DIRECTORATE OF STEAM BOILERS

(MAHARASHTRA STATE)

(Under Boiler Operation Rules, 2021)

Boiler Technology - II

8th March 2024

(Time : 2-30 p.m. to 5-30 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) State whether the following statements are *true* or *false* and write   10
          the correct sentence :—

          (1) In a demineralization plant, the cation exchange resin is in the hydroxyl form and anion exchange resin is in the hydrogen form.

          (2) Secondary air in a pulverized fuel boiler is used to carry pulverized coal to the burners.

          (3) Increase of steam pressure results in steam temp. going up and enthalpy of evaporation going up.

          (4) Set pressure of Superheater Safety valve is kept higher than Drum Safety valve.

          (5) If steam and water can coexist at 1.033 Kg/cm2 and 100⁰C, at this condition, steam is called saturated vapor and water is called saturated liquid.

          (6) Inverted bucket steam traps operate on the principle of difference in temperature between steam and condensate.

          (7) Suspension burning as well as Grate burning takes place in the spreader stroker Boiler.

          (8) Any branch connection welding can be waived against 100% radiograph by the Boiler Inspector during repairing.

          (9) ASTM- 106 Gr.II is the Specification of Material used for Boiler tubes manufacturing.

          (10) Boiler water PH is always more than Feed water PH.

    (B) Define the following terms in *one* or *two* sentences :—   5

          (1) Turndown Ratio.

          (2) Conductivity of Boiler Feed water.

          (3) Circulation Ratio

          (4) Boiler as per The Boilers Act, 1923.

          (5) Degree of Superheat.

Marks

(C) Convert following units as directed :—   5

    (1) 167 mm of Hg into mm of water column.

    (2) 500 Btu/lb into Kcal/Kg.

    (3) 1 KWh into Kcal.

    (4) Convert 2300 Kcal into KJ.

    (5) 905 watts into Joule/sec.

2. (a) Explain the terminology used for Safety valve –   4

    (1) Set pressure, (2) Blowdown, (3) Chattering.

  (b) Explain the stages of Inspection for registration of new Boiler as   5
per Indian Boiler Regulations.

  (c) Explain the importance of RLA study, RLA methodology and   5
approach.

  (d) Efficiency of 300 TPH coal fired boiler is 84%. Calculate quantity   6
of coal required per day. Feed water temp. is $140°C$, GCV of coal
3600 kcal/kg. The enthalpy of superheated steam is 803 kcal/kg.

3. (a) What automatic action is taken by safety interlocks in the   4
following cases :—

    (1) Drum level very high.

    (2) Furnace pressure very high.

    (3) Deaerator level very low.

    (4) Superheated steam temp. high.

  (b) Explain heat transfer by Conduction, Convection and Radiation   5
as applied to various parts of water tube high pressure
Boilers.

  (c) Which factors are responsible for Superheater fouling ?   5

  (d) Calculate power required to drive a forced draft fan which   6
maintains a draft of 80 mm of water. Under the following
conditions :—

    • Temperature of air in boiler house = 22 °C.

    • Density of air at NTP =1.29 kg/m³.

    • Air supplied per kg of coal = 18 kg.

    • Mass of fuel burnt = 2 kg/sec.

    • Efficiency of fan = 80%.

4. (a) What is the principle of CFBC boiler ?   4

  (b) What are the causes of Boiler accidents and precautions to be   5
taken to avoid accidents ?

  (c) Elaborate procedure of Cold Startup of 10 TPH, Agro waste fired,   5
Composite Boiler.

  (d) Calculate height of Chimney to produce a draught of 16 mm of   6
water column when temp. of flue gases in chimney is $317°$ C. The
mean temp. of outside air is $38°$ C and quantity of air supplied is
18 Kg/Kg of fuel.

Marks

5. (a) State principle of thermodynamic steam trap.   4

   (b) Explain the advantages of Fluidized Bed Combustion (FBC)   5
       Boilers over conventional coal fired Boilers.

   (c) What is importance of Thermal Insulation and Name any four   5
       insulating materials.

   (d) Estimate the pipe size required to carry dry saturated steam at   6
       65Kg/cm^2(g) Pressure from Boiler giving steam flow 68750 Kg/
       Hr. Assume Steam Velocity 38m/sec.

6. Write short notes on (any *four*) :—   20

   (a) Equivalent Evaporation.

   (b) Types of Pollution control Equipments and its necessity.

   (c) Different types of welding defects.

   (d) Spreader stoker furnace.

   (e) Chemical Cleaning of Boiler.

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