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Topic 1

1. Boiler efficiency

$$\text{Boiler efficiency (Direct method)} = \frac{\text{Useful energy output}}{\text{Energy input}}$$

$$\text{Boiler Efficiency (Indirect method)} = \frac{\text{Energy input} - \text{Loss}}{\text{Energy input}} = 1 - \frac{\text{Loss}}{\text{Energy input}}$$

1.1 Efficiency is less than one

The boiler efficiency is **always less than one** due to the following reasons.

- Some part of energy is lost along with dry flue gas.
- Loss due to presence of hydrogen in fuel as water formed during combustion remains in vapour form.
- Loss due to moisture in fuel.
- Loss due to moisture in air
- Loss due to formation of carbon monoxide
- Loss due to radiation and convection from boiler surface to atmosphere
- Loss due to un-burnt carbon in fly ash and bottom ash for coal fired boilers.

1.2 Disadvantages of measuring boiler efficiency by direct method

The accuracy in measuring efficiency by direct method depends upon the accuracy in measuring steam production, fuel consumption and determination of calorific value of fuel. An error of 1 % in efficiency calculation by direct method results in significant variation in measured efficiency.

$$90 \pm 0.9 = 89.1 \text{ to } 90.9 \%$$

1.3 Advantages of measuring boiler efficiency by indirect method

The disadvantages of direct method can be overcome by indirect method. In this method various losses are calculated and deducted from 100. The impact on efficiency due to 1 % error in measurement by indirect method is indicated as under:

$$\text{Efficiency} = 100 - (10 \pm 0.1) = 90 \pm 0.1 = 89.9 \text{ to } 90.1 \%$$