

Tutorial

- A. Determine W/m_f for a Claude Cycle with N_2 as working fluid. The system operates between 1.013 bar (1 atm) and 50.65 bar (50 atm). The expander inlet T_3 is at 250 K. The expander flow ratio is varied between 0.1 and 0.9. The efficiencies are as given below.

Comp.	$\eta_{oval,c} = 0.75$
Expd.	$\eta_{mech,e} = 0.86$
	$\eta_{ad,e} = 0.86$

- B. Repeat the above problem for $T_3 = 300$ K, 275 K and 250 K. Plot the data y , W/m_f versus x graphically and comment on the results.

Tutorial

Given

Cycle : Claude System

Working Pressure : 1 atm \rightarrow 50 atm

Working Fluid : Nitrogen

T_3 : 300 K, 275 K, 250 K

Mass flow ratio : $x = 0.1 \rightarrow 0.9$

Efficiencies : $\eta_{oval,c} = 0.75$, $\eta_{mech,e} = 0.86$, $\eta_{ad,e} = 0.86$

For above System, Calculate

1 Work/unit mass of gas liquefied

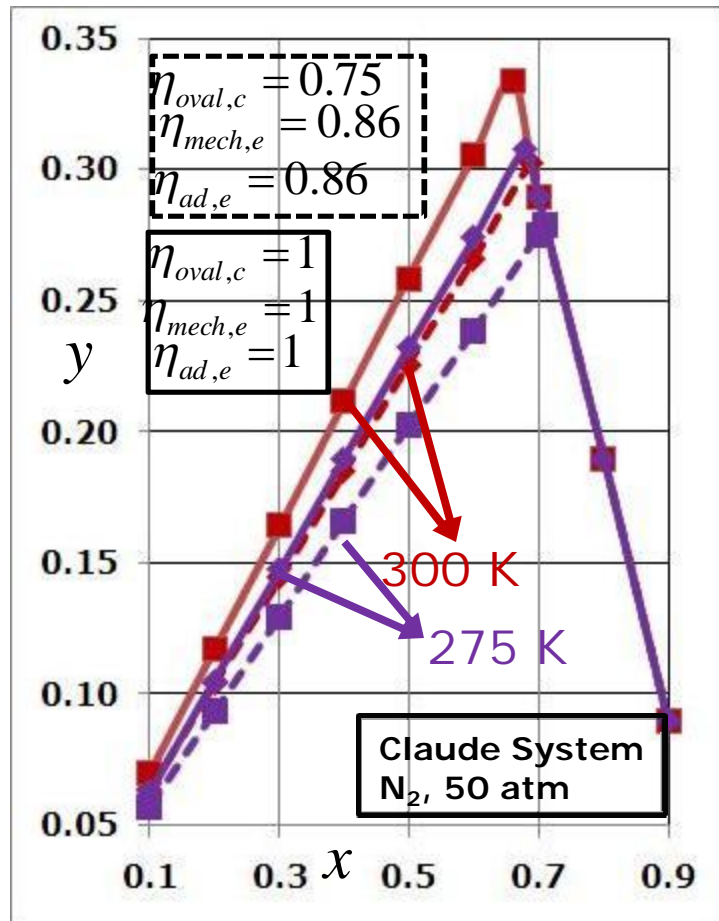
N_2	Point 3
I	300 K
II	275 K
III	250 K

Methodology

- In the earlier lecture, an assignment problem on a reversible Claude cycle with the answers was given.
- As stated earlier, the same problem is taken up and the effects of inefficiencies of the compressor and the expander are studied.
- All the calculations are left as an exercise for the students and the final results are graphically plotted.

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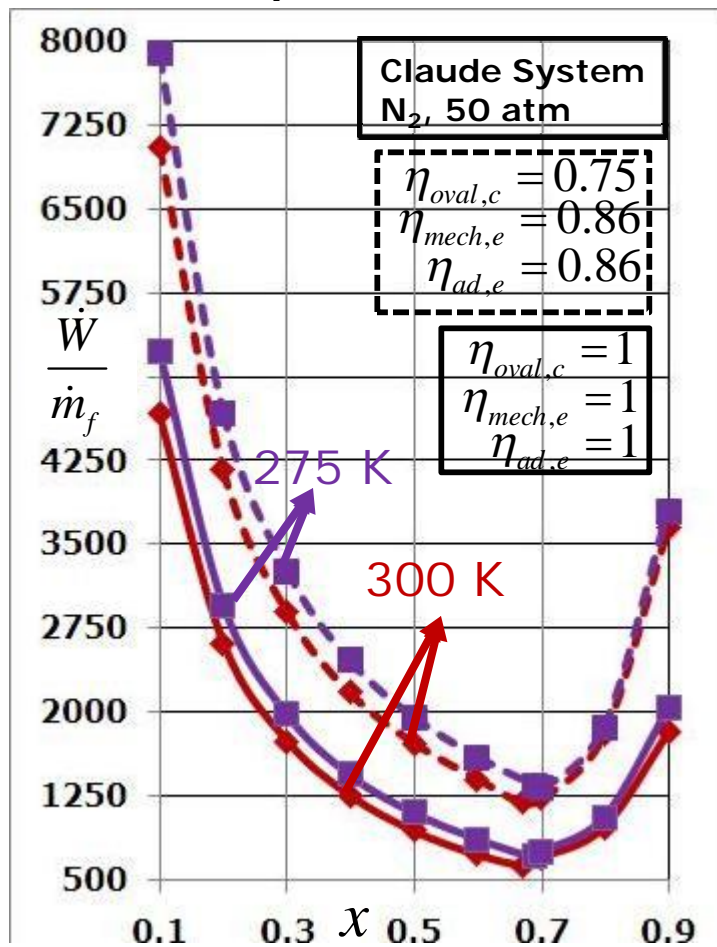
- Liquid yield v/s. x



- The plot for y v/s x for a $T_3 = 300$ and 275 K is shown.
- It is clear that maximum yield of the system decreases due to the irreversibility.
- The % decrease in the y_{max} is 10% and 9% for **300** and **275 K** respectively.

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- W/m_f v/s. x



- The plot for W/m_f v/s x for a $T_3 = 300$ and 275 K is shown.
- It is clear that minimum work requirement of the system increases due to the irreversibility.
- The % increase in the W/m_{fmin} is 89% and 87% for 300 and 275 K respectively.