Team 4

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Course: MET 330

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HW 1.3

Throughout the various problems that our group has encountered for this class, there have been many fluid mechanics that stood out to us. One of them is the fact that there is no pressure increment when moving horizontally within the same fluid; this particular mechanic emerged as we considered fluid properties while solving the problems in the Pressure Measurement chapter. Another important piece of knowledge was how we could use Bernoulli equation throughout this semester; specifically, when we will use Bernoulli equation to solve many different scenarios that would involve pump and turbine, but never friction loss as there would be a separate equation for that.

A few other things that we learned while reviewing these problems, is that the points that are picked to work the problem are very important. It doesn’t matter if we’re doing a problem with Pressure Measurement, or a problem dealing with Bernoulli’s Equations, picking the point with the most and least information will make the problem easier to work out. Also, the design considerations are something that we can’t forget about when attempting to solve a problem.

Richard Fox

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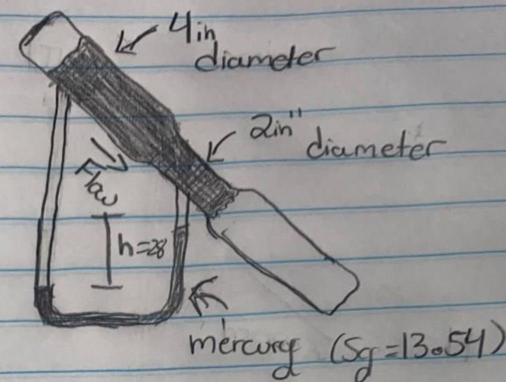
- Problem (6.79)



Given:

S.g. mercury = 13.54

h = 28 inch

$D_1 = 4 in$

$D_2 = 2 in$

$A_1 = \pi/4 \left(\frac{4}{12}\right)^2 = 0.087 \, ft^2$

$A_2 = \pi/4 \left(\frac{2}{12}\right)^2 = 0.022 \, ft^2$

$$\gamma_{oil} h + \gamma_{oil} H = \gamma_{Hg} H$$

$$h = \left(\frac{\gamma_{Hg}}{\gamma_{oil}} - 1\right) H \rightarrow \left(\frac{13.54(1000)}{0.9(1000)}\right)$$

$$h = 32.7 \, ft$$

$C_d = 1$

$$Q = C_d \frac{A_1 A_2}{\sqrt{A_1^2 - A_2^2}} \left(\sqrt{2gh}\right)$$

$$Q = 1 \left(\frac{0.087(0.022)}{\sqrt{0.087^2 - 0.022^2}}\right) \sqrt{(2)(32.2)(32.77)} = 1.045$$

$$\boxed{Q = 1.045 \, ft^3/s}$$

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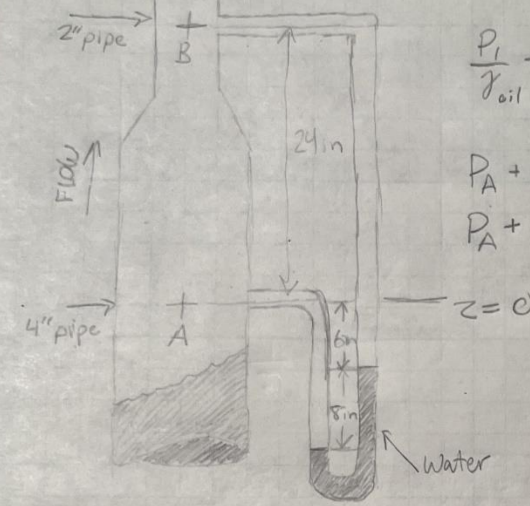
82) Oil with a specific weight of 55 lb/ft^3 flows from A to B. Calculate the volume flow rate of the oil.



$$\frac{P_1}{\gamma_{oil}} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{\gamma_{oil}} + \frac{V_2^2}{2g} + z_2$$

$$P_A + 14in(\gamma_{oil}) - 8in(\gamma_w) - 30in(\gamma_{oil}) = P_B$$

$$P_A + 14in(55\ lb/ft^3) - 8in(62.4\ lb/ft^3) - 30(55\ lb/ft^3) =$$

$$P_A + 64.17\ lb/ft^2 - 41.6\ lb/ft^2 - 137.5\ lb/ft^3 = P_B$$

$$P_A - 114.9\ lb/ft^2 = P_B$$

$$V_1 A_1 = V_2 A_2$$

$$V_A \cdot 4\pi = V_B \cdot \pi$$

$$4V_A = V_B$$

$$\frac{P_A}{\gamma_{oil}} + \frac{V_A^2}{2g} + z_A = \frac{P_B}{\gamma_{oil}} + \frac{V_B^2}{2g} + z_B$$

$$\frac{P_A}{55\ lb/ft^3} + \frac{V_A^2}{(2 \cdot 32.2\ ft/s^2)} + 0 = \frac{(P_A - 114.9\ lb/ft^2)}{55\ lb/ft^3} + \frac{V_B^2}{(2 \cdot 32.2)} + 2\ ft$$

$$\frac{\cancel{P_A}}{55\ lb/ft^3} + \frac{V_A^2}{64.4\ ft/s^2} = \frac{\cancel{P_A} - 114.9\ lb/ft^2}{55\ lb/ft^3} + \frac{16 V_A^2}{64.4\ ft/s^2} + 2ft$$

$$\frac{-15}{64.4} V_A^2 = \frac{-114.9\ lb/ft^2}{55\ lb/ft^3} + 2ft$$

$$V_A = \sqrt{-15/64.4\left(\frac{-114.9}{55} + 2\right)} = .144\ ft/s$$

$$Q = V_A A_A = .144\ ft/s \cdot 4\pi\ ft^2 = \boxed{.576\ ft^3/s}$$

HW 1.3

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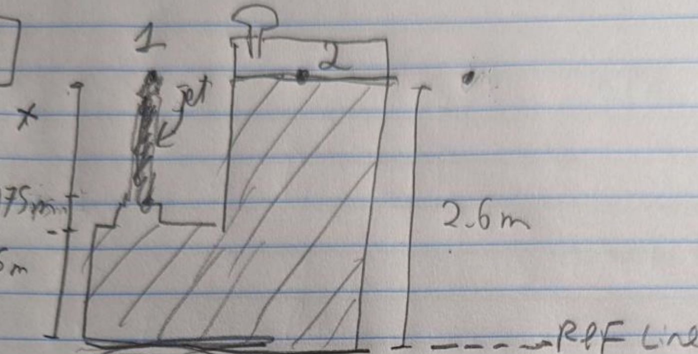

Torricelli's Theorem

$$\frac{P_1}{\gamma}+\frac{V_1^2}{2g}+z_1=\frac{P_2}{\gamma}+\frac{V_2^2}{2g}+z_2$$

P_1 & P_2 are simplified out as they're atm pressure

V_1 & V_2 are also simplified out to 0

V_1 is maximum height so it's not moving vertically

$$\cancel{\frac{P_1}{\gamma}}+\cancel{\frac{V_1^2}{2g}}+z_1=\cancel{\frac{P_2}{\gamma}}+\cancel{\frac{V_2^2}{2g}}+z_2$$

$(-0.85-0.075-x)=-2.6\,m$

$-x=-2.6\,m+.85+.075$

$x=1.675\,m$

$\therefore$ maximum height $=1.675+.85+.075=2.6\,m$