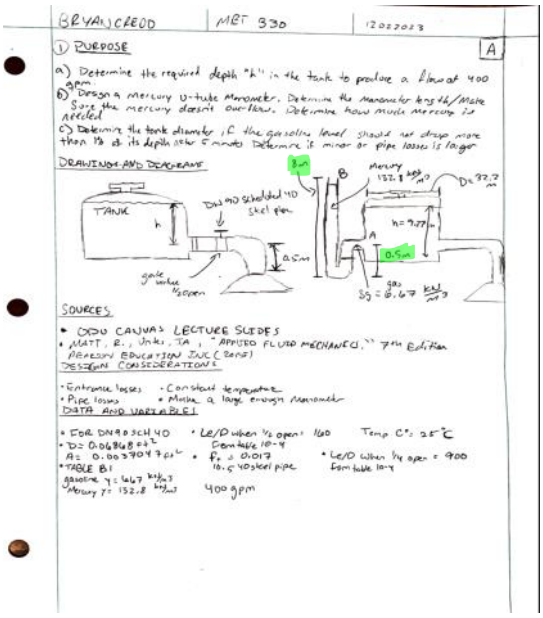


BRYAN CREED | MET 330 | 12022023

A

1) PURPOSE

a) Determine the required depth "h" in the tank to produce a flow at 400 gpm
b) Design a mercury U-tube Manometer. Determine the manometer height/size. Size the mercury density overhead. Determine how much mercury is needed
c) Determine the tank diameter if the gasoline level should not change more than 1% at its depth after 5 minutes. Determine if minor or pipe losses is larger

DRAWINGS AND DIAGRAMS

SOURCES

- ODU CANVAS LECTURE SLIDES
- MATT, R., Jnki, JA, "APPLIED FLUID MECHANICS," 7th Edition PEARSON EDUCATION INC (2011)

DESIGN CONSIDERATIONS

- Entrance losses
- Pipe losses
- Constant temperature
- Make a large enough Manometer

DATA AND VARIABLES

- FOR DN 90 SCH 40
- D = 0.06868 ft
- A = 0.003704 ft²
- TABLE B.1 gasoline γ = 6.67 kN/m³ Mercury γ = 132.8 kN/m³
- Le/D when ½ open: 160 from table 10-4
- f_T = 0.017 10.5" 40 steel pipe
- Le/D when ¼ open = 900 from table 10-4
- Temp C°: 25°C
- 400 gpm

Grading:

Writing Rubric:
1) Purpose: 0.5/10
2) Drawings: 1/10
3) Sources: 1/10
4) Design/Concept.: 1/10
5) Data and Variables: 0.5/10
6) Procedure: 2/10
7) Calculations: 2/10
8) Summary: 0.5/10
9) Materials: 0.5/10
10) Analysis: 1/10
total: 10/10

Part 1a:
1) 1/8
2) 1/8
3) 1/8
4) 2/8
5) 0/8
6) 0/8
7) 0/8
total: 5/8

Part 1b:
1) 1/6
2) 1/6
3) 2/6
4) 1/6
5) 0/6
total: 5/6

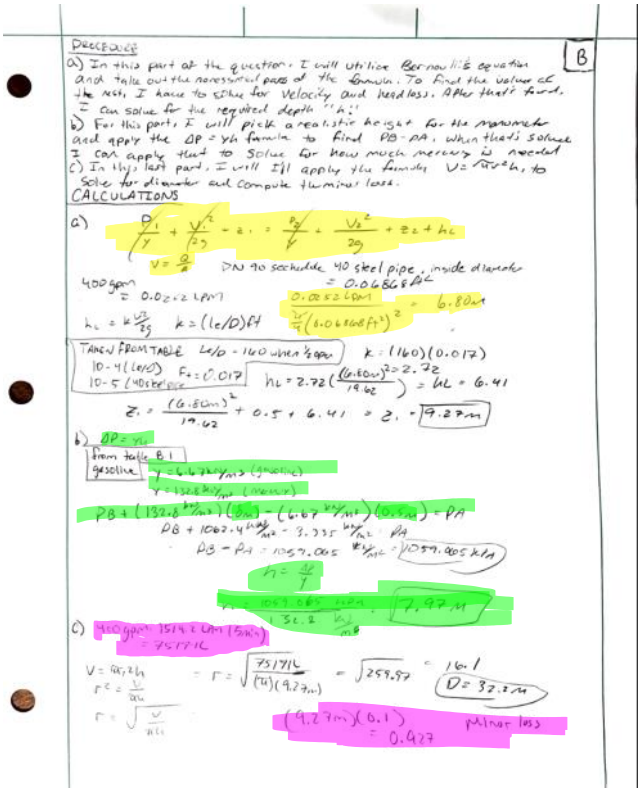
Part 1c:
1) 1/4
2) 0/4
3) 1/4
4) 0/4
total: 2/4

Part 2:
1) 0/8
2) 1/8
3) 0/8
4) 0/8
5) 1/8
6) 1/8
7) 0/8
total: 3/8

56.7%

↑

Final Grade



B

PROCEDURE

a) In this part of the question, I will utilize Bernoulli's equation and take out the unnecessary parts of the formula. To find the value of the next, I have to solve for velocity and head loss. After that's found, I can solve for the required depth "h".
b) For this part, I will pick a realistic height for the manometer and apply the $\Delta P = \gamma h$ formula to find PB - PA; which that's solved I can apply that to solve for how much mercury is needed
c) In this last part, I will apply the formula $V = \sqrt{2gh}$, to solve for diameter and compute the minor loss.

CALCULATIONS

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

$V = \frac{Q}{A}$ DN 90 schedule 40 steel pipe, inside diameter = 0.06868 ft

400 gpm = 0.02522 CFM | 0.02522 CFM / $\frac{\pi}{4}(0.06868\,ft)^2$ = 6.80 m/s

$h_L = k\frac{V^2}{2g}$ $k = (Le/D)f_T$

TAKEN FROM TABLE Le/D = 160 when ½ open $k = (160)(0.017)$

10-4 (Le/D) $f_T = 0.017$ $h_L = 2.72\left(\frac{(6.80m)^2}{19.62}\right) = 2.72$ $h_L = 6.41$

10-5 (40 steel pipe)

$z_1 = \frac{(6.80m)^2}{19.62} + 0.5 + 6.41$ $z_1 = 9.27m$

b) $\Delta P = \gamma h$

from table B.1 gasoline $\gamma = 6.67\,kN/m^3$ (gasoline)

$\gamma = 132.8\,kN/m^3$ (mercury)

$P_B + (132.8\,kN/m^3)(9.27m) = (6.67\,kN/m^3)(0.5m) + P_A$

$P_B + 1067.4\,kN/m^2 = 3.335\,kN/m^2 + P_A$

$P_B - P_A = 1057.065\,kN/m^2 = 1059.065\,kPa$

$h = \frac{\Delta P}{\gamma}$ $\frac{1059.065\,kPa}{132.8\,kN/m^3} = 7.97m$

c) 400 gpm = 1514 LPM (SI)

$= 25.233\,L/s$

$V = 9.27\,m/s$ $r = \sqrt{\frac{25.233}{(\pi)(9.27m)}} = \sqrt{259.97} = 16.1$ $D = 32.2m$

$r = \sqrt{\frac{V}{\pi L}}$ $(9.27m)(0.1) = 0.927$ minor loss

SUMMARY

C

a) The height at the required depth "h" is 9.28m giving me the value of the missing value in the picture

b) The height I selected was 8m to ensure the mercury doesn't overflow. The pressure difference is 1057.065 kPa, and after applying that to find the height of mercury, it is 7.93m which is less than my selected height.

c) The diameter of the tank is 32.2m and after multiplying the "h" by 1% it shows the minor loss is larger

MATERIALS

- Gasoline - Mercury - 90 NS Schedule 40 steel pipe
- 1/2 open gate valve - Manometer

Analysis:

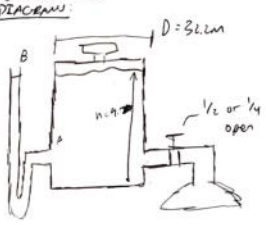
- After solving the height of the tank, It gave me an idea for the height selected for the manometer. After calculating the height of the mercury does not exceed the selected height of the manometer. The minor loss is larger.

(2) PURPOSE:

Determine the required depth h in the tank for different flow values when the gate valve is 1/4 open and the required depth h is equal to the one when the gate valve is 1/2 open. With the gate is 1/4 open, Solve for the U tube manometer reading, percentage of gasoline depth after 10 min and the percentage of minor losses

DRAWINGS AND DIAGRAMS:

(Excel Attached)



D

SOURCES

- ODU CANVAS LECTURE SLIDES
- MATT, R., UNTES, JA, "APPLIED FLUID MECHANICS," 7th EDITION PEARSON EDUCATION INC(2010)

DESIGN CONSIDERATIONS

- ¼ open gate valve - 10 mins of operation
- Constant temperature

DATA AND VARIABLES

- FOR DN 90 SCH 40
- D = 0.0680 ft
- A = 0.00370472 ft²
- TABLE B.1 gasoline γ = 6.67 kN/m³, mercury γ = 132.8 kN/m³
- Le/D ½ open = 160 from table 10-4
- ft = 0.017 10.5 40 steel pipe
- TEMP = 25°C
- Le/D ¼ open = 900 table 10-4

PROCEDURE

2) To start off I have to apply the same procedure from part (1a) to find the required depth when the valve is ¼ open. After, I get another, that will give me an idea how to plot the flow rate.

2a) Tabulate different values of flow rate and select for deflection.

2b) Convert the flow of 400 gpm and convert to LPM and find the % gas depth drop

2c) Use the minor loss equation and find the percentages

CALCULATIONS

¼ open = 900 Le/D

$h_L = f\frac{L}{D}\frac{v^2}{2g}$ $\quad k = (Le/D)\,ft$

$h_L = 15.8\left(\frac{(6.50)^2}{19.62}\right)$ $\quad (900)(0.017)$

$h_L = 36.06$ $\quad k = 0.017$

$$z_1 = \frac{(6.80)^2}{19.62} + 0.5 + 36.06$$

$$= 38.92\,m$$

The rest is plotted on excel

E

SUMMARY

2b) After finding the new required depth at the ¼ open valve (z = 38.92m) I plotted new values of height in the excel and plotted

2a) I ussed different pressure to solve for different deflections

2c) After using the minor loss equation, I solved for different velocity values

MATERIAL

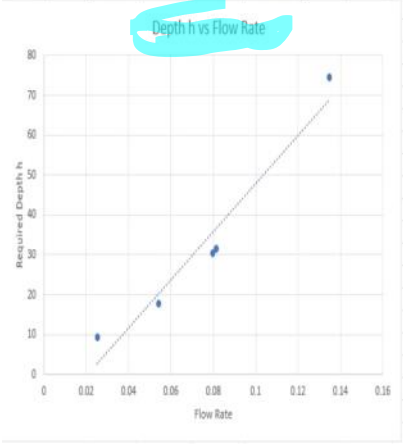
- GASOLINE
- ¼ open gate
- ½ open gate
- DN 90 SCH 40 STEEL PIPE
- MANOMETER

ANALYSIS:

- After plotting, As the height increases, the flow rate increases as well. Same as the deflection of the pressure for the manometer.

						A)U Tube Manometer				B)% of gas depth drop			
Velocity:	Flow Rate:	Cross Area:	Height (BE):			Pressure Kpa	SG for gasoline KN/m^3	Deflection		Flow LPM	Time (min)	h	

Velocity:	Flow Rate:	Cross Area:	Height (BE):
6.810811	0.0252	0.0037	9.27427849
14.64865	0.0542	0.0037	17.8469474
21.51351	0.0796	0.0037	30.4997688
21.97297	0.0813	0.0037	31.5181316
36.40541	0.1347	0.0037	74.461149



A)U Tube Manometer

Pressure Kpa	SG for gasoline KN/m^3	Deflection
1059.065	6.67	158.7803598
2315.768	6.67	347.1916042
4983.944	6.67	747.217991
5628.345	6.67	843.8298351
8391.672	6.67	1258.121739

B)% of gas depth drop

Flow LPM	Time (min)	h
1514.2	10	15142

C) Minor Loss

Velocity	K	hm (minor loss)	Percentage
6.81	15.3	36.16484862	0.361648486
14.64	15.3	167.1377615	1.671377615
21.51	15.3	360.8055826	3.608055826
21.97	15.3	376.4025367	3.764025367
36.41	15.3	1033.793472	10.33793472