Swamee-Jain Friction Factor

Brett Towler, UMass Amherst

The Swamee–Jain equation can be used to solve directly for the Darcy–Weisbach friction factor for a full-flowing pipe. It approximates the implicit Colebrook–White equation.

1. The following constants are used in this solution:

$$g := 32.17 \frac{ft}{sec^2}$$

2. The Reynolds Number is an intermediate calculation and an input to the Swamee-Jain equation.

$$RE(V, D, \nu) := \frac{V \cdot D}{\nu}$$

3. The friction factor can be approximated using the Swamee-Jain equation.

$$f(V, D, \nu, \varepsilon) := \frac{0.25}{\left(\log10\left(\frac{\varepsilon}{3.7 \cdot D} + \frac{5.74}{RE(V, D, \nu)^{0.9}}\right)^2\right)}$$

4. The Darcy-Weisbach describes the head loss in a circular pipe. The result is dependent on the velocity head, length, pipe diameter, and an estimate of the friction factor.

$$h_f(L, V, D, \nu, \varepsilon) := f(V, D, \nu, \varepsilon) \cdot \frac{L}{D} \cdot \frac{V^2}{2 \cdot g}$$

5. For example, the headloss through a 16-inch diameter, 300-foot-long pipe with a mean velocity of 6 feet-per-second can be calculated using the equations above.

$L_1 := 300\ ft$	length of the pipe
$V_1 := 6 \frac{ft}{sec}$	mean velocity through the pipe
$D_1 := 16\ in$	inside diameter of the pipe
$\nu_1 := 1.407 \cdot 10^{-5} \frac{ft^2}{sec}$	kinematic viscosity at 50 degrees Farenheit

Using the variables above as inputs to the functions created in steps 1 through 4:

$$h_f\left(L_1, V_1, D_1, \nu_1, 0.01\ ft\right) = 4.3655\ ft$$