

EXPLICIT EQUATIONS FOR THE FRICTION FACTOR
Prepared for ENVE 204, Spring 2012

NOTE: $\ln(u) = 2.3026\log(u)$

JAIN EQUATION

$$\frac{1}{\sqrt{f}} = -2\log\left(\frac{\varepsilon/D}{3.7} + 5.74\text{Re}^{-0.9}\right) \implies f = \frac{1.325}{\left\{\ln\left(\frac{\varepsilon/D}{3.7} + 5.74\text{Re}^{-0.9}\right)\right\}^2}$$

(Use if $5000 < \text{Re} < 10^8$; $10^{-6} < \varepsilon/D < 10^{-2}$)

HAALAND EQUATION

$$\frac{1}{\sqrt{f}} = -1.8\log\left[\left(\frac{\varepsilon/D}{3.7}\right)^{1.11} + \frac{6.9}{\text{Re}}\right] \quad (4000 < \text{Re} < 10^8)$$

SWAMEE-JAIN EQUATIONS

$$h_f = 1.07 \frac{Q^2 L}{gD^5} \left\{ \ln \left[\frac{\varepsilon/D}{3.7} + 4.62 \left(\frac{vD}{Q} \right)^{0.9} \right] \right\}^{-2}$$

$$Q = -0.965 \sqrt{\frac{gD^5 h_f}{L}} \ln \left[\frac{\varepsilon/D}{3.7} + \left(\frac{3.17v^2 L}{gD^3 h_f} \right)^{1/2} \right]$$

$$D = 0.66 \left[\varepsilon^{1.25} \left(\frac{LQ^2}{gh_f} \right)^{4.75} + vQ^{9.4} \left(\frac{L}{gh_f} \right)^{5.2} \right]^{0.04}$$

Q : m³/sec (ft³/sec)
 g : m/sec² (ft/sec²)
 h_f, L, D, ε : m (ft)
 $v = \mu/\rho$: m²/sec (ft²/sec)

REFERENCES

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