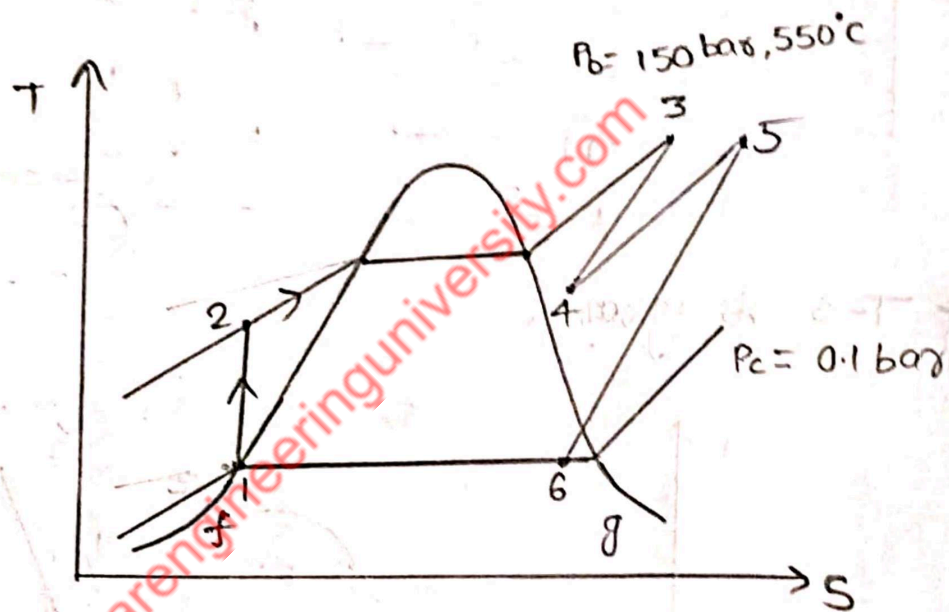


Q:- In a reheat cycle, the initial steam pressure and the maximum temperature are 150 bar and 550°C respectively. If the condenser pressure is 0.1 bar and the moisture at the condenser inlet is 5%, and assuming ideal processes, determine -

- the reheat pressure
- the cycle efficiency,
- the steam rate.

Solⁿ:-

$$\alpha = 95\% = 0.95$$



$$\begin{aligned} h_6 &= h_f + \alpha \cdot h_{fg} \\ &= 192.5 + 0.95 \times 2392.5 \\ &= 2465.375 \text{ KJ/Kg} \end{aligned}$$

$$h_1 = h_f = 192.5 \text{ KJ/Kg}$$

$$\begin{aligned} s_6 &= s_f + \alpha \cdot s_{fg} = 0.651 + 0.95 \times 7.497 \\ &= 7.77315 = s_5 \end{aligned}$$

from steam
table

$$\text{At } s_5 = 7.77, T = 550^\circ$$

$$P = 13.25 \text{ bar}$$

$$h_5 = 3510 \text{ KJ/Kg}$$

$$h_2 - h_1 = V_f (P_b - P_c)$$

$$h_2 = h_1 + V_f (P_b - P_c)$$

$$= 192.5 + \frac{0.001010 (150 - 0.1) \times 10^5}{10^3}$$

$$= 192.5 + 15.14$$

$$= 207.64 \text{ kJ/kg}$$

at 150 bar, 550°C

$$h_3 = 3370 \text{ kJ/kg}$$

$$s_3 = 6.410 = s_4; P = 13.25 \text{ bar}$$

at ~~150~~ 13.25 bar, $s_3 = 6.410 \text{ kJ/kg-K}$

$$T = 450$$

$$h_4 = 3325 \text{ kJ/kg}$$

$$\left. \begin{aligned} h_1 &= 192.5 \\ h_2 &= 207.64 \\ h_3 &= 3370 \\ h_4 &= 3325 \\ h_5 &= 3510 \\ h_6 &= 2465.325 \end{aligned} \right\}$$

(a) the reheat pressure, $P = 13.25 \text{ bar}$

$$\eta = \frac{Q_{out}}{Q_{in}} = 1 - \frac{h_6 - h_1}{h_3 - h_2}$$

$$= 1 - \frac{2465.375 - 192.5}{3370 - 207.64}$$

$$(b) \eta_{cycle} = \frac{W_{net}}{Q}$$

$$W_{net} = W_T - W_P$$

$$W_{net} = [(h_3 - h_4) + (h_5 - h_6)] - [h_2 - h_1]$$

$$= [(3370 - 3325) + (3510 - 2465.325)]$$

$$- [207.64 - 192.5]$$

$$= 1089.625 - 15.14$$

$$= 1074.485$$

$$Q_{in} = (h_3 - h_2) + (h_5 - h_4)$$

$$= (3370 - 207.64) + (3510 - 3325)$$

$$= 3347.36$$

$$\eta_{cycle} = \frac{W_{net}}{Q_{in}} = 32\%$$

$$(c) \text{ steam rate} = \frac{3600}{1074.485} = 3.35 \text{ kg/kWh say}$$

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