Effectiveness of A HX

- Ratio of the actual heat transfer rate to maximum available heat transfer rate.

$$\varepsilon = \frac{\dot{Q}_{act}}{\dot{Q}_{\max}}$$

- Maximum available temperature difference or minimum thermal capacity fluid.

$$\Delta T_{\max,\, fluid} = T_{h,i} - T_{c,i}$$

- Actual heat transfer rate:

$$\dot{Q}_{act} = UA\Delta T_{LMTD}$$

Dimensionless Groups for HXs

- Thermal capacity Ratio:

$$R = \frac{(\dot{m}c_p)_{\min}}{(\dot{m}c_p)_{\max}} = \frac{C_{\min}}{C_{\max}}$$

- $R = 0$ corresponds to condensing or evaporating HX.
- $R < 1$ *a general heat exchanger.*

- Exchanger heat communicative Effectiveness:

$$\varepsilon = \frac{\dot{Q}_{act}}{\dot{Q}_{\max}}$$

$\dot{Q}_{\max}$: Thermodyna mically limited maximum possible heat trans fer

Number of Transfer Units

$$\varepsilon = \frac{UA\Delta T_{LMTD}}{(\dot{m}c_p)_{\min}(T_{h,i} - T_{c,i})}$$

$$\varepsilon = NTU_{\max} \frac{\Delta T_{LMTD}}{(T_{h,i} - T_{c,i})}$$

$$\varepsilon = NTU_{\max} \frac{\dfrac{(\Delta T_{comm,2} - \Delta T_{comm,1})}{\ln\left[\dfrac{\Delta T_{comm,2}}{\Delta T_{comm,1}}\right]}}{(T_{h,i} - T_{c,i})}$$

Arithmetic of A Simple Counter Flow HX

Gn	UA
1	26587
2	26967
3	26541

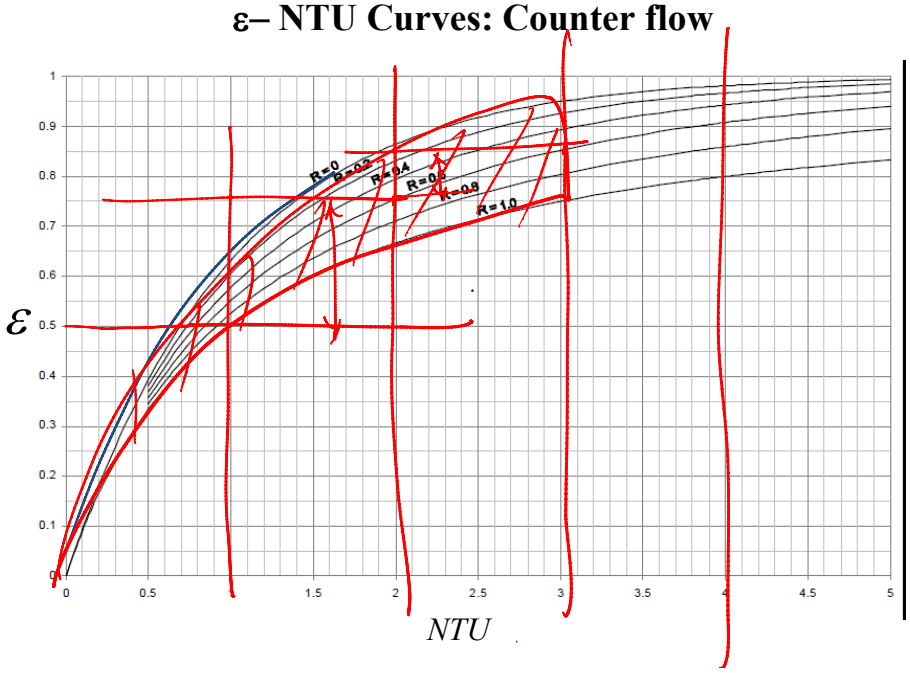
$$\varepsilon = \frac{1 - \exp\{NTU \times [R-1]\}}{1 - R \times \exp\{NTU \times [R-1]\}} = 0.86$$

$$NTU = \frac{\ln\left\{\dfrac{(1-\varepsilon)}{(1-R\varepsilon)}\right\}}{1-R}$$

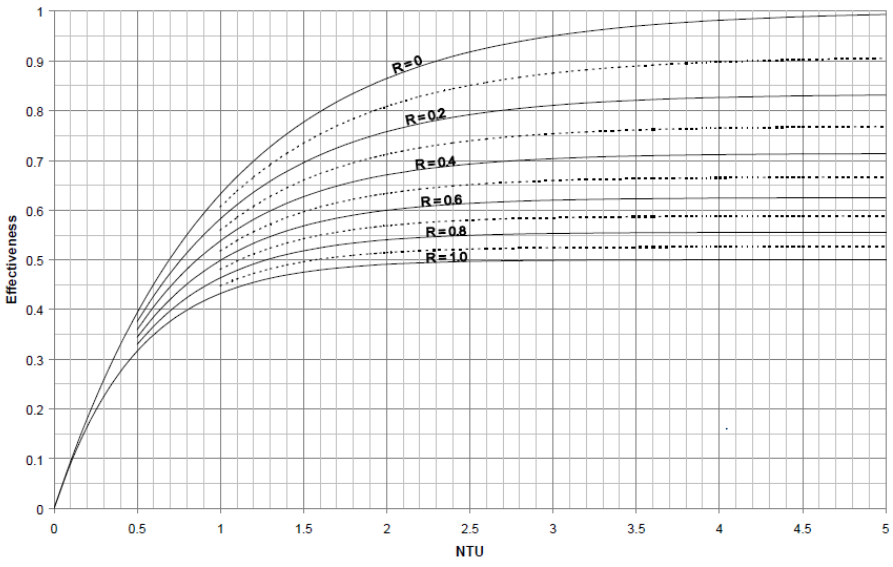
$$R = \frac{(\dot{m}c_p)_{\min}}{(\dot{m}c_p)_{\max}} = \frac{C_{\min}}{C_{\max}} = 0.57$$

$$NTU = \frac{UA}{C_{\min}} = 3.195$$

ε– NTU Curves: Counter flow



ε– NTU Curves: Counter Vs parallel flow



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Other web sources