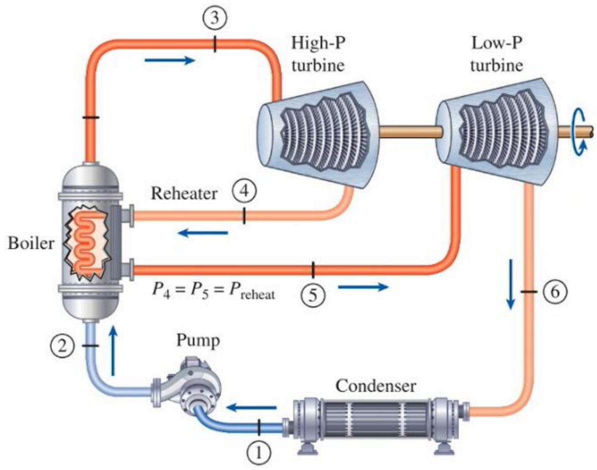
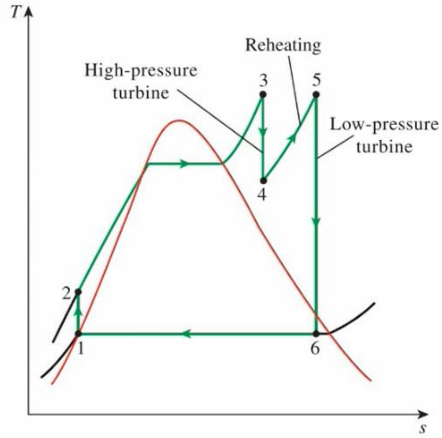
1)





State # i	State	P_i/kPa	T_i/°C	v_i/ m^3 kg^{-1}	x_i	h_i /kJ kg^{-1}	s_i /kJ (kg. K)$^{-1}$
1	Saturated Liquid	6	36.16	0.00100645	0	151.494	0.520873
2s	Subcooled Liquid	10.000	36.42	0.00100215	0	161.518	0.520873
2	Subcooled Liquid	10,000	-	-	-	164.024	-
3	Superheated Vapour	10,000	480	0.0316292	-	3322.89	6.53096
4s*	Saturated Liquid-Vapour Mixture	700	164.953	0.262622	0.962667	2685.630	6.53096
4*	Superheated Vapour	700	-	-	-	2813.082	-
5**	Superheated Vapour	700	480	0.493636	-	3439.22	7.87534
6s	Saturated Liquid-Vapour Mixture	6	36.16	22.3549	0.941882	2426.3	7.87534
6	Saturated Liquid-Vapour Mixture	6	-	-	-	2628.884	-

i)

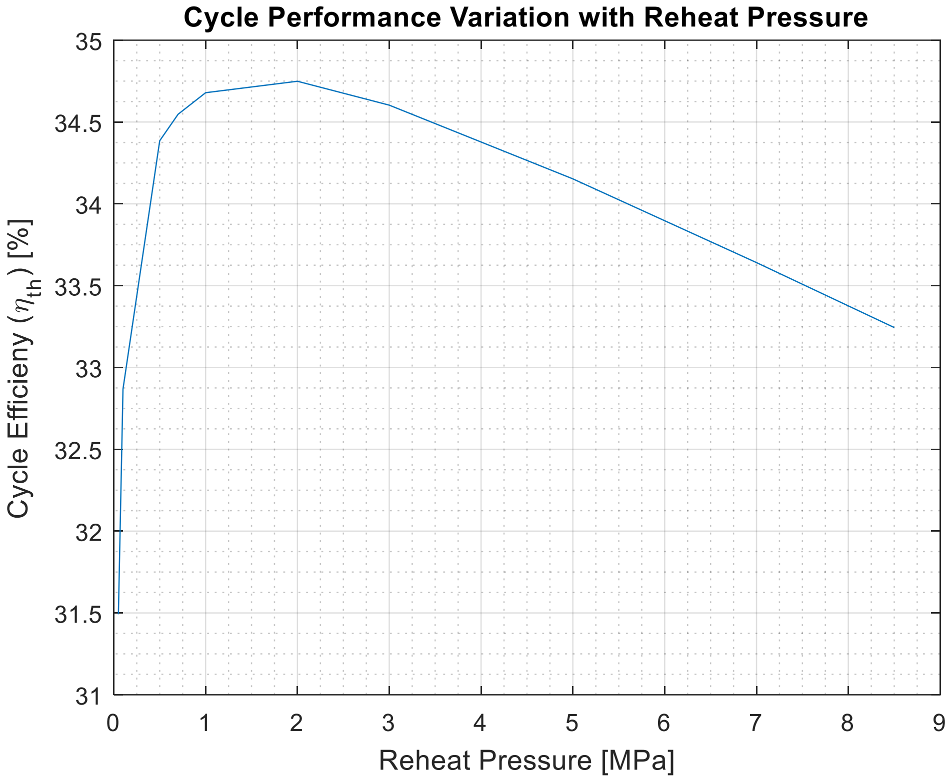
$$q_{\text{in}} = (h_3 - h_2) + (h_5 - h_4) = 3785.00 \text{ kJ kg}^{-1}$$

ii)

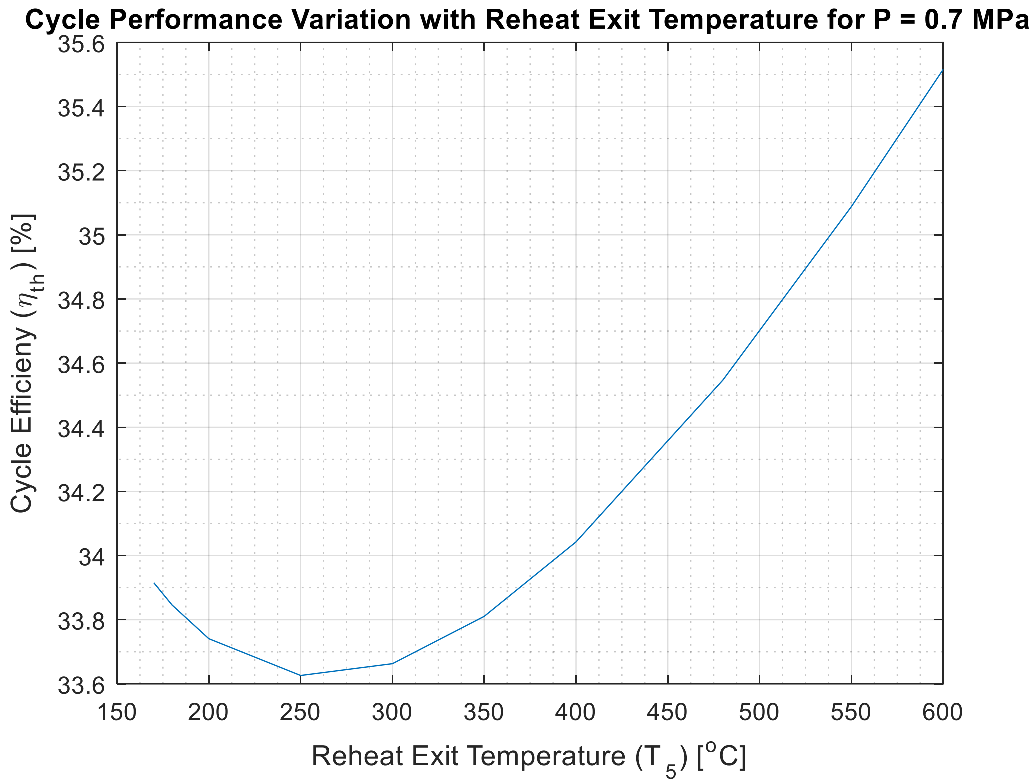
$$\eta_{\text{th}} = 1 - \frac{(h_6 - h_1)}{(h_3 - h_2) + (h_5 - h_4)} \times 100\% = 34.547\%$$

iii)

$$q_w = h_6 - h_1 = 2477.39 \text{kJ kg}^{-1}$$

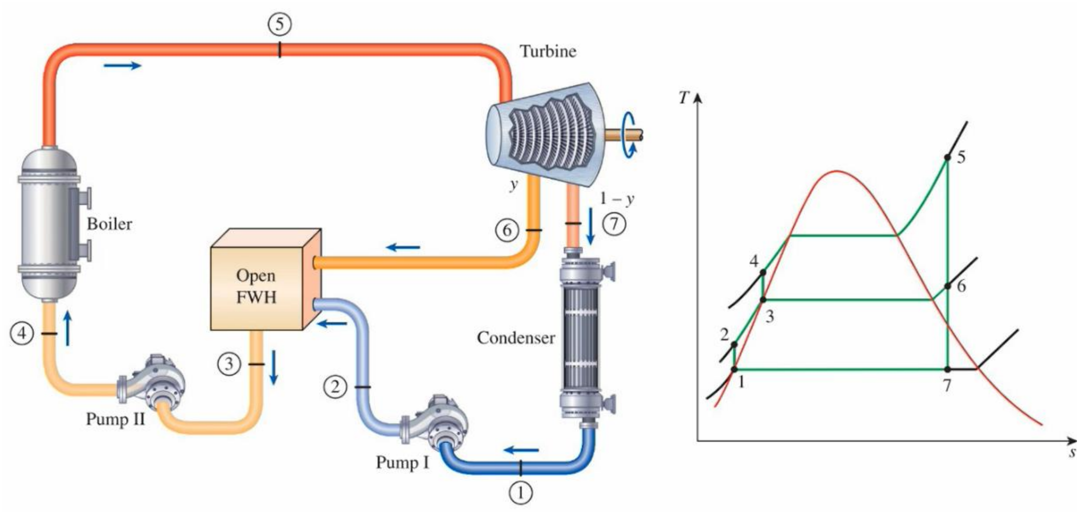


It can be seen that there is an optimum pressure for a given temperature of reheat. Which is 20% of the boiler operating pressure. All pressures higher and lower result in decrease in the cycle efficiency, however the drop is drastic for lower pressures and gradual for higher pressures.



It can be seen that for a given pressure of reheat, the cycle efficiency decreases with increase in the final reheat temperature; up to 250°C, after which there is a roughly linear increase in efficiency for increase in the final reheat temperature, T_5 at 0.7 MPa.

2)



State # i	State	P_i/kPa	T_i/°C	v_i/ $\mathrm{m^3\ kg^{-1}}$	x_i	h_i /kJ $\mathrm{kg^{-1}}$	s_i /kJ $\mathrm{(kg.K)^{-1}}$
1	Saturated Liquid	8	41.51	0.00100847	0	173.852	0.592532
2*	Subcooled Liquid	1000	41.54	0.00100804	-	174.835	0.592532
3*	Saturated Liquid	1000	179.89	0.00112723	0	762.683	2.13843
4	Subcooled Liquid	16,000	181.96	0.00111776	-	779.508	2.13843
5	Superheated Vapour	16,000	560	0.0217396	-	3467.28	6.51637
6*	Saturated Liquid-Vapour Mixture	1000	179.89	0.191367	0.98457	2746.04	6.51637
7	Saturated Liquid-Vapour Mixture	8	41.51	14.0434	0.775891	2037.84	6.51637

i)

$$y = \frac{h_3 - h_2}{h_6 - h_2} = 0.2286$$

$$\dot{W}_{\text{net}} = \dot{m}_s\{y(h_5 - h_6) + (1 - y)[(h_5 - h_7) - (h_2 - h_1)] - (h_4 - h_3)\} = 149{,}993\ \text{kW}$$

ii)

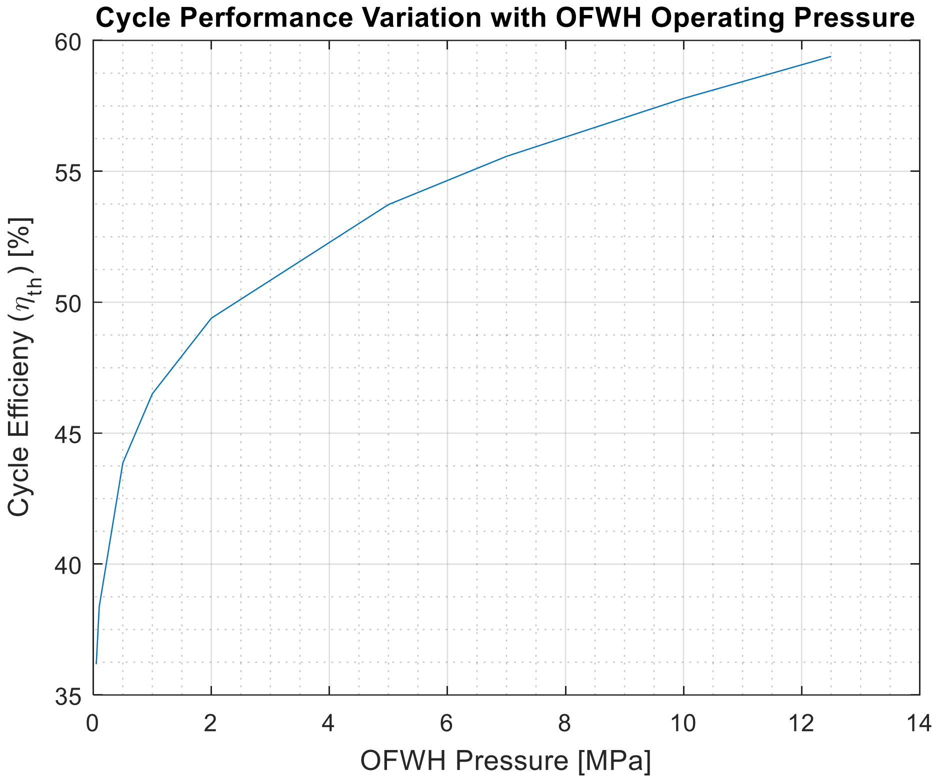
$$\dot{Q}_{\text{boiler}} = \dot{m}_s(h_5 - h_4) = 322{,}532\ \text{kW}$$

iii)

$$\eta_{\text{th}} = \frac{\dot{W}_{\text{net}}}{\dot{Q}_{\text{boiler}}} \times 100\% = 46.505\ \%$$

iv)

$$\dot{m}_{cw} = \frac{\dot{m}_s[(1-y)(h_7-h_1)]}{c_p \Delta T} = 2{,}293 \text{ kg s}^{-1}$$



It can be seen that the cycle performance improves with increase in the OFWH operating pressure. The increase is drastic up to 2MPa, after which the increase in cycle efficiency is gradual and roughly linear. The MATLAB code developed is given below.

```
clc
clear all
close all
format long

ms = 120;
P = [12.5 10 7 5 2 1 0.5 0.1
0.05];%Extraction Pressure
h2 = [186.405 183.895 180.879 178.866
175.844 174.835 174.331 173.927 173.877];
h3 = [1511.46 1407.87 1267.44 1154.5
908.622 762.683 640.185 417.436 340.476];
h6 = [3383.69 3311.93 3204.29 3110.22
2887.09 2746.04 2618.82 2360.92 2263.6];
cp = 4.18;
dT = 18;
i = 1;
while i <= length(P)
%Specific Enthalpies at respective states
[kJ/kg]
h = [173.852
h2(i)%h(2) to vary
h3(i)%h(3) to vary
779.508
3467.28
h6(i)%h(6) to vary
2037.84]';

y(i) = (h(3)-h(2))/(h(6)-h(2));
Wnet(i) = ms*(y(i)*(h(5)-h(6))+(1-
y(i))*((h(5)-h(7))-(h(2)-h(1)))-(h(4)-
h(3)));
Qb(i) = ms*(h(5)-h(4))
eta(i) = (Wnet(i)/Qb(i))*100
mcw(i) = ms*((1-y(i))*(h(7)-
h(1)))/(cp*dT)

i = i+1;
end
figure(1)
plot(P,eta)
title('Cycle Performance Variation with
OFWH Operating Pressure')
xlabel('OFWH Pressure [MPa]')
ylabel('Cycle Efficieny (\eta_t_h) [%]')
grid on
grid minor

%Pressure Variation
eta = 0.8;
P = [8.5 7 5 3 2 1 0.7 0.5 0.1
0.05];%Reheat Pressure
h4s = [3272.4 3214.39 3119.54 2988.49
2894.65 2752.65 2685.63 2625.02 2366.36
2268.77];
h5 = [3342.96 3362.48 3387.71 3412.1
3424.01 3435.74 3439.22 3441.54 3446.15
3446.73];
h6s = [2039.99 2073.83 2129.73 2210.21
2271.76 2374.31 2426.3 2475.04 2724.16
2860.99];
i = 1;
while i <= length(P)
% Specific Enthalpies at respective
states [kJ/kg]
h = [151.494
161.518%2s
0
3322.89
h4s(i)%h(5) to vary
0%h(6) to vary
h5(i)%h(7) to vary
h6s(i)%6s
0]';
h(3) = (h(2)-h(1))/eta+h(1);
h(6) = h(4)-eta*(h(4)-h(5));
h(9) = h(7)-eta*(h(7)-h(8));

qin(i) = (h(4)-h(3))+(h(7)-h(6));
qw(i) = (h(9)-h(1));
etaP(i) = (1-qw(i)/qin(i))*100

i = i+1;
end
figure(2)
plot(P,etaP)
title('Cycle Performance Variation with
Reheat Pressure')
xlabel('Reheat Pressure [MPa]')
ylabel('Cycle Efficieny (\eta_t_h) [%]')
grid on
grid minor

%Temperature Variation for P = 0.7 MPa
eta = 0.8;
T = [170 180 200 250 300 350 400 480 550
600];%Reheat Temperature
h5 = [2775.36 2799.38 2845.29 2954.12
3059.5 3164.13 3269.14 3439.22 3590.82
3700.9];
h6s = [2073.77 2090.35 2121.02 2188.68
2248.2 2302.33 2352.47 2426.3 2485.82
2525.98];
i = 1;
while i <= length(T)
% Specific Enthalpies at respective
states [kJ/kg]
h = [151.494
161.518%2s
0
3322.89
2685.63
0
h5(i)%h(7) to vary
h6s(i)%6s varies as a result
0]';
h(3) = (h(2)-h(1))/eta+h(1);
h(6) = h(4)-eta*(h(4)-h(5));
h(9) = h(7)-eta*(h(7)-h(8));

qin(i) = (h(4)-h(3))+(h(7)-h(6));
qw(i) = (h(9)-h(1));
etaT(i) = (1-qw(i)/qin(i))*100

i = i+1;
end
figure(3)
plot(T,etaT)
title('Cycle Performance Variation with
Reheat Exit Temperature for P = 0.7 MPa')
xlabel('Reheat Exit Temperature (T_5)
[^oC]')
ylabel('Cycle Efficieny (\eta_t_h) [%]')
grid on
grid minor
```