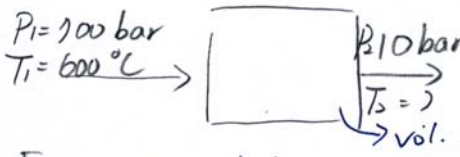
4.4 adiabatic expand



From mass balance

for steady state ↙ flow rate is constant

$$\frac{dM}{dt} = \dot{M}_1 + \dot{M}_2 \Rightarrow \dot{M}_2 = -\dot{M}_1 \quad -①$$

From energy balance

steady state. adiabatic No shaft work. vol. is constant

$$\frac{dU}{dt} = \dot{M}_1\hat{H}_1 + \dot{M}_2\hat{H}_2 + \dot{Q} + \dot{W}_s - P\frac{dV}{dt}$$

$$\Rightarrow \dot{M}_1\hat{H}_1 + \dot{M}_2\hat{H}_2 = 0 \quad -②$$

from eqn ① $\dot{M}_2 = -\dot{M}_1$

$\Rightarrow \hat{H}_1 = \hat{H}_2$ from Mollier Diagram $\hat{H}_1 = 3063\ kJ/kg$.

$\Rightarrow \hat{H}_2 = 3063\ kJ/kg$.

$\Rightarrow$ from Mollier Diagram $\hat{S}_1 = 5.5\ kJ/kg\cdot k$. $\hat{S}_2 = 7.3\ kJ/kg\cdot k$

$T_2 = 308°C$ ※

From entropy balance

steady state

$$\frac{dS}{dt} = \sum_{k=1}^{k} \dot{M}_k\hat{S}_k + \frac{\dot{Q}}{T} + \dot{S}_{gen}$$

$$\Rightarrow \dot{S}_{gen} = -\dot{M}_1\hat{S}_1 - \dot{M}_2\hat{S}_2$$

$$= -\dot{M}_1(\hat{S}_1 - \hat{S}_2) = -2\ kg/min\ (5.5\ kJ/kg\cdot k - 7.3\ kJ/kg\cdot k) = 4.4$$