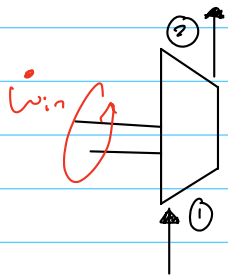
Trevor Swan **ECHE225: QUIZ #5 // 10.3.24**

3-6) Adiabatic Compressor



$P_2 = 2.5\,MPa$

$\dot{W}_{in} = 89.9\,kW$

$T_1 = 50°C$

Sat Vapor

$\dot{m} = 0.05\,kg/s$

3) Find Outlet °C T_2

$T_1 = 50°C$, Sat Vapor $\Rightarrow$ $P_1 = 12.852$, $h_g = h_1 = 2591.3$, $s_g = s_1 = 8.0748$

1st Law: $\dot{Q}_{in} - \dot{Q}_{out} + \dot{W}_{in} - \dot{W}_{out} = \dot{m}(h_2 - h_1)$

$\dot{W}_{in} = \dot{m}(h_2 - h_1)$

$h_2 = \frac{\dot{W}_{in}}{\dot{m}} + h_1 = \frac{89.9\,kW}{0.05\,kg/s} + 2591.30$

$h_2 = 4389.30$

$P_2 = 2.5\,MPa$, $h_2 = 4389.30$ $\Rightarrow$ $h_f < h_g < h_2$ $\overset{SH}{\Rightarrow}$ $T_2 = 900°C$

$\boxed{T_2 = 900°C}$

↖ Exact match @ $P = 2.5\,MPa$, no interpolation

4) Phase change fluid: isentropic -> $s_1 = s_2$

$T_1 = 50°C$, Sat Vapor $\Rightarrow$ $s_1 = 8.0748\ \frac{kJ}{kg\,K}$

$\boxed{s_2 = 8.0748\ \frac{kJ}{kg\,K}}$

5) ~~Entropy~~ $= 4149.2\ \frac{kJ}{kg}$? Enthalpy is in units $\frac{kJ}{kg}$, will assume enthalpy

$\dot{W}_{ideal} = \dot{m}(h_{2s} - h_1) = 0.05(4149.2 - 2591.3) = 77.895\,kW$

$\boxed{\dot{W}_{ideal} = 77.895\,kW}$

Assume Typo made

6) $\eta_c = \frac{h_{2s} - h_1}{h_{2A} - h_1} = \frac{\dot{W}_{ideal}}{\dot{W}_{actual}} = \frac{4149.2\ \frac{kJ}{kg} - 2591.30\ \frac{kJ}{kg}}{4369.30\ \frac{kJ}{kg} - 2591.30\ \frac{kJ}{kg}} = 0.866$