

Colebrook-White Equation

The Colebrook-White equation gives the friction factor (λ) implicitly as a function of Reynolds number (Re) and relative roughness (k_s/D) in turbulent pipe flow:

$$\frac{1}{\sqrt{\lambda}} = -2.0 \log_{10} \left(\frac{k_s}{3.7D} + \frac{2.51}{\text{Re} \sqrt{\lambda}} \right). \quad (1)$$

The variables are:

λ = Darcy friction factor (defined by frictional head loss $h = \lambda \frac{L V^2}{D 2g}$);

Re = Reynolds number (defined here by $\text{Re} = \frac{VD}{\nu}$);

k_s = equivalent sand roughness height;

D = pipe diameter;

L = length of pipe;

Q = volumetric flow rate (aka *discharge* or *quantity of flow*);

V = bulk velocity (defined by $V = \frac{Q}{\pi D^2 / 4}$);

ν = kinematic viscosity.