

**Given:**

A coal burning steam power plant produces a net power of 300 MW with an overall thermal efficiency of 32%. The actual air-fuel ratio in the furnace is calculated to be 12:1 (air:fuel). The heating value of the coal is 28,000 kJ/kg.

**Required:**

Determine the amount of coal consumed during a 24 hour period and the rate of air flowing through the furnace.

**Solution:**

The net work out of the power plant is defined as

$$\dot{W}'_{net,out} := 300 \text{ MW}$$

The thermal efficiency is defined as

$$\eta_{th} := 32 \%$$

The air to fuel ratio is defined as

$$r_{af} := \frac{12 \text{ kg}}{1 \text{ kg}}$$

The heating value of the coal is defined as

$$HV := 28000 \frac{\text{kJ}}{\text{kg}}$$

The period of interest is defined as

$$\Delta t := 24 \text{ hr}$$

From the definition of thermal efficiency, the heat supplied to the furnace is

$$\eta_{th} = \frac{\dot{W}'_{net,out}}{\dot{Q}'_H} \quad \text{or} \quad \dot{Q}'_H := \frac{\dot{W}'_{net,out}}{\eta_{th}} = 937.5 \text{ MW}$$

The rate at which coal is consumed is then given by

$$\dot{m}'_{coal} := \frac{\dot{Q}'_H}{HV} = 33.48 \frac{\text{kg}}{\text{s}}$$

The total amount of coal consumed in a 24 hour period is then given by

$$m_{coal} := \dot{m}'_{coal} \cdot \Delta t = 2.893 \cdot 10^6 \text{ kg}$$

The rate of air flowing through the furnace is then given by

$$\dot{m}'_{air} := r_{af} \cdot \dot{m}'_{coal} = 401.8 \frac{\text{kg}}{\text{s}}$$

Additionally, the heat rejected by the furnace may be found by

$$\dot{Q}'_L := \dot{Q}'_H - \dot{W}'_{net,out} = 637.5 \text{ MW}$$