Boiler Calculations

Q. What is equivalent evaporation?

Ans. It is the quantity of water evaporated from and at 100°C to produce dry saturated steam at 100°C by absorbing the same amount of heat as used in the boiler under actual operating conditions.

$$M_{eq} = M_{act} (H - H_{w_1}) / 539$$

where M_{eq} = equivalent evaporation

Mact = actual mass of steam generated per unit mass of fuel burnt

H = total specific enthalpy of steam under operating conditions, kcal/kg

Hw. - specific enthalpy of feedwater, kcal/kg

Latent heat of dry, saturated steam at 100°C is 539 kcal/kg.

Q. What is factor of evaporation?

Ans. It is the factor to be multiplied with the quantity of steam generated under working conditions to get the equivalent evaporation.

Equivalent evaporation - Actual evaporation × (f')

or
$$M_{eq} = M_{act}(f)$$

or
$$M_{act}(H - H_{w_a})/539 = M_{act}f$$

$$f = (H - H_{w_0})/539$$

Q. What is boiler efficiency?

Ans. It is the ratio of the heat load of the generated steam to the heat supplied by the fuel over the same period.

Heat load of generated steam

$$=G_s(H-H_{w_s})$$
 kcal/s

where G_s = rate of steam generation, kg/s

Rate of heat supplied by fuel = $G_f \times (CV)_f$ kcal/s where G_f = rate of fuel burning, kg/s

$$\eta_{\text{boiler}} = \frac{G_{\text{s}}}{G_{\text{f}}} \frac{(H - H_{\text{w}_{\text{t}}})}{(\text{CV})_{\text{f}}}$$

$$= M_{\text{act}} (H - H_{\text{w}_{\text{t}}}) \vee (\text{CV})_{\text{f}}$$

where G_s/G_f - actual evaporation - M_{act}

Q. What is economizer efficiency?

Ans. It is defined as the ratio of the heat absorbed by the BFW in the economizer to the heat supplied by the flue gases in the economizer, the temperature of flue gases being reckoned above the temperature of the air supplied to the boiler

$$\eta_{\rm eccon} = \frac{M_{\rm act} \Delta \Theta}{M_{\rm f_1} C_p (\Theta_{\rm f} - \Theta_{\rm air})}$$

where $\Delta \Theta$ - rise in BFW temperature in the economizer

 M_{f_u} - mass of flue gases per unit mass of fuel

 C_p - specific heat of flue gases

 Θ_f - flue gas temperature at inlet to economizer

 Θ_{air} - temperature of air delivered to the boiler

Problem 6.1 A boiler generates 4.5 t of superheated steam (500°C, 90 kgf/cm² abs.) per ton of coal feed.

The BFW temperature - 45°C

What is the equivalent evaporation from and at 100°C per ton of coal?

Solution

Nboilermaker Mathematics Questions

Peipei Pang

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