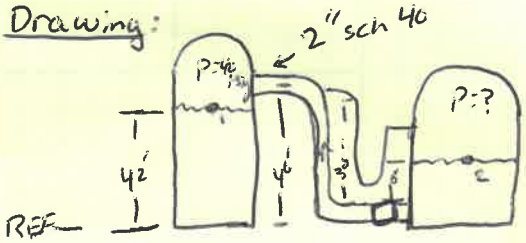
PURPOSE: Determine the required AIR pressure in the right tank so that Q is equal to 250 gal/min

Drawing:



Sources: MOTT, R., UNTENER, J.A. "APPLIED Fluid mechanics", 7th edition, pearson education, inc, 2015

Design Considerations

T = 77°F
- incompressible
- pipe size

DATA AND VARIABLES

T = 70°F
Q = 250 gal/min
2" sch 40
OD → 2.375"
ID → 2.067"
WALL → 0.154"

$S_{gJet} \rightarrow 0.787$

$S_w(\gamma) = 7.72\ kN/m^3 \rightarrow 1.54\ slug/ft^3 \rightarrow 0.0287\ lb/in^3$

Procedure

① FIND P_2 using BERNOLLIS equation $\frac{P_1}{\gamma} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{\gamma} + \frac{V_2^2}{2g} + z_2$

② Using P_2 Find Deflection in manometer

CALCULATIONS

$P_1 = 40$ psig

$P_2 = P_1 + \frac{\gamma}{2g}(V_1^2 + V_2^2) + \gamma(z_1 - z_2)$ $\quad V = Q/A$

$V = 962.5\ in^3/s \div 3.36\ in^2$

$P_2 = 40 + \frac{0.0287}{2(32.2)}(286.45^2 + 286.45^2) + (0.0287)(504 - 312)$

$P_2 = 40 + 0.000\,445\,65\,(164107.205) + (0.0287)(192)$

$P_2 = 40 + 73.134\,37 + 5.5104$

$\boxed{P_2 = 118.64\ psig}$

MANOMETER $\Rightarrow \Delta P = \gamma(h)$ $\quad \gamma_{mg} \rightarrow 132.8\ kN/m \rightarrow .4892\ lb/in^3$

$(118.64 - 40) = 0.0287\ lb/in^3\,(h)$

$\frac{78.64}{0.0287} = (h)\ 13.3\ ft$ $\quad \frac{\Delta H}{2} = 6.69\ ft$

SUMMARY

(1) The pressure required in the right tank to achive A Flow rate of 250 gal/min is 118.64 PSIG

(2) with that pressure the manometer will deform by 6.69 Feet

MATERIALS

Ethyl alcohol and mercury

ANALYSIS

Pressure IN the RIght tank is Higher causing the Fluid to move to the lower pressure tank on the left. the pressure Determines the Flow rate.

Purpose: Determine at what air pressure in the right tank will result in the stoppage of Flow, $Q=0$. Then determine the MANometer reading

Drawing:

Sources: MOTT, R., UNTENER, J.A., "APPLIED FLUID mechanics", 7th edition, pearson, education, inc, 2015

Design considerations:

$Q = 0$ in/s
$T = 77°F$
$Sg_{EA} \rightarrow 0.787$
$Sw_{(g)} \rightarrow 0.0287$ lb/in³
$Sw_{hg(g)} \rightarrow 0.4892$ lb/in³

2" Sch 40
ID → 2.067"
WALL → 0.154"
OD → 2.375"

Procedure:

① To find pressure 2 use Bernoulli's equation where velocity equals 0 & To find where the flow rate equals 0.
② Using that pressure Find Deflection of manometer

Calculations:

$V = Q/A \quad V = 0/A = 0 \quad V_1 = V_2$

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

$$\frac{P_1}{\gamma} + z_1 = \frac{P_2}{\gamma} + z_2$$

$$\frac{P_1}{\gamma} + (z_1 - z_2) = \frac{P_2}{\gamma}$$

$$\frac{P_2}{0.0287} = \frac{40\ psig}{0.0287} + (504" - 312")$$

$$\frac{P_2}{0.0287} = 1393.72 + 192"$$

$$P_2 = (1585.73)\ 0.0287$$

$$\boxed{P_2 = 45.5\ PSIG}$$

MANOMETER $\Rightarrow \Delta p = \gamma(h)$

$(45.5 - 40) = (0.4892\ lb/in^3)(h)$

$\frac{5.5\ PSIG}{0.4892\ lb/in^3} = (h)$ $\quad \boxed{h = 11.25''}$

SUMMARY

(1) The pressure in the right tank to stop flow with a flow rate of Q has to equal 45.5 PSIG

(2) WITH A FLOW RATE OF zero the height of the MANOMETER would be 11.25"

MATERIALS

Ethyl Alcohol and mercury

ANALYSIS

Pressure in the right TANK HAS to be slightly higher to push the fluid up the two inch pipe even though the flow rate is 0