CON 566

DIRECTORATE OF STEAM BOILERS

(MAHARASHTRA STATE)

(Under Boiler Operation Rules, 2021)

Boiler Technology - I

8th March 2024

(TIME : 10-00 A.M. TO 1-00 P.M.)

(Max. Marks—100)

Instructions to Candidates:—

(1) Attempt only *five* questions.

(2) Question No. 1 is *Compulsory*.

(3) All questions carries equal *Marks*.

(4) Answer in brief and to the point attract more *Marks*.

(5) Draw neat sketches wherever *necessary* for correct explanations.

(6) *Assume suitable data, if necessary.*

Marks

1. (A) :— (10 × 1)

(1) The capacity of induced draft fan compared to forced draft fan in a boiler is .....

(*a*) Same (*b*) More

(*c*) Less (*d*) Depending upon size of boiler.

(2) During hot Banking Boiler is kept in.

(*a*) Depressurized Condition (*b*) Pressurized Condition

(*c*) Firing Condition (*d*) High air flow condition.

(3) Name the instrument used for measurement of specific gravity of liquid fuel.

(*a*) Gravimeter (*b*) Bomb Calorimeter

(*c*) Hydrometer (*d*) None of the Above.

(4) Buck stays are used to avoid...

(*a*) Buckling (*b*) Expansion

(*c*) Fire (*d*) over pressure.

(5) The Heat required to raise temperature of 1 kg of water from 0°C up to boiling temperature is called as..... .

(*a*) Latent heat of evaporation (*b*) Sensible heat

(*c*) Boiling point (*d*) Excess heat.

(6) In case of fuel oils, choose the correct answer from the following, which describes the relation between "specific heat" and "specific gravity" ?

(*a*) Lighter oil have higher specific heat. (*b*) Heavier oil have lower specific heat.

(*c*) Lighter oil have lower specific heat. (*d*) none of the above.

Marks

(7) Which one of the following fuels has the highest hydrogen content and lowest sulfur content ?

(*a*) Coal (*b*) Furnace Oil

(*c*) Natural Gas (*d*) LSHS.

(8) Super Critical Technology is more sensitive to..... .

(*a*) Fuel quality (*b*) Power generated

(*c*) Water chemistry (*d*) Environment.

(9) What is the typical value for excess air supplied in bagasse fired boiler ?

(*a*) 15-20 (*b*) 15-50

(*c*) 25-35 (*d*) 25-50.

(10) The fusible plug, in small boilers is located at.

(*a*) In the drum (*b*) In the fire tubes

(*c*) Above steam dome (*d*) Over the combustion chamber.

(B) :— (5 × 2)

(*a*) Define Steam Pipe as per The Boilers Act, 1923.

(*b*) Define Evaporation ratio.

(*c*) Find out the excess air percentage supplied for a boiler if the theoretical CO_2 is 20.67% and the actual CO_2 measured in the flue gas is 14%.

(*d*) Explain term grindability index of coal.

(*e*) Explain the term carryover.

2. (*a*) What is the function of orifices in coal pipes of mills? 4

(*b*) Explain the difference between Jet Condensers and Surface condensers. 5

(*c*) How is re-heater temp is controlled in a typical utility boiler? 5

(*d*) Calculate cooling water quantity required for a surface condenser in the following case.— 6

(*i*) Quantity of steam flow—55 Ton/Hr

(*ii*) Condenser vacuum—0.92 kg/cm^2

(*iii*) Dryness fraction of steam—85%

(*iv*) Condensate temperature—48°C

(*v*) Cooling water inlet temperature—31°C

(*vi*) Cooling water outlet temperature—42°C

Marks

3. (*a*) In a boiler operation, why is it crucial to regularly monitor and maintain proper water levels? What specific risks or issues can arise if the water level is too high or too low? 4

(*b*) Explain the difference between subcritical and supercritical boilers. 5

(*c*) Digital-based instrumentation and control systems are part of modern boilers. What are the advantages gained with the use of these systems? 5

(*d*) The performance parameters of a boiler plant are as given below :— 6

A boiler generates 6.51 ton of steam per ton of coal fired.

The steam generated is at 18kg/cm^2 (g).

The boiler feed water temperature = 110°C downstream of deaerator.

Boiler Efficiency = 75%.

Factor of evaporation = 1.15

C_p of the steam = 0.55 kCal/kg ^{0}C

Determine :—

(*i*) The temperature of the steam and degree of superheat, if any.

(*ii*) The equivalent evaporation per ton of coal burned.

(*iii*) The calorific value of coal.

4. (*a*) Define the term Cogeneration. List out important technical parameters to be considered in a Cogeneration system. 4

(*b*) What are the principal heat losses that occur in the Boiler and list out the data required to calculate Boiler Efficiency using Indirect method and Direct method. 5

(*c*) What are the methods to improve Efficiency of Bagasse fired Water Tube Boiler ? 5

(*d*) Find the volume of 1Kg of steam at pressure of 14 Kg/cm^2 (g) in each of the following case.— 6

(*i*) When steam is dry saturated ?

(*ii*) When steam is wet having dryness fraction 0.9. ?

(*iii*) When steam is superheated, the degree of superheat being 40^0 C. ?

5. (*a*) Explain the importance of magnetite layer in Boiler and how it is formed in Boiler. 4

(*b*) Explain the effects of Impurities in water on Boiler Components. 5

(*c*) Differentiate short term and long-term overheating of boiler pressure part tubes. 5

(*d*) The following are the data collected for typical oil-fired Boiler. Find out the efficiency of the Boiler by indirect method and Boiler Evaporation ratio. 6

(*i*) Type of Boiler – Oil fired.

(*ii*) Ultimate analysis of Oil – C-84%, H2-12%, S-3%, O2-1%

(*iii*) GCV of Oil – 10200 kCal/kg

(*iv*) Steam Generation pressure – 7 kg/cm^2 (g)-saturated

(*v*) Enthalpy of steam – 660 kCal/kg

(*vi*) Feed water temperature - 60°C

(*vii*) % of Oxygen in flue gas – 7

(*viii*) % of CO2 in flue gas – 11%

(*ix*) Flue gas temperature (Tf) - 220°C

(*x*) Ambient temperature (Ta) - 27°C

(*xi*) Humidity of air – 0.018 kg/kg of dry air.

6. Write Short Note (Any *Four*).— (4 × 5)

(*a*) Three element drum level control.

(*b*) Boiler Drum and its Internals.

(*c*) Boiler preservation methods.

(*d*) Causes of Boiler Tube Leakages

(*e*) Boiler Steam Test

(*f*) Off season maintenance of bagasse fired boiler in Sugar Factory.
