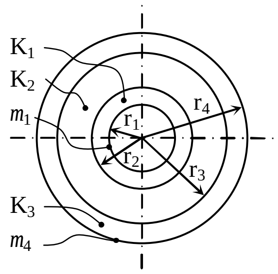
HEAT FLOW

<u>Conduction</u>: takes place in solid bodies (or thin layers of liquid or gas)

$$Q = k\,A\,\frac{\Delta t}{\Delta x}$$

Thermal conductivity: K – W/m.K



<u>Convection</u>: takes place in liquids and gasses (from a solid to air)

$$Q = m\,A\,\Delta t$$

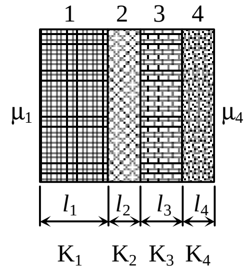
Heat transfer (convection) coefficient: m - W/m^2.K

<u>Pipes</u>:

$$Q = \frac{2\,p\,l\,\Delta t}{\frac{1}{m_1\,r_1} + \frac{1}{m_2\,r_2} + ... + \frac{1}{K_1}\ln\frac{r_2}{r_1} + \frac{1}{K_2}\ln\frac{r_3}{r_2} + ...}$$

<u>Walls</u>:

$$Q = \frac{A\,\Delta t}{\frac{1}{m_1} + \frac{1}{m_2} + ... + \frac{l_1}{K_1} + \frac{l_2}{K_2} + ...}$$



<u>Multi-Stage Compressors:</u>

In many high pressure applications compressors with more than two stages are needed. These compressors normally operate at minimum work conditions, requiring perfect intercooling. The power and pressure ratio formulae thus looks similar to those of the two stage compressor.

Pressure ratio $$\frac{P_2}{P_1} = \frac{P_3}{P_2} = \frac{P_4}{P_3} = ... = \frac{P_{x+1}}{P_x} = k$$

$P_2 = k\,P_1$ and $P_3 = k\,P_2 = k^2\,P_1$ and $P_4 = k\,P_3 = k^3\,P_1$ etc.

x number of stages
k stage pressure ratio

Thus $P_{(x+1)} = k\,P_x = k^x\,P_1$

Giving $k^x = \frac{P_{(x+1)}}{P_1}$ or $k = \sqrt[x]{\frac{P_{(x+1)}}{P_1}}$

Work done $$WD = \frac{xn}{n-1}P_1V_1\left[\left(\frac{P_{x+1}}{P_1}\right)^{\frac{n-1}{xn}} - 1\right] = \frac{xn}{n-1}P_1V_1\left[\left(\frac{P_2}{P_1}\right)^{\frac{n-1}{n}} - 1\right]$$

$\frac{P_2}{P_1}$ use $\frac{n-1}{n}$ or $\frac{P_{x+1}}{P_1}$ use $\frac{n-1}{xn}$ Thus $k^{\frac{n-1}{n}}$