

PROCESS TECHNOLOGY-**INORGANIC-I**

- Commercially produced nitric acid is available in concentration from:
(a) 22 to 42 %, (b) 33 to 50 %, (c) 52 to 69 %, (d) 52 to 99 %
- Which of the following grades of nitric acid is described as —fuming||
(a) acid over 63 % concentration, (b) acid over 72 % concentration, (c) acid over 86 % concentration, (d) acid over 98 % concentration
- Hydrochloric acid is available in four concentrations ranging from:
(a) 12 to 31 %, (b) 27 to 37 %, (c) 43 to 66 %, (d) 71 to 95 %
- Reagent grade hydrochloric acid is normally:
(a) 22.3 % acid, (b) 37.1 % acid, (c) 43.7 % acid, (d) 59.2 % acid
- Which of the following acids is the largest volume inorganic acid in the present day ?
(a) Sulfuric acid, (b) Perchloric acid, (c) Nitric acid, (d) Hydrochloric acid
- Which of the following catalysts is employed for converting SO₂ to SO₃ in the contact process for sulfuric acid manufacture ?
(a) P₂O₅, (b) V₂O₅, (c) N₂O₅, (d) PCl₅
- In the contact process for sulfuric acid manufacture, the feed gas entering the converter (where SO₂ is oxidized to SO₃) contains :
(a) 0.1 to 1% sulfur dioxide, (b) 7 to 10% sulfur dioxide, (c) 20 to 30% sulfur dioxide, (d) 60 to 70% sulfur dioxide
- Nitric acid is chiefly produced all over the world by the ammonia oxidation route. Catalyst used for oxidation of ammonia to nitric oxide is –
(a) γ - alumina, (b) Iron, (c) Platinum – rhodium, (d) Nickel
- There are two industrial processes for sulfuric acid manufacture : contact process and chamber process. Chamber process was developed first, in the year 1746, but the process produced acid of concentration ;--
(a) Less than 10%, (b) Less than 30%, (c) Less than 60%, (d) Less than 80%
- Raw materials for the production of urea are –
(a) Carbon dioxide and brine, (b) Carbon dioxide and ammonia, (c) Carbon disulfide and ammonia, (d) Carbon disulfide, brine and ammonia
- Catalyst employed for ammonia manufacture from syngas is –
(a) platinum – rhodium, (b) alpha – alumina, (c) silica – alumina, (d) Iron oxide promoted by potassium oxide and aluminum oxide
- Raw materials for the production of urea are –
(a) carbon dioxide and sodium chloride, (b) carbon dioxide and ammonia, (c) ammonia and carbon disulfide, (d) Sodium chloride, ammonia and carbon disulfide
- Catalyst employed for ammonia manufacture from syngas (nitrogen and hydrogen) is

(a) platinum – rhodium alloy, (b) alpha – alumina,
(c) silica – alumina, (d) iron oxide promoted by potassium oxide
and alumina.

14. Dowtherm —A|| is

- (a) a 50 : 50 mixture of m – and p – xylenes,
- (b) trade name of an aromatic mineral oil,
- (c) an eutectic mixture : 73.5% diphenyloxide and 26.5% diphenyl,
- (d) none of the foregoing,

15. Hot fluids (employed for heating purpose) most widely used in chemical process industries in the temperature range of 100OC to 500OC are –

- (a) Steam, (b) aromatic mineral oils or molten salts
- (c) the eutectic mixture : 73.5% diphenyl oxide and 26.5% diphenyl,
- (d)all of the foregoing,

16. The practical range of use of water as heat transfer fluid (both for cooling and heating) in chemical process industries is limited to the range between –

- (a) –40 oC and 100 oC, (b) 0 oC and 100 oC,
- (c) 20 oC and 200 oC, (d) 100 oC and 200 oC,

17. Chemical formulae for Refrigerant 12 and Refrigerant 21 are –

- (a) CCl₂F₂ and CHCl₂F, (b) CHCl F₂ and CHCl₂F,
- (c) CH₂ClF and CCl₂F₂, (d) CHCl₂F and CCl₂F₂,

18. In nuclear industry heating is provided by –

- (a) direct flame (combustion of flue gases),
- (b) electricity, (c) heat transfer from Dowtherm —A||
- (d) heat transfer from molten alkali metals.

19. Hardness of water is of two kinds : Temporary hardness and permanent hardness.

Temporary hardness is caused by the presence of –

- (a) Soluble bicarbonates of calcium, magnesium and iron,
- (b) Soluble chlorides of calcium and magnesium,
- (c) Soluble sulfates of calcium and magnesium,
- (d) Soluble bicarbonates of sodium and potassium,

20. Permanent hardness is caused by the presence of –

- (a) insoluble carbonates of calcium and magnesium,
- (b) soluble chlorides or sulfates of calcium and magnesium,
- (c) all of the foregoing,

21. Temporary hardness can be easily removed by boiling hard water because in this process:

- (a) Soluble bicarbonates of calcium and magnesium decompose and produce insoluble carbonates which can readily be filtered and removed,
- (b) Soluble bicarbonates are converted to gaseous products and they leave water as it is heated.
- (c) Soluble bicarbonates form some kind of soluble complex which, although present in water, does not interact with soap.
- (d) I do not agree with the statement of the question; temporary hardness cannot be removed by boiling.

22. Total hardness of water can be determined by titrating hard water against –

- (a) Dilute sulfuric or hydrochloric acid solution,

- (b) Dilute phosphoric acid solution, (c) Sodium sulfite solution,
(d) Solution of disodium salt of ethylene diamine tetra-acetic acid,
23. In the determination of total hardness of water by titrating hard water with a solution of sodium salt of EDTA, indicator used is –
(a) methyl orange, (b) phenolphthalein,
(c) B-naphthol, (d) Solochrome Black T
24. Lime – soda treatment of hard water :
(a) removes only temporary hardness,
(b) removes only permanent hardness,
(c) removes both temporary and permanent hardness,
(d) adjusts the pH of water; removes neither temporary nor permanent hardness.
25. Versene is --
(a) another name of Solochrome Black T indicator,
(b) the trade name of sodium hypochlorite solution,
(c) the trade name of sodium hexametaphosphate,
(d) the disodium salt of ethylene diamine tetra-acetic acid.
26. Most sea water contains approximately :
(a) 0.5% dissolved sodium chloride, (b) 2.6% dissolved sodium chloride,
(c) 7.5% dissolved sodium chloride, (d) 19.7% dissolved sodium chloride,
27. Fluorspar is—
(a) Ca F_2 , (b) $\text{Na}_3 \text{Al F}_6$,
(c) $\text{Ca F}_2, 3 \text{Ca}_3 (\text{PO}_4)_2$, (d) Anhydrous HF,
28. The percentage available chlorine in a good commercial sample of bleaching powder is
(a) 15 to 17 %, (b) 35 to 37 %, (c) 53 to 56 %, (d) 69 to 71 %,
29. Raw materials for production of soda ash by standard Solvay process are –
(a) ammonia and sodium chloride, (b) carbon dioxide and sodium chloride,
(c) carbon dioxide, ammonia & sodium chloride, (d) none of the above,
30. Carbon dioxide required in the Solvay process is obtained by
(a) burning 100% pure coke, (b) burning coal,
(c) by heating limestone, (d) by heating magnesium bicarbonate,
31. Principal constituents of rock phosphate is / are
(a) calcium chloride, calcium carbonate and phosphorous pentoxide,
(b) calcium fluoride and di-ammonium phosphate,
(c) tricalcium phosphate, calcium fluoride and calcium carbonate,
(d) ammonium nitrate, calcium fluoride and phosphorous pentoxide,
32. Rock phosphate used for industrial production of phosphoric acid should contain at least
(a) 5 % P_2O_5 , (b) 12 % P_2O_5 ,
(c) 20% P_2O_5 , (d) 30 % P_2O_5 ,
33. There are variations in the wet process phosphoric acid manufacture depending on the extent of hydration of the calcium sulfate crystals formed during the digestion. The calcium sulfate can be --
(a) anhydrite, Ca SO_4 (b) dihydrate, $\text{Ca SO}_4 \cdot 2 \text{H}_2\text{O}$,
(c) hemihydrate, $\text{Ca SO}_4 \cdot \frac{1}{2} \text{H}_2\text{O}$, (d) all of the above

34. Which of the following processes produces phosphoric acid of the highest concentration?

- (a) Dihydrate route, (b) Hemihydrate route, (c) Anhydrite route, (d) All (a), (b), (c) produce phosphoric acid of the same concentration.

35. Below are given the different routes for wet process phosphoric acid production and the temperatures at which rock phosphate is digested with sulfuric acid in different routes. Select the correct process – temperature combination.

Route : Digestion temperature

- (i). Dihydrate, a. 120 to 130 °C,
(ii). Hemihydrate, b. 70 to 75 °C,
(iii) Anhydrite, c. 100 °C,

36. Thermal process (dry process) produces phosphoric acid of –

- (a) superior quality compared to wet process,
(b) inferior quality compared to wet process,
(c) the same quality as that obtained in wet process,

37. In the normal contact process for sulfuric acid manufacture, sulfur dioxide to sulfur trioxide conversion efficiency is around –

- (a) 20 % (b) 50 %, (c) 75 %, (d) 98 %,

38. In the double absorption double catalyst process for sulfuric acid production, sulfur dioxide to sulfur trioxide conversion efficiency is more than that in the normal contact process and is equal to –

- (a) 98.1 %, (b) 98.5 %, (c) at least 99.5 %, (d) 100 %,

39. In contact process, sulfur dioxide required can be produced either by burning elemental sulfur or by roasting iron, copper or zinc pyrites. In India the majority of sulfuric acid plants still use –

- (a) elemental sulfur, (b) iron pyrites, (c) zinc pyrites, (d) copper pyrites,

40. Molten sulfur has minimum viscosity in the temperature range between –

- (a) 120° and 125 °C, (b) 130° and 140 °C, (c) 150° and 155 °C, (d) none of the above,

(Note that molten sulfur is pumped from the sulfur storage tank to the sulfur burner at temperatures at which the viscosity of molten sulfur is minimum)

41. In the contact process the catalyst loading per tonne of 100% sulfuric acid per day in the converter (where sulfur dioxide to sulfur trioxide conversion occurs) is of the order of –

- (a) 0.01 m³ of V₂O₅, (b) 0.05 m³ of V₂O₅, (c) 0.1 m³ of V₂O₅, (d) 0.2 m³ of V₂O₅,

42. The linear velocity of gas over the catalyst bed in the sulfur dioxide to sulfur trioxide converter is around –

- (a) 0.1 to 0.25 m/s, (b) 0.4 to 0.55 m/s, (c) 0.75 to 0.90 m/s, (d) 1.8 to 2.5 m/s,

43. Commercial catalyst used for sulfuric acid manufacture contains approximately –

- (a) 6.2 to 6.5% vanadium pentoxide supported on silica and 1% potassium sulfate,

(b) 25% vanadium pentoxide supported on silica and 1% potassium sulfate,

(c) 50% vanadium pentoxide and 50% potassium sulfate mixture (by weight),

(d) 100% pure vanadium pentoxide,

44. Oxidation of ammonia with air in presence of 90% platinum – 10% rhodium catalyst in the converter constitutes the first step in industrial production of nitric acid. The feed gas to the converter contains around –

(a) 1 to 2% ammonia in air, (b) 10 to 12% ammonia in air,

(c) 40 to 50% ammonia in air, (d) 70 to 80% ammonia in air,

45. Extent of oxidation of ammonia to nitric oxide in the converter (in nitric acid manufacture) is usually around –

(a) 10 to 15% (conversion) (b) 25 to 30 %,

(c) 50 to 60 %, (d) 97 to 98 %,

46. The rate-limiting step in the ammonia oxidation reaction (in nitric acid manufacture) is –

(a) diffusion of oxygen from the bulk gas phase to the Pt-Rh catalyst surface,

(b) diffusion of ammonia from the bulk gas phase to the Pt-Rh catalyst surface,

(c) diffusion of product nitric oxide from the Pt-Rh catalyst surface into the bulk gas phase,

(d) surface reaction between ammonia and oxygen on the catalyst,

47. In nitric acid production by ammonia oxidation process, ammonia to nitric oxide conversion occurs in presence of Pt-Rh gauze catalyst of platinum and rhodium,

(a) platinum acts as catalyst and rhodium increases the strength of the gauze and its resistance to erosion

(b) rhodium acts as catalyst,

(c) platinum imparts strength to the gauze and increases its resistance to erosion,

48. Contact time between the gas and the catalyst gauze in the converter for ammonia to nitric oxide oxidation in the nitric acid manufacturing plant is important, contact time is determined by the gas flow rate through the converter. Optimum gas flow rate is that which provides contact time of around –

(a) 0.25 ms, (b) 0.1 to 0.2 S,

(c) 1 to 2 S, (d) 10 to 20 S,

49. In nitric acid manufacturing process, nitric oxide from the converter is passed into the absorber where oxidation of NO to NO₂ and absorption of NO in water to produce HNO₃ occur, Nitric acid obtained from the absorber is in the concentration range of –

(a) 10 to 15 %, (b) 25 to 35 %,

(c) 50 to 70 %, (d) 85 to 92 %,

50. Other than sulfuric acid which of the following chemicals is used commercially to concentrate nitric acid ?

(a) potassium nitrate solution, (b) calcium chloride solution,

(c) anhydrous sodium sulfate, (d) magnesium nitrate solution,

Answers:

1d,2c,3b,4b,5a,6b,7b,8c,9d,10b,11d,12b,13d,14c,15d,16c,17a,18d,19a,20b,21a,22c,23d,24c,25d,26b,27a,28b,29c,30c,31c,32d,33d,34c,35ib,iic,iiia,36a,37d,38c,39a,40b,41d,42c,43a,44b,45d,46b,47a,48a,49c,50d.