HEAT TRANSFER

ANALYSIS OF HEAT EXCHANGERS

There are two methods used in the analysis of heat exchangers:

- Log mean temperature difference (LMTD) method
- Effectiveness (NTU) method

First law of thermodynamics requires that the rate of heat transfer from the hot fluid to be equal to the rate of heat transfer to the cold one. Hence

$$q = \dot{m}_c C_{pc}\left(T_{c,out} - T_{c,in}\right)$$
$$q = \dot{m}_h C_{ph}\left(T_{h,in} - T_{h,out}\right)$$

Where

$\dot{m}_c, \dot{m}_h$ = mass flow rates
C_{pc}, C_{ph} = specific heats
$T_{c,\,out}, T_{h,\,out}$ = outlet temperatures
$T_{c,\,in}, T_{h,\,in}$ = inlet temperatures

In heat exchanger analysis, it is often convenient to combine the product of mass flow rate and specific heat of a fluid into a single quantity. This quantity is called the **heat capacity rate** and it is define for the hot and cold fluid streams as

$$C_h = \dot{m}_h C_{ph}$$
$$C_c = \dot{m}_c C_{pc}$$

Hence

$$q = C_c\left(T_{c,out} - T_{c,in}\right)$$
$$q = C_h\left(T_{h,in} - T_{h,out}\right)$$

Note:
In a condenser or boiler

$$q = \dot{m} h_{fg}$$

Where

$\dot{m}$ is the rate of vaporization or condensation
h_{fg} is the enthalpy of vaporization