

Q.2 what do you understand by boiler draught and explain in brief the various types of draught system.

Ans. - Boiler Draught: Draught may be defined as the small diff. b/w the pressure of air outside and that of gases within a furnace or chimney which causes flow of gases to take place. In a boiler it performs following fun.

1. To force air through the fuel bed to aid in the proper combustion of fuel.
2. To draw the resultant hot gases through the system.
3. To remove the products of combustion to the atmosphere after they have given their heat to the water being evaporated.

→ Classification of Draught:

1. Natural draught: Let us assume the pressure is equal to  $P_1$ . The pressure at the top of chimney is  $P_2$ . The value of  $P_2$  is less than  $P_1$  because atmospheric pressure decreases with increase in altitude. The pressure at grate level outside the boiler in the ashpit shall also remain unaffected. But the pressure at the base of the chimney will equal to sum of press  $P_2$  at top and pressure due to hot gas column of height  $H$ .

Determination of the height of chimney:

$$h = 35.3 H \left[ \frac{1}{T_1} - \frac{m+1}{m} \times \frac{1}{T} \right] \text{ mm of water}$$

where  $m$  = mass of air required per kg of fuel burnt.

$T$  = mean absolute temp of chimney gases in K.

$T_1$  = absolute temp of outside air in K.

$H$  = height of chimney,  $h$  = draught.

for diameter of chimney

$$D = 1.128 \sqrt{\frac{mF}{V \cdot \rho}}$$

Efficiency of chimney.

$$\text{chimney Efficiency} = \frac{H \left[ \left( \frac{m}{m+1} \right) \times \frac{T}{T_1} - 1 \right]}{C_p (T - T_2)}$$

where

$T$  = Temp. of flue gases in natural draught.

$T_2$  = Temp. of flue gases in artificial draught.

$C_p$  = mean specific heat of flue gases (KJ/kgK)

2. Artificial draught: In steam power plants the total static draught required varies from 25 to 35 mm of water column. The natural draught is dependent upon climate conditions. The artificial draught may either be produced by fans and boilers known as mechanical draught. It has following advantages

A. It does not depend on climate conditions.

- b. Efficiency is much greater than the chimney and Natural draught.
- c. inferior quality of fuel can be economically burnt.
- d. It is possible to regulate it Acc. to requirement of surface.

3. Steam Jet draught: The simple and easy way of producing Artificial draught is by steam jet. It is of two types:

- forced draught: In forced draught steam from boiler having been throttled to a press. of 1.5 to 2 bar.
- In induced draught: The jet of exhaust steam is directed into the smoke box.

Advantages: It is quite simple and cheap, it has the capability of using low grade fuels, it occupies very little space.

4. Mechanical draught: The draught produced by fans and blowers is known as mechanical draught. It has two types.

- Induced draught: In this system the fan is placed near or at the base of the chimney. This type of draught is usually used when economiser and pre-heater are incorporated.
- forced draught: In this system a fan or blower is installed near or at the base of the boiler grate to deliver air to the furnace under pressure varying from 2.5 cm to about 7.5 cm of water.

Ques Explain various heat losses in a boiler and prepare heat balance sheet?

Ans. Heat losses in a boiler: The Efficiency of a boiler is never 100% as only a portion of heat supplied by fuel is usually utilized and rest of it is lost in the following.

- Heat carried away by dry products of combustion.
- Heat carried away by the steam produced by the combustion of hydrogen present in the fuel.
- Heat lost due to incomplete combustion of carbon to carbon monoxide instead of carbon dioxide and they escape of the combustible matter in the flue gases and ash.
- Heat carried away by moisture in fuel and air.
- Heat loss due to radiations.

The efficiency of a boiler can be improved by utilizing the heat of flue gases in Superheater, Economiser and air preheater.

Heat Balance Sheet of a boiler: