



LAMPIRAN

1. Perhitungan performance Waste Heat Boiler B-1104 data desain

a. Data yang diketahui

Q Boiler	: $27,339 \times 10^6$ kcal/h
	: 27339000 kcal/h
	: 114386376 kJ/h
Q losses	: $0,102 \times 10^6$ kcal/h
	: 102000 kcal/h
	: 426768 kJ/h

b. Efisiensi Boiler

$$\begin{aligned}\eta &= \frac{Q_{Boiler} - Q_{losses}}{Q_{boiler}} \times 100\% \\ &= \frac{114386376 \frac{kJ}{h} - 426768 \frac{kJ}{h}}{114386376 \frac{kJ}{h}} \times 100\% \\ &= 99,62 \%\end{aligned}$$

2. Perhitungan performance Waste Heat Boiler B-1104 data aktual

a. Data yang diketahui

m steam	: 54970 kg/h
Temperatur steam	: 400°C
Temperatur BFW	: 102°C
H in	: 427,5 kJ/kg
H out	: 3249,946 kJ/kg
q bahan bakar	: 89260 kg/h
GCV sulfur	: 550 kcal/kg



c. Perhitungan efisiensi Boiler

$$\begin{aligned}\eta &= \frac{m_{\text{steam}} \times (H_{\text{out}} - H_{\text{in}})}{q_{\text{bahan bakar}} \times GCV} \times 100\% \\ &= \frac{54970 \frac{\text{kg}}{\text{h}} \times (3249,946 - 427,5) \frac{\text{kJ}}{\text{kg}}}{89260 \frac{\text{kg}}{\text{h}} \times 550 \frac{\text{kcal}}{\text{kg}}} \\ &= 75,5 \%\end{aligned}$$

3. Perhitungan kebutuhan bahan bakar Gas Alam pada Boiler B-1104

a. Data yang diketahui

m steam	: 54970 kg/h
Temperatur steam	: 400°C
Temperatur BFW	: 102°C
H Steam	: 3273,728 kJ/kg
H BFW	: 427,5 kJ/kg
Heating Value gas alam	: 1184,691 btu/scf

b. Perhitungan bahan bakar Gas Alam

$$\begin{aligned}Q &= m \times \Delta H \\ &= 54970 \text{ kg/h} \times (3273,728 \text{ kJ/kg} - 427,5 \text{ kJ/kg}) \\ &= 156457153,2 \text{ kJ/h}\end{aligned}$$

Konversi kJ/h menjadi Btu/h dikalikan 0,947817

$$156457153,2 \text{ kJ/h} \times 0,947817 = 148292749,5 \text{ Btu/h}$$

$$\begin{aligned}m_{\text{gas alam}} &= \frac{Q}{\text{Heating value}} \\ &= \frac{148292749,5 \text{ Btu/h}}{1184,691 \text{ Btu/scf}} \\ &= 125174,254 \text{ scf/h}\end{aligned}$$

$$\begin{aligned}\text{Konversi} &= \frac{125174,254 \text{ scf/h} \times 24}{1000000} \\ &= 3,00418 \text{ mmscfd}\end{aligned}$$



4. Perhitungan kebutuhan bahan bakar Gas Alam pada Boiler B-1104 dengan efisiensi 75%

$$\begin{aligned} Q_{75\%} &= \frac{100 \times Q}{75} \\ &= \frac{100 \times 1564571532,2 \frac{\text{kJ}}{\text{h}}}{75} \\ &= 208609537,5 \text{ kJ/h} \end{aligned}$$

Konversi kJ/h menjadi Btu/h dikalikan 0,947817

$$208609537,5 \text{ kJ/h} \times 0,947817 = 197723666 \text{ Btu/h}$$

$$\begin{aligned} \text{m gas alam} &= \frac{Q}{\text{Heating value}} \\ &= \frac{197723666 \text{ Btu/h}}{1184,691 \text{ Btu/scf}} \\ &= 166899,01 \text{ scf/h} \end{aligned}$$

$$\begin{aligned} \text{Konversi} &= \frac{166899,01 \text{ scf/h} \times 24}{1000000} \\ &= 4,00558 \text{ mmscfd} \end{aligned}$$