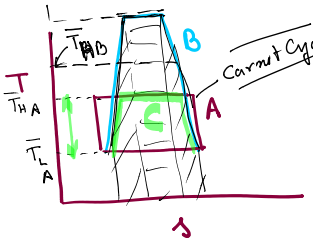
Tuesday, December 14, 2021 10:10 AM

$\bar{T}_{HB} > \bar{T}_{HA}$

$\eta_B > \eta_A$



$\eta_A < \eta_B$

$\eta_{Carnot} = 1 - \frac{\bar{T}_L}{\bar{T}_H}$

$\eta_C < \eta_A$

For any cycle, $\eta = 1 - \frac{\bar{T}_L}{\bar{T}_H}$

$\bar{T}_L$ = Average temp. of Heat Rejection

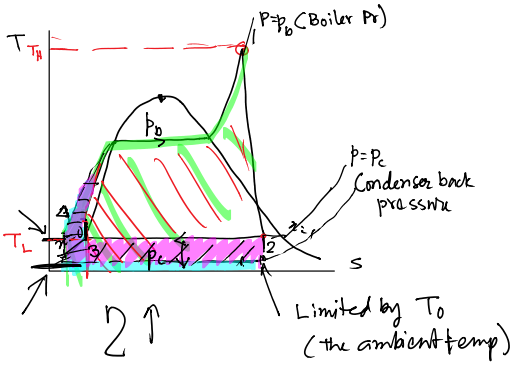
$\bar{T}_H$ = Average temp. of Heat addition

How to increase η_R ?

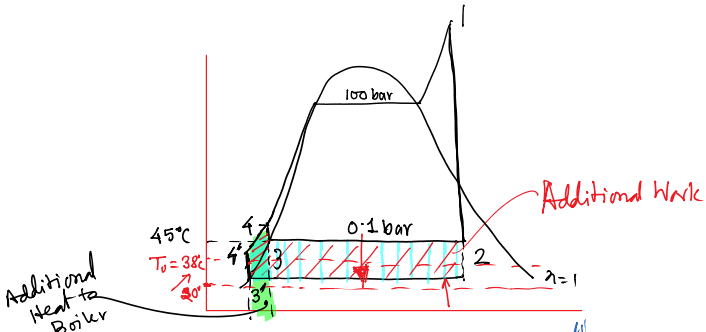
By increasing $\bar{T}_H$

By decreasing $\bar{T}_L$

$\eta = 1 - \frac{\bar{T}_L}{\bar{T}_H}$



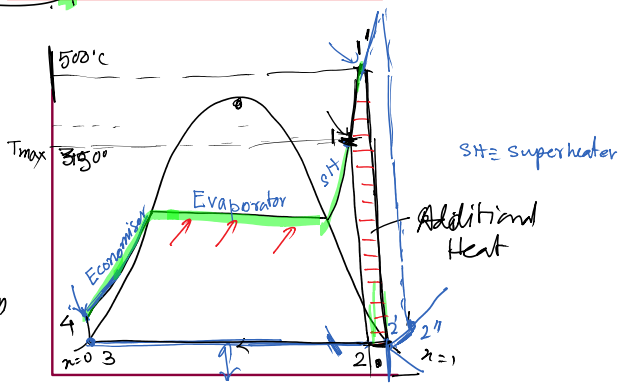
$\bar{T}_L \downarrow$ $\eta \uparrow$



increase $\bar{T}_H$

→ By increasing T_{max}

→ " " P_B



Effect ↑ increased T_{max}

1. Heat added increases
2. Work done increased
3. $\bar{T}_H$ increases
4. $\bar{T}_L$ remains the same (as long as point 2' is in the wet region)

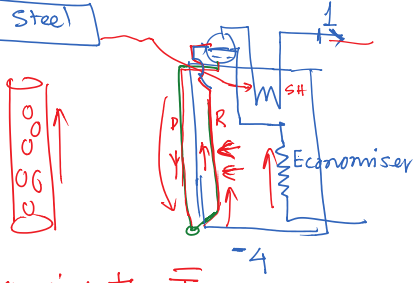
$\Rightarrow \eta_R \uparrow$ as T_{max} increases

T_{max} can increase ONLY up to the T_{melt}

Boiler tubes (superheater) are made of

Cr - Mo - V Steel

Boiler tubes (superheater) are made of Cr-Mo-V Steel

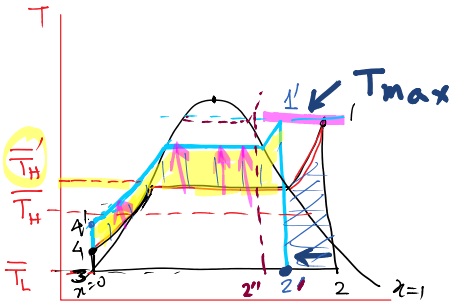


Another way ↑ increasing the $\bar{T}_H$

To increase the boiler pr.

If p_b ↑,

1) $\bar{T}_H$ ↑
2) η ↑ — ve
3) W_{net} = ? , Q_{add} =

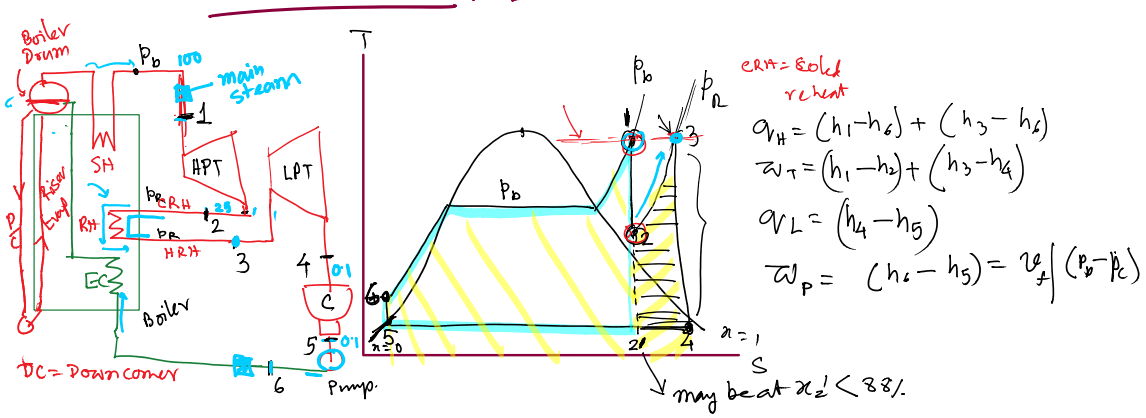


For Rankine cycles η ↑ is achieved by increasing T_{max} (limited by the metallurgical limit) & increasing the P_b

With increasing pr, x at turbine exit goes down

To ameliorate (reduce) this problem

Reheating ↑ steam



ERH = Ecked reheat

$q_H = (h_1 - h_6) + (h_3 - h_5)$

$w_T = (h_1 - h_2) + (h_3 - h_4)$

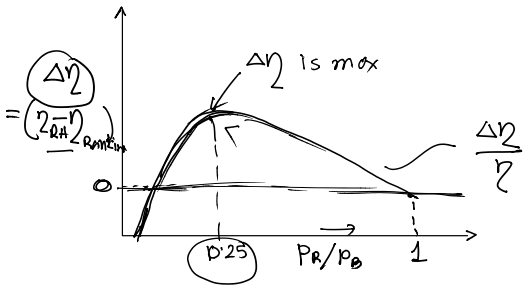
$q_L = (h_4 - h_5)$

$w_P = (h_6 - h_5) = v_f (P_b - P_c)$

Heat added = Heat added in Economiser, Evaporator & superheater $\{= (h_1 - h_6)\}$ + Heat Added in the R/H $\{= (h_3 - h_2)\}$

Effect ↑ Reheating:

1) Heat Added increases
2) Specific work output increases
3) η = ?



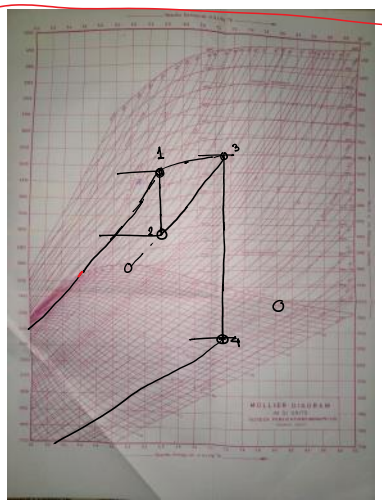
P_B = 100 bar

P_c = 0.1 "

$P_R \approx$ 25 bar

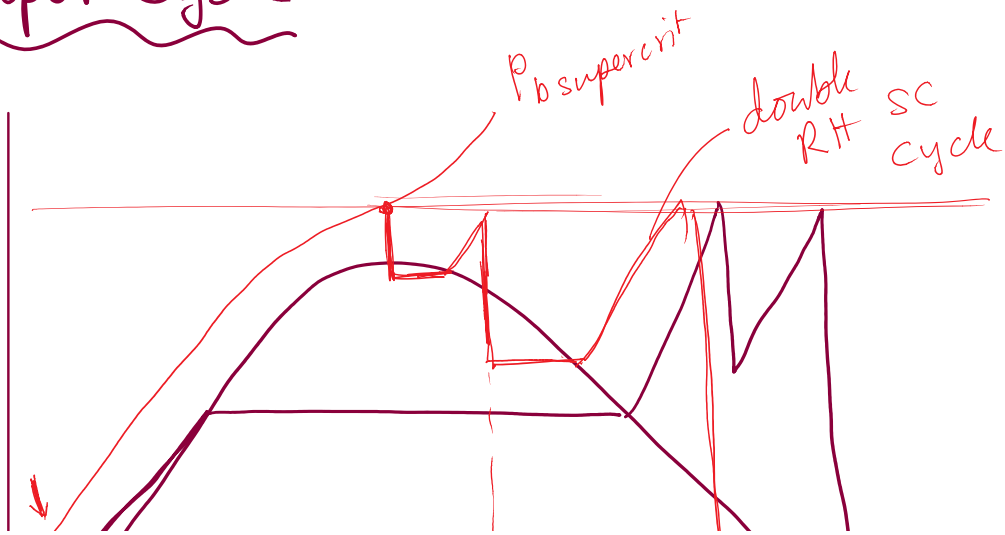
HW: Find the η, SSC, r_w & η_{II} of the R/H cycle for P_b = 100 bar, T_{max} = 500°C & P_c = 0.1 bar
Assume P_R/P_b = 0.25

h_1 = ✓
h_2 =
h_3 =
h_4 =
h_5 = ✓
h_6 = ✓



Primary purpose of RH is to improve the dryness fraction of steam at the turbine exit

Supercritical vapor cycle




x=0