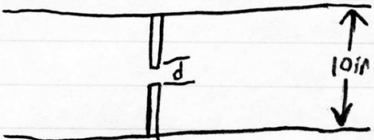
MET 330 HW 2.3

15.4




$sg = 0.83 \quad Q = 25\,gal/min$

$d = 1in, 7in \quad \eta = 2.5\times10^{-6}\,lb\cdot s/ft^2$

Calculate the deflection of a water manometer at $d = 1in$ and $d = 7in$

$\beta_1 = \frac{1in}{10in} = .1 \quad P_{Loss} = 96\%$ Figure 15.9

$\beta_7 = \frac{7in}{10in} = .7 \quad P_{loss} = 52\%$

$Q = 25\,gal/min = .416\,gal/s = .0557\,ft^3/s \qquad V = \frac{.0557\,ft^3/s}{\left(\frac{10}{12}\right)^2\cdot\pi/4} = .102\,ft/s$

$$N_R = \frac{V\cdot D\cdot\rho}{\eta} = \frac{.102\,ft/s\cdot\frac{5}{6}ft\cdot .83\cdot 62.4\,lb/ft^3}{2.5\times10^{-6}\,lb\,s/ft^2} = 1763082$$

$$\cancel{\frac{P_1}{\gamma} - h_L = \frac{P_3}{\gamma} \quad P_1 - \gamma h_L = P_3}$$

$$\frac{(P_1 - P_2)}{\gamma_F} = h\left(\frac{\gamma_m}{\gamma_F} - 1\right) \quad \cancel{h = \frac{P_1 - P_3}{\gamma_m - \gamma_F} = \frac{.04P_1}{62.4\,lb/ft^3\cdot(1-.83)} = \frac{.04P_1}{10.608\,lb/ft^3}}$$

$C_1 = .59 \quad C_7 = .61 \quad A_1 = (5/6\,ft)^2 = .694\,ft^2 \quad A_{2_1} = \left(\frac{1}{12}ft\right)^2 = .00694\,ft^2$

$A_{2_7} = \left(\frac{7}{12}ft\right)^2 = .34027\,ft^2$

$$h_1 = \frac{\left(\frac{Q}{A_1\cdot C}\right)^2\cdot\left[\left(\frac{A_1}{A_2}\right)^2 - 1\right]}{2g\left(\frac{\gamma_w}{\gamma_f} - 1\right)} = \frac{\left(\frac{.0557\,ft^3/s}{.694\,ft^2\cdot .59}\right)^2\cdot\left[\left(\frac{.694\,ft^2}{.00694\,ft^2}\right)^2 - 1\right]}{2\cdot 32.2\,ft/s^2\left(\frac{1}{.83} - 1\right)}$$

$$h_1 = \frac{(.136\,ft/s)^2\cdot((100)^2 - 1)}{64.4\,ft/s^2\,(1.2051)} = \frac{.0185\,ft/s^2\cdot 9999}{64.4\,ft/s^2\cdot .205} = \frac{184.8\,ft/lb}{13.19\,ft/lb} = \boxed{14\,ft}$$

$$h_7 = \frac{\left(\frac{.0557\,ft^3/s}{.694\,ft^2\cdot .61}\right)^2\cdot\left[\left(\frac{.694\,ft^2}{.340\,ft^2}\right)^2 - 1\right]}{2\cdot 32.2\,ft/s^2\left(\frac{1}{.83} - 1\right)} = \frac{(.131\,ft/s)^2\cdot(2.041 - 1)}{64.4\,ft/s^2\,(.205)} = \frac{.0173\,ft^2/s^2\cdot 1.041}{13.19\,ft/s^2} = \frac{.018\,ft^2/s^2}{13.19\,ft/s^2}$$

$= \boxed{.00136\,ft = .0164\,in}$

In this assignment I learned how to calculate the pressure drop caused by an orifice inserted into a pipe. I also learned that the pressure drop is largely based on the ratio of the pipe's diameter and the diameter of the orifice's hole. Finally, I learned that the pressure drop is exponential and not linear, based on the ratio mentioned above.

9)

Given: Linseed @ 77 °F

flowrate 700 gal/min to 1000 gal/min

manometer ranges from 0 to 8


$D = 4.805 \text{ in} \left(\frac{1 \text{ ft}}{12 \text{ in}}\right) = 0.400 \text{ ft}$

Flow rate $= 0.1259 \text{ ft}^2$

$g = 32.2 \text{ ft/s}^2$

$$1000 \text{ gal/min} \left(\frac{0.1337 \text{ ft}^3}{1 \text{ gal}}\right)\left(\frac{1 \text{ min}}{60 \text{ sec}}\right) = 2.228 \text{ ft}^3/\text{sec}$$

$$V_{max} = \frac{Q_{max}}{A} = \frac{2.228 \text{ ft}^3/\text{s}}{0.1259 \text{ ft}^2} = 17.69 \text{ ft/s}$$

$$N_R \text{ Max} = \frac{(17.69 \text{ ft/s})(0.400 \text{ ft})}{(3.84 \times 10^{-4} \text{ ft}^2/\text{s})} = 18416.6$$

$C = 0.96$ $\quad$ $8 \text{ in} = 0.667 \text{ ft}$ $\quad$ $\gamma_m = 844.9 \text{ lb/ft}^2$ $\quad$ $\gamma_w = 58 \text{ lb/ft}^2$

$$A_1 = \frac{A}{\sqrt{\frac{2gh\left(\frac{\gamma_m}{\gamma_w}\right)(c_{max})^2}{(V_{max}^2)} + 1}}$$

$$A_1 = \frac{0.1259 \text{ ft}^2}{\sqrt{\frac{2(32.2 \text{ ft/s}^2)(0.667 \text{ ft})\left(\frac{844.9 \text{ lb/ft}^2}{58 \text{ lb/ft}^2}\right)(0.96)^2}{17.68^2} + 1}}$$

$A_1 = 0.075 \text{ ft}^2$

$A = \frac{\pi}{4} d^2$

$$d = \sqrt{\frac{A_1 \times 4}{\pi}} = \sqrt{\frac{(0.075 \text{ ft}^2)(4)}{\pi}} = 0.309 \text{ ft}$$

$d = 0.309 \text{ ft} \times \left(\frac{12 \text{ in}}{1 \text{ ft}}\right)$

$\boxed{d = 3.71 \text{ in}}$

In this chapter I learned how to determine for diameter of the flow nozzle ; orifice. Also how to compute for velocity of flow and the volume flow rate as well as how to determine for the discharge coefficient by using the Reynolds number. In some cases discharge coefficient C have to be assumed and recompute at New Reynolds number.

15.5) $T_a$ @ $80^\circ$ $h = 0.24$ in, $\gamma = 0.0736$ lb/ft$^3$, $\gamma_g = 62.4$ lb/ft$^3$

$= 0.02$ ft

$$V_1 = \sqrt{2gh(\gamma_g - \gamma)/\gamma} \rightarrow \sqrt{2(32.2)(0.02)(62.4 - 0.0736)/0.0736} = 33.03 \text{ ft/s}$$

duct