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3. Heat transfer by conduction (One Dimensional unsteady-state)

Three types of problems to be discussed only;

a) Simplified case for the systems with negligible internal resistance (Lumped System Analysis)

b) Infinite body subjected to sudden convective

c) Transient heat flow in semi infinite solid:

Graphical solutions of unsteady state heat conduction problem, use of various charts for b and c

Example:

Properties of metal sphere:
ρ=3000 kg/m^3, k=20 W/mK, Cp=1000 j/kgK, α=6.66x10^{-6} m^2/s

r = 0.05 m

Ti=400°C

T∞ =20°C

To=335°C

Using Figure 6 →

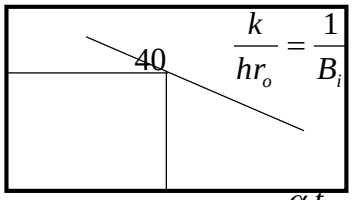
$$\frac{T_0 - T_\infty}{T_i - T_\infty} = \frac{335 - 20}{400 - 20} = 0.83$$

$$\frac{k}{hr_0} = \frac{20}{10 * 0.5} = 40$$

Read from Figure 6 as 0.25

Fig.6. Center temperature for a sphere of radius r_o

$\frac{T_o - T_\infty}{T_i - T_\infty}$ 0.83



$$\frac{\alpha t}{r_0{}^2} = 0.25 = \frac{(6.66x10^{-6})t}{(0.05)^2} \rightarrow t = 93.85s$$