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9. Heat transfer to fluids by forced convection in laminar and turbulent flows (cont.), analogy between transfer of momentum and heat

$$\frac{h}{C_p G} = \frac{f}{2} \text{ Reynolds analogy}$$

$$\frac{h}{C_p G} N_{Pr}^{2/3} = \frac{f}{2} = J_H \text{ Colburn analogy between heat transfer and fluid friction}$$

Example :

$\Delta P=30$ kPa, $L=75$ m, $D= 0.02$ m, $C_p= 1880$ J/kgK, $V= 3$ m/s

Re analogy;

$$\frac{h}{C_p G} = \frac{f}{2} \quad \frac{\Delta P}{\rho} = 2f \frac{LV^2}{D} \quad \text{Combining the two equations;}$$

$$f = \frac{2h}{C_p G} = \frac{2h}{C_p \rho V} \quad ; \quad \frac{\Delta P}{\rho} = 2 \frac{2h}{C_p \rho V} \frac{LV^2}{D}$$

$$30000 = 2 * \frac{2h}{1880*3} \frac{75*3^2}{0.02} \rightarrow h=1253 \text{ W/m}^2\text{K}$$