IRON MAKING

(MULTIPLE CHOICE QUESTIONS)

1. Limestone is added in the blast furnace

(during pig iron manufacture) to

(a) form slag by combining with impurities.

(b) supply heat by undergoing exothermic reaction with impurities.

(c) reduce the coke consumption.

(d) none of these.

2. Coke is added in iron blast furnace to

(a) reduce & melt the iron ore.

(b) increase the fluidity of the slag.

(c) remove sulphur & phosphorous from molten metal.

(d) none of these.

3. The diameter of the blast furnace is the maximum at the

(a) hearth

(c) stack

(b) bosh

(d) throat

4. Blast furnace slag is mainly molten

(a) sand (b) magnesium silicate

(c) calcium silicate (d) iron pyrite

5. The main reducing agent in blast furnace is

(a) air

(b) carbon monoxide

(b) hydrogen

(d) limestone

6. Dust content in raw B.F. gas is about gm/Nm3, hence it is cleaned to the level of about <10 mg/Nm3.

(a) 15-30

(c) 70-100

(b) 1-2

(d) 150-200

7. In the top portion of the stack of shaft of the blast furnace, the

(a) burden material is completely in solid form.

(b) melting of the burden (except coke) takes place.

(c) gangue & flux combine to form the slag.

(d) iron oxide reduction just starts.

8. The value of an iron ore is drastically reduced by the presence of ,

(a) lime & magnesia (b) alumina

(c) alkali oxides (d) both b & c

9. The approximate height of a blast furnace having a useful volume of 2000 m3 is about .....metres.

(a) 20

(c) 60

(b) 35

(d) 80

10. Blast furnace coke should contain a maximum of 2% of

(a) volatile matter

(c) ash

(b) phosphorous

(d) sulphur

11. The height of blast furnace stoves meant for

supplying hot blast at 1000°C to the blast furnace of 2000 m3 useful volume is about ..... metres.

(a) 15

(c)45

(b) 25

(d) 65

12. Chief source of sulphur in the blast furnace is

(a) iron ore (b) coke

(c) sinter (d) limestone

13. Maximum height of the modern blast furnace is decided mainly by the

(a) strength of the coke available.

(b) maximum wind rate to be blown

(c) production capacity of the blast furnace.

(d) maximum hot blast temperature to be used.

14. The production rate of the blast furnace is directly determined by the rate of reduction of iron oxide & rate of heating of the descending burden, which in turn depends on the degree & time of contact of the gases with the burden in the region which, is a diffusion controlled counter-current gas-solid reactor.

(a) bosh (b) throat

(c) hearth (d) stack

15. Optimum size range of iron ore lump to be charged in B.F is 10-30 mm. Charging of too large size ore lump will result in increased

(a) productivity of B.F.

(b) total demand of heat.

(c) flow of unreduced material down the stack into the tuyere area.

(d) both b & c.

16. Pick out the wrong statement pertaining to efficient blast furnace operation leading to its high productivity. For achieving optimum level of productivity in B.F., the

(a) Alp/Fe ratio ofburden should be< 0.05.

(b) Al20 /SiO 2 ratio of the burden should be <l.

(c) iron content of the ore should be above60%.

(d) Sinter in the burden should be maximum

50%.

17. Which of the following is not an objective of sintering process ?

(a) To incorporate flux in the burden.

(B) To increase the size of iron ore fines to form a strong agglomerates with high bulk reducibility.

(c) To convert Fe of iron ore to FeO, which has better reducibility.

(d) To remove volatiles like C02 from carbonates , sulphur from sulphides & H2 0 from hydroxides.

18. Binder used for making stronger pellets of iron bearing material is

(a) bentonite (b) tar

(c) lime (d) pitch

19. Desulphurisation in blast furnace is not favored by

(a) raising the hearth temperature.

(b) making the slag acidic in nature.

(c) having higher basicity of the slag.

(d) increasing the slag volume.

20. Pick out the wrong statement about the use of pellets in the blast furnace charge.

(a) The swelling properties of pellets is a result of transformation of hematite to magnetite during reduction.

(a) Size degradation of pellets during transportation is much less than that of sinter.

(c) Excessive swelling of pellets improves its crushing strength & permeability of the blast furnace burden.

(d) Pellets with more than 40% swelling should not be used in B.F burden, how• ever pellets with less than 20% swelling can be used upto 70% in the B.F. burden.

21. Silicon & sulphur content in the pig iron produced in the blast furnace does not depend upon the

(a) furnace operating temperature

(b) blast pressure (c) slag volume (d) slag basicity

22. For reasons of poor off take of pig iron to the steel melting shop because of its shutdown/breakdown, the production rate of blast furnace is reduced by reducing the blast input. If the blast is reduced to a value less than percent of the normal value. the technique is termed as the fanning.

(a) 10 (b) 25

(c) 50 (d) 75

23. Hanging in a blast furnace does not take place because of the

(a) use of larger average size of the burden materials, particularly coke.

(b) condensation of alkali oxide vapor in the upper part of the stack, thereby cementing the charge into an impervious mass.

(c) carbon deposition (due to Neumann reversal reaction) in voids in the stack resulting in decrease in burden permeability .

(d) solidification of previously fused slag in bosh particularly in sinter, into a large impervious mass.

24. Scaffold is a large mass of material that gets stuck to the blast furnace wall, a single, block particularly in the top portion of the bosh. Formation tendency of scaffold is not due to the

(a) presence of high amount of alkali oxides in the burden.

(b) presence of chlorides or other com•

pounds of alkali metals in the burden,

(c) sudden lowering of the fusion zone ad•

jacent to the wall.

(d) increasing refractoriness of the slag.

25. Scaffold formation tendency in the blast furnace can be reduced by reducing the

(a) alkali content of the burden,

(b) coke rate in the furnace,

(c) flux content in the burden.

(d) heavy burden charging.

26. Scaffolding in a blast furnace does not cause

(a) uneven movement of the burden.

(b) rise in blast pressure.

(c) decrease in furnace output.

(d) decrease in coke consumption rate.

27. Chilled hearth in the blast furnace is not caused by the

(a) excessive humidification of the blast.

(b) leakage of water from the tuyers.

(c) lower coke input in the furnace.

(d) higher blast pressure.

28. The ratio of the density of the pig iron to that of the blast furnace slag is

(a) 1.5 (b) 3

(c)5.5 (d)8.5

29. Rate of reduction of iron oxide in the blast furnace is

(a) slower in case of hematite as compared to magnetite.

(b) reduced by the presence of associated gangue oxide.

(c) more, if the temperature of the out going blast furnace gas is more.

(d) not a diffusion controlled gas-solid reaction.

30. Pick out the wrong statement pertaining to the use of sinter in the blast furnace.

(a) Acid sinter does not contain flux at all.

(b) In case of fluxed sinter, the basicity of the sinter mix is equal to that of the slag to be produced in the blast furnace.

(c) In case of super fluxed sinter, the basicity of the sinter mix is more than that of the slag to be produced in the blast furnace.

(d) A blast furnace can not operate on < 80 % of fluxed sinter in the burden.

31. Hot blast enters the blast furnace through the tuyers at a velocity of about metre/ second at a gage pressure of 2-4 kg/cm2.

(a)l0-20

(b)50-60

(c) 200 - 300

(d) 1000- 1500

32. Backward direction of the solution loss reaction in a blast furnace e.g., 2CO = C +

is known as the reaction.

(a) Boudouard

(b) Neumann reversal

(c) shift conversion

(d) gasification

33. Sensible heat of the blast provides about ..... percent of the total process heat required in a blast furnace.

(a) 10 (b) 30

(c) 60 (d) 80

34. Which of the following portion of blast furnace is not lined with fireclay bricks ?

(a) Stack

(b) Bosh

(c) Hearth bottom

(d) Throat

35. Volume of the blast furnace slag is about ..... times that of the hot metal (pig iron) of the same weight.

(a) 1.5 (b) 3 (c)6 (d)8

36. Hanging in a blast furnace can not be controlled by

(a) reducing the concentration of alkali chlorides in the burden.

(b) reducing the hot blast pressure & temperature.

(c) blowing down the furnace to the bosh level & filling it with coke blank.

(d) charging large size limestone to facilitate improvement of bed permeability by generating co2 upon its dissociation, which in turn forces the solution less reaction to take place.

37. Burden slipping in the blast furnace i.e .. sudden sinking of the stock caused by collapse of the hanging/wedging/ scaffold etc., may

(a) be due to the bad bosh design.

(b) cause heart h chilling or even explosion in severe cases.

(c) be controlled by adjustment of blast pressure & temperature.

(d) all a, b & c.

38. Formation of cold central column of the stock with an annular hot zone all around it in a B.F is known as pillaring, which can be eliminated by

(a) increasing the blast pressure, which will penetrate more & heat up the pillar.

(b) increasing the coke input in the furnace.

(c) increasing the wind blowing rate in the furnace.

(d) increasing the hot blast temperature

39. Preferential flow of ascending gases through certain areas of burden, because of their relatively much better permeability is termed as channeling, which

(a) may cause coke ejection through metal tap hole.

(b) is caused by wide size range & improper distribution of the burden in the B.F.

(c) reduces the effective cross-section of the furnace for gas-solid interaction and thereby decreases the B.F. productivity directly.

(d) both b & c.

40. Pick out the wrong statement pertaining to blast furnace operation.

(a) An increase in the bosh gas flow prevents

the liquid metal/slag flow downwards through the permeable coke bed causing it to accumulate in the coke interstices. If the weight ofthe liquid overcomes the upward thrust of the gases & descends suddenly into the hearth, the phenomenon is known as flooding.

(b) Flooding in the blast furnace can be

minimised by using higher mean size ofthe coke.

(c) Coke ejection through the tap hole of

the B.F. can be remedied by its uniform blowing.

(d) Blast furnace hearth breakout may be

caused by the chilling of hearth due to low coke input.

41.Pig iron production rate of the blast furnace is directly not determined by the rate of

(a) heating of the burden

(b) burden descent velocity

(c) reduction of iron oxide

(d) all a, b and c

42. All the solid material present in the blast furnace hearth and bosh is

(a) flux (b) iron ore lump

(c) coke (d) gaunge

43 While the process of stopping the blast furnace operation at the end of its com-paign is termed as blowing out; the temporary shutdown of blast furnace is called

(a) back-draughting

(b) banking

(c) drying

(d) salamander tapping

44. In external ladle de-seliconisation of big iron (hot metal) by oxygen lancing depends upon the amount of flux bath temperature and rate and quantity of oxygen blown. The find level of silicon achieved after ladle de-seliconisation is percent.

(a) 0.1-0.15 (b) .0.30 - 0.50

(c) 0.60-0.80 (d) 0.80-1.0

45. The elastic limit of cast iron is close to its ultimate breaking strength. High silicon (14%) cast iron has an important property of high

(a) hardness

(c) tenacity

(b) brittleness

(d) plasticity

46.Oxygen enrichment of hot blast in the blast furnace results in

(a) less B.F. gas yield.
(b) higher hearth temperature.
(c) larger concentration of CO in the furnace.
(d) all (a), (b) & (c).

47. High top pressure operation of blast furnace results in

(a) suppression of dissociation of carbon monoxide.
(b) increase in upward gas velocity in the furnace.
(c) more loss of iron ore, sinter and coke fines in outgoing B.F. gas.
(d) none of these.

48.Basicity of super-fluxed sinter is
(a) 0 (b) 1
(c) <l (d) > 1

49. Which ofthe following is not removed from the charged material in the blast furnace?
(a) Sulphur (b) Gaunge
(c) Phosphorous (d) Alumina

50. Basicity of acidic sinter is
(a)> 4 (b) 1

(c) < 1 (d) >1

51. Decomposition of limestone occurs in the ..... region of the blast furnace.
(a) stack (b) bosh
(c) hearth (d) inter-bell space

52.In blast furnace operating on humidified blast, the reducing agent is
(a) C02 (b) H2
(c) CO (d) both (b) & (c).

53.External desiliconisation of pig iron is done by
(a) mixing lime with pig iron.
(b) oxygen lancing (using consumable mild steel pipe) in a transfer ladle.
(c) mixing CaC2 with pig iron.
(d) none of these.

54.Indian iron ores are mostly
(a) hematites (b) magnetites
(c) siderites (d) laterites

55.Solution loss reaction (C + C02 - 2CO) is also called the reaction.
(a) Boudourd (b) Neumann
(c) reduction (d) none of these
56. Which is a dry dust removal equipment used in the blast furnace gas cleaning system ?
(a) Dust catcher
(b) Scrubber
(c) Venturi scrubber
(d) None of these.

57.In case of fuel oil injection in the blast furnace, the coke replacement ratio is about

(a) 0.2 (b) 1.5
(c) 2 (d) 3.5

58.Humidification of hot blast
(a) affects the temperature level in the combustion zone adversely.
(b) controls the silicon content in pig iron.
(c) provides extra reductant in the form of hydrogen.
(d) all (a), (b) & (c).

59.With increase in the top pressure of the blast
(a) indirect reduction
(b) direct reduction
(c) solution loss
(d) none of these.
60.Blast humidity in blast furnace is maintained in the range of gm/Nm3 of blast.

(a) 1-5 (b) 35-65
(c) 150-200 (d) 500-750

61.Coke rate in Indian blast furnaces is double than that of modern blast furnaces abroad due to
(a) higher ash content.
(b) poor coke quality (i.e. micum index).
(c) lack of use of advanced techniques for
B.F. operation.
(d) all (a), , (b) & (c).

62.Coke replacement ratio in the blast furnace by non coking coal dust injection is about
(a) 0.5 (b) 1.0
(c) 2.8 (d) 5.6
63.With increase in the alumina percentage of
B.F. slag, its
(a) basicity decreases.
(b) free running temperature increases.
(c) viscosity increases.
(d) all (a), (b) & (c).

64.Maximum practical limit of oxygen enrichment of hot blast in the blast furnace is about .....percent oxygen.

(a) 4 (b) 10

(c) 15 (d) 25
65.Higher hot blast temperature in blast furnaces
(a) reduces coke rate.
(b) is used in conjunction with humidified blast or hydrocarbon oil/gas injection.
(c) may cause hanging of the burden.
(d) all (a), (b) & (c).

66.With increase in the top pressure of the blast furnace,
(a) the dust content in B.F. gas decreases.
(b) solution loss reaction is stiflled (i. e. Boudouard equilibrium moves to the left).
(c) its output increases.
(d) all (a), (b) & (c).

67.One kilogram of furnace oil injected in blast furnace saves about kilogram of coke.
(a) 0.1
(b) 1.5

(c) 0.5
(d) 5

68.Desirable value of shatter index of+ 10 mm sinter for blast furnace burden is about .....percent.

(a) 1.5
(b) 15
(c) 5
(d) 25

69.The output of a blast furnace is limited by the
(a) appearance of flooding in the bosh.
(b) hot blast temperature mainly,
(c) top pressure mainly.
(d) maximum hearth temperature attainable.

70.Pellets compared to sinter
(a) require finer (100 mesh) raw materials.
(b) is less prone to hanging in the blast furnace.
(c) give better bulk permeability of burden.
(d) all (a), (b) & (c).

71.Productivity of a blast furnace does not depend upon the
(a) driving rate.
(b) bulk permeability of the burden.
(c) shape & size of the burden particles.
(d) none of these.

72.Desulphurisation inside the blast furnace can be done by
(a) increasing the slag volume.
(b) having higher slag basicity.
(c) raising the hearth temperature.
(d) all (a), (b) & (c).

73.Phosphorous percentage in most of the world's pig iron is about
(a) 0.15-0.35 (b) 1.5-2
(c) <0.015 (d) <0.01

74.Ideal silicon content in pig iron used for basic process of steel making is percent.
(a) 0.01 (b) 0.5
(c) 1.5 (d) 2

75. Basic pig iron is the one, which contains phosphorous more than percent.
(a) 0.001 (b) 0.04
(c) 0.5 (d) 1.5

76. Silicon and sulphur content in the blast furnace pig iron depends upon the
(a) slag volume. (b) slag basicity.
(c) operating temperature of the furnace. (d) all (a), (b) & (c).

77.Channelling in a blast furnace does not decrease its
(a)productivity directly.

(b)effective cross-section for gas-solid interaction.
(c) both (a) & (b).
(d) neither (a) nor (b).

78.Flooding in the iron blast furnace can be minimised by
(a) having a high voidage in bosh region.
(b) using higher mean size of the coke.
(c) using better quality coke.
(d) all (a), (b) & (c).

79.Chilled hearth in blast furnace operation is caused because of
(a) low coke input.
(b) excessive steam injection in the blast.
(c) water leaking in from tueyers.
(d) all (a), (b) & (c).

80. Heating of a newly lined blast furnace stove
to optimum dome temperature requires about days.
(a) 1-2 (b) 15-20
(c) 60-90 (d) 120-150

81. Maximum thermal efficiency of B.F. stoves may be about percent.
(a) 10 (b) 25
(c) 50 (d) 80

82.For better reduction efficiency of the blast furnace, the percent in blast furnace gas should be minimum.
(a) co (b) co,
(c) N2 (d) 02

83. The process of starting a newly lined blast furnace is called
(a) blowing in (b) blowing out
(c) back draughting (d) banking

84. Flush slag basicity (CaO/SiOJ in Indian blast furnace slag is about
(a) 0.5 (b) 1
(c) 1.7 (d) 2.5

85. Fluidity of B.F. slag can be increased (i.e. viscosity can be decreased) by
(a) charging quartz in the blast furnace.
(b) maintaining high MgO (10-12%) in the slag.
(c) both (a) & (b).
(d) neither (a) nor (b).

86. Gas cleaning efficiency of an electrostatic precipitator may be about percent.

(a) 15 (b) 30
(c) 65 (d) 99

87. Potential (i. e. pressure) energy of high top pressure blast furnace gas is used for
(a) increasing the hot blast pressure.
(b)operating the small bell in the charging system.
(c) meeting the requirement of pressure drop of the gas during its long distance transportation.
(d) generating electrical power in a top pressure recovery turbine (TRT).

88. Alumina content in the blast furnace slag in
India is in the range of percent.
(a) 8 - 12 (b) 18 - 22
(c) 32 -36 (d) 2-6

89. 1% increase in ash content of coke decreases the effective carbon percentage in coke by about percent.
(a) 1 (b) 1.5
(c) 0.5 (d) 3

90. The main reaction in the tuyers area of blast furnace is the
(a) reduction of iron oxide.
(b) combustion of coke.
(c) solution loss reaction.
(d) melting of slag.

91. Reduction efficiency of blast furnace is increased, if iron ore
(a) is more porous and of uniform size.
(b) contains no fines.
(c) burden permeability is more.
(d) all (a), (b) & (c)

92. A good blast furnace coke should be
(a) of narrow size range.
(b) strong & abrasive.
(c) thermally stable at high temperature.
(d) all (a), (b) & (c).

93. Most of the iron ore deposits in India are
located in
(a) Jharkhand & West Bengal.
(b) Jharkhand & Orissa.
(c) Andhra Pradesh & West Bengal.
(d) Madhya Pradesh & West Bengal.

94. Most of the coking coal reserves in India are located in
(a) Jharkhand & West Bengal.
(b) Jharkhand & Orissa.
(c) Orissa & Madhya Pradesh.
(d) Andhra Pradesh & Orissa.

95. Function of coke in the blast furnace is to
(a) provide heat for meeting the endothermic requirements of chemical reactionsand melting of slag & metal
(b) produce and regenerate reducing gases for the reduction of iron oxides.
(c) provide an open permeable bed through which slag & metal pass down into the hearth and hot reducing gases pass upwards.
(d) all (a), (b) & (c).

96. Flux is added during iron ore smelting to reduce the
(a) softening point of gangue materials.
(b) viscosity of slag.
(c) activity of some of its components to make them stable or unstable in the slag phase.
(d) all (a), (b) & (c).

97. Fe content in hematite is about percent.
(a) 45 (b) 60
(c) 70 (d) 80

98. Solid raw materials required to produce a ton of pig iron is about tons.
(a) 1 (b) 3
(c) 6 (d) 10

99. Temperature of blast furnace gas (top gas)
emanating from blast furnace is about °C.
(a) 80- 100 (b) 200-250
(c) 350 - 500 (d) 650 – 750

100. Hot blast temperature in Indian blast fur- naces is in the range of °C.
(a) 300 - 500 (b) 500 - 700
(c) 800 - 1100 (d) 1300 - 1500