Gas turbine: add-ons, improvements: power production

1. Regeneration
2. Intercooling

Regenerator

Regenerator, 2-fluid HX

\[ T_1, T_2 \]

\[ M_{H1} \Delta h_{H1} + M_{C1} \Delta h_{C1} = 0 \]

Assume constant \( C_p \)

\[ M_{H1} = M_{C1} : T_{1y} - T_{1y} + T_{2z} - T_{2z} = 0 \]

Knowns vs Unknowns:

→ Ideal compressor: \( T_2 = T_1, \frac{k-1}{k} \)

→ Would know combustor exit \( T = T_3 \)

→ Turbine ideally \( T_4 = T_3 \frac{k}{k-1} \)

Need additional info to 'close' this problem

\[ \begin{align*}
4' &: 600 K \\
\text{Perfect HX} &: 900 K \\
2 &: 600 K \\
\text{Counterflow HX} &: 900 K \\
\end{align*} \]

→ Analyze cycle for perfect HX
→ Look at what happens when HX is not perfect.

\[ T_{2z} = T_{4y} \]

\[ \text{Quiz:} \quad L = 10^{-3} \text{ m}^3, \quad kW = \frac{1}{0.762} \text{ HP} \]

Given: 4L Spark ignition IC engine has a compression ratio of \( r = 8 \)

\[ V_D = 4L, \text{ assume constant } C_p, \frac{d}{k} = 1.4 \]

Heat input: \( q_H = 1500 \text{ kJ} \)

Engine operates @ 3000 RPM: Find Power output.