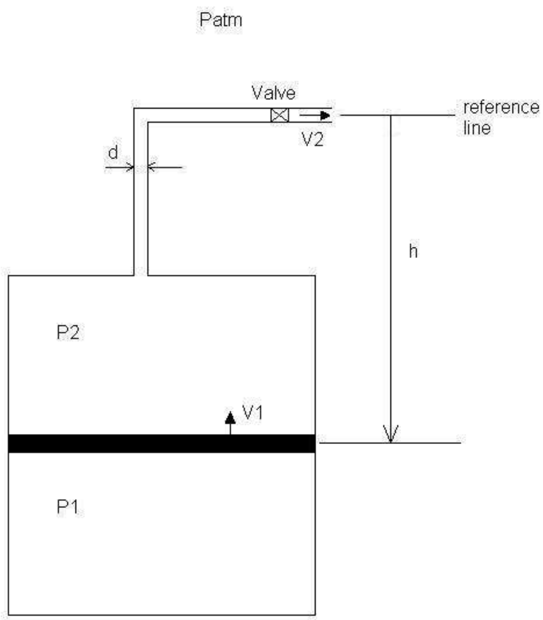

Darcy - Weisbach Equation for Pressure Loss over a Length of Pipe :

$$\Delta P_{friction} = f \frac{L}{D} \frac{\rho v^2}{2}$$

$\Delta P_{friction}$ - Pressure Drop over Pipe $[\mathrm{Pa}]$

$f = \lambda$ - Friction Factor

L - Length of Pipe $[\mathrm{m}]$

D - Hydraulic Diameter of Pipe $[\mathrm{m}]$ $\quad D = 2r$ for a circular c/s

ρ - Density of Fluid $[\mathrm{kg/m^3}]$

v - Average Velocity of Fluid Flow $[\mathrm{m/s}]$

Bernoulli's Equation :

$$P + \frac{1}{2}\rho v^2 + \rho g h = \text{Constant}$$

P - Pressure $[\mathrm{Pa}]$

ρ - Density of Fluid $[\mathrm{kg/m^3}]$

v - Average Velocity of Fluid Flow $[\mathrm{m/s}]$

g - Gravitational Acceleration $\quad g = 9{,}81\,[\mathrm{m/s^2}]$

h - Height above or below Mean $[\mathrm{m}]$

The valve is opened rapidly.

So putting the two equations together for this problem:

$$P_1 + \tfrac{1}{2}\rho v_1{}^2 + \rho g h_1 = P_2 + \tfrac{1}{2}\rho v_2{}^2 + \rho g h_2 + \Delta P_{friction}$$

Assuming densities are the same and that h_2 is on the reference line, $h_1 = -h$, and that v_1 is negligible compared to v_2 (large container, small pipe area) and rearranging:

$$P_1 - P_2 - \rho g h = \tfrac{1}{2}\rho v_2{}^2 + f\frac{L}{D}\frac{\rho v_2{}^2}{2}$$

$D = d$ in this example.

Making v_2 the subject of the formula:

$$\sqrt{\frac{2\left(\frac{P_1 - P_2}{\rho} - gh\right)}{1 + f\frac{L}{d}}} = v_2$$

- Does this appear correct?
- What am I missing here?
- Why does P_{atm} not come into it, should I include it (P_1 an P_2 are larger than Patm)?