **ANS: Natural**

57. Ion free water is known as _____. **ANS: Deionized or Demineralized water**

58. The exhausted zeolite is regenerated by _____. **ANS: NaCl.**

59. Among the dissolved gases _____ is the most corroding impurity. **ANS: Oxygen.**

60. The exhausted anion exchange resin is regenerated by _____. **ANS: NaOH**

61. Zeolites are _____. **ANS: Cation ion exchangers**

62. A copolymer of _____ or _____ is use as anion exchange resin.

ANS: Phenol formaldehyde or amine formaldehyde.

63. Deionization must be followed by _____. **ANS : Degasification**

64. Steam turbines convert _____ energy to rotary motion. **ANS: Thermal / Heat**

65. A turbine is rotary mechanical device that extracts energy from a _____. **ANS: Fluid flow.**

66. Uneven deposition of turbines causes

a. Vibrational problems

b. Heat problems

c. Power problems

d. Uncontrolled cooling.

67. Zeolite softening process removes

a. Only temporary hardness of water

b. Only permanent hardness of water

c. Both temporary and permanent hardness of water

d. The dissolved gases in permanent hard water.

68. Zeolite used in zeolite softening process for the treatment of hard water gets exhausted after certain time of usage but can be regenerated by flushing it with

a. 10% calcium chloride solution b. 10% Magnesium Chloride solution

c. 10% Magnesium sulphate solution **d. 10% sodium chloride solution**

69. Which of the following physical method is used as germicidal in modern time for the treatment of drinking water?
    a. Chlorination b. Treating with Potassium permanganate
    c. **UV radiation** d. Treating with Bleaching powder
70. The common methods used for disinfection in waste water treatment plants are
    a. Chlorination b. UV light **c. Both a & b** d. Phenolic solvent
71. Which of the following substances are commonly used in a filter?
    a. Charcoal b. Sand **c. both a & b** d. Aluminium Chloride
72. Biological oxidation processes usually referred as biological treatment, are the most common form of
    a. Primary treatment **b. secondary treatment**
    c. Tertiary treatment d. all of the above
73. Liquid chlorine is a most effective
    a. **Disinfectant** b. coagulant c. floculant d. sterilizing agent
74. Disinfection by ozone is due to liberation of
    a. Oxygen **b. nascent Oxygen** c. Molecular Oxygen d. oxide
75. The process of allowing water to stand undisturbed in big tanks for settling of the suspended particles due to force of gravity
    a. Coagulation b. conditioning **c. sedimentation** d. screening
76. The formula of chloramine is
    a. **ClNH2** b. NHCl2 c. NCl3 d. NH2Cl2
77. Ultraviolet rays are used in the treatment of water for
    a. Filtration b. Sedimentation c. Screening **d. Sterilization.**
78. Chlorine when treated with water produce _____ acid, which acts as a powerful gerimicide.
    ANS Hypochlorous acid
79. Brackish water mainly contains
    a. Calcium salts b. Magnesium salts c. Turbidity **d. sodium chloride**
80. The method by which ions are pulled out of salt water by direct current, and employing thin and rigid membrane is called
    a. **Electrodialysis** b. reverse osmosis
    c. Zeolite d. ion exchange
81. The purification of brackish water y reverse osmosis is also called as
    a. **Super – filtration** b. Supra – filtration
    c. Hypo – filtration d. filtration
82. Which of the following methods separates ionic and non – ionic impurities from water?
    a. Electrodialysis b. deionization **c. reverse osmosis** d. zeolite process
83. The membrane filtration adopted in reverse osmosis is also called as __. **ANS Super filtration**