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A

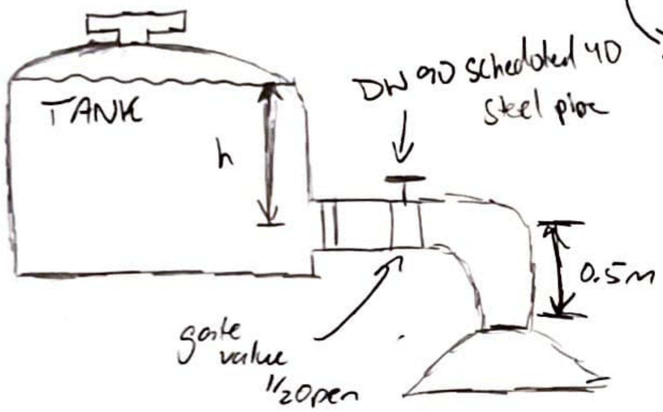
① PURPOSE

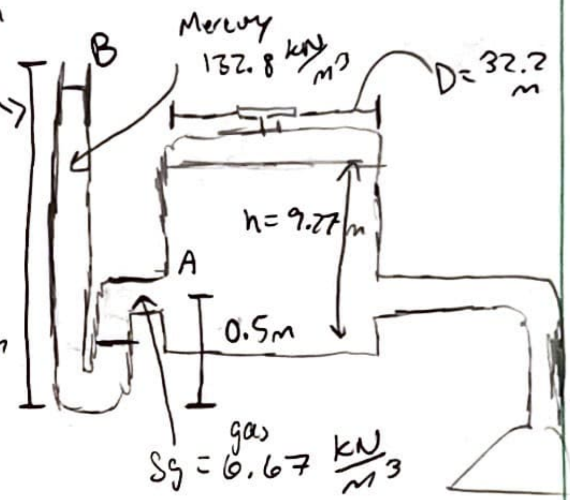
a) Determine the required depth "h" in the tank to produce a flow at 400 gpm.

b) Design a mercury U-tube Manometer. Determine the manometer length/Make sure the mercury doesn't overflow. Determine how much mercury is needed

c) Determine the tank diameter if the gasoline level should not drop more than 1% of its depth after 5 minutes. Determine if minor or pipe losses is larger

DRAWINGS AND DIAGRAMS





SOURCES

- ODU CANVAS LECTURE SLIDES
- MATT, R., Untes, JA, "APPLIED FLUID MECHANICS," 7th Edition PEARSON EDUCATION INC (2015)

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^2
  A = 0.0037047 ft^2
- TABLE B1
  gasoline γ = 6.67 kN/m3
  Mercury γ = 132.8 kN/m3
- Le/D when 1/2 open: 160
  from table 10-4
- f_T = 0.017
  16.5 40 steel pipe

400 gpm

Temp C°: 25°C

- Le/D when 1/4 open = 900
  from table 10-4

B

PROCEDURE

a) In this part of the question, I will utilize Bernoulli's equation and take out the nonessential parts of the formula. To find the value of the rest, 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, when that's solved I can apply that to solve for how much mercury is needed

c) In this last part, I will I'll apply the formula $V = \pi r^2 h$, 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 $= 0.06868 ft^2$

400 gpm $= 0.0252$ LPM

$$\frac{0.0252 \text{ LPM}}{\frac{\pi}{4}(0.06868 ft^2)^2} = 6.80 m$$

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

TAKEN FROM TABLE $L_e/D = 160$ when ½ open
10-4 (l_e/D) $F_t = 0.017$
10-5 (40 steel pipe)

$k = (160)(0.017) = 2.72$

$$h_L = 2.72\left(\frac{(6.80m)^2}{19.62}\right) = h_L = 6.41$$

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

b) $\Delta P = \gamma h$

from table B.1 gasoline

$\gamma = 6.67 kN/m^3$ (gasoline)

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

$$PB + (132.8 kN/m^3)(8m) - (6.67 kN/m^3)(0.5m) = PA$$

$$PB + 1062.4 kN/m^2 - 3.335 kN/m^2 = PA$$

$$PB - PA = 1059.065 kN/m^2 = 1059.065 kPa$$

$$h = \frac{\Delta P}{\gamma}$$

$$h = \frac{1059.065 kPa}{132.8 kN/m^3} = \boxed{7.97 M}$$

c) 400 gpm = 1514.2 LPM (5 min) = 7517 L

$V = \pi r^2 h$

$r^2 = \frac{V}{\pi h}$

$r = \sqrt{\frac{V}{\pi h}}$

$$= r = \sqrt{\frac{7517L}{(\pi)(9.27m)}} = \sqrt{259.97} = 16.1$$

$D = 32.2 m$

$$(9.27m)(0.1) = 0.927$$ Minor loss

C

SUMMARY

a) The height of the required depth "h" is 9.27m giving me the value at the missing value in the picture

b) The height I selected was 8m to ensue the mercury doesn't overflow. The pessure difference is 1059.065 kPa, and after applying that to find the height at mercury, it is 7.97m 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 - DN 90 Schedule 40 steel pipe
- 1/2 open gate valve - Manometer

Analysis:

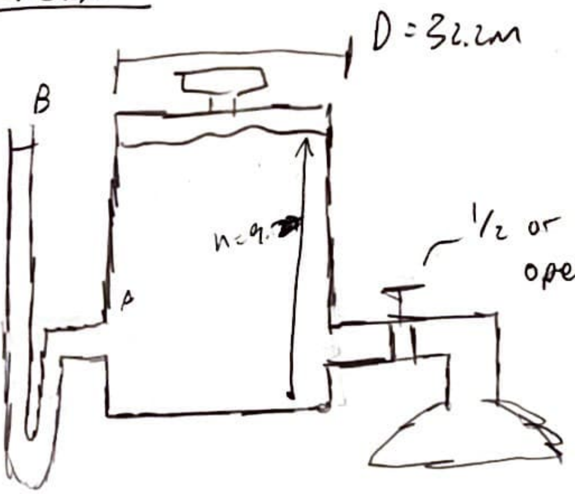
- After solving the height at the tank, It gave me an idea for the height I selected for the manometer. After calculating the height at the mercury does not exceed the selected height at the manometer. The minor loss is larger.

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. When the gate is 1/4 open, Solve for the U tube manometer reading, percentage at gasoline depth drop after 10 mins and the percentage at minor losses

DRAWINGS AND DIAGRAMS:

(Excel Attached)



D

SOURCES

- ODU CANVAS LECTURE SLIDES
- MATT, R., UNTES, TA, "APPLIED FLUID MECHANICSS," 7th EDITION PEARSON EDUCATION INC(2015)

DESIGN CONSIDERATIONS

- 1/4 open gate valve
- 10 Minutes of operation
- Constant temperature

DATA AND VARIABLES

- FOR DN 90 SCH 40
- $D = 0.06868 ft^2$
- $A = 0.003704 7 ft^2$
- TABLE B.1
  gasoline $\gamma = 6.67 \, kN/m^3$
  Mercury $\gamma = 132.8 \, kN/m^3$

- Le/D 1/2 open = 160
  from table 10-4
- $f_T = 0.017$
  10.5 40 steel pipe

TEMP = 25°C

Le/D 1/4 open = 900
table 10-4

PROCEDURE

2) To start all I have to apply the same procedure from part (1a) to find the required depth when the valve is 1/4 open. After, I get a value. That will give me an idea how to plot the h vs. flow rate.

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

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

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

CALCULATIONS

$1/4 \text{ open} = 900 \; Le/D$

$h_L = k \frac{v^2}{2g}$

$h_L = 15.3 \left(\frac{(6.80)^2}{19.62} \right)$

$h_L = 36.06$

$k = (Le/D) f_T$

$(900)(0.017)$

$k = 0.017$

$$Z_1 = \frac{(6.80)^2}{19.62} + 0.5 + 36.06$$

$$= 38.92 m$$

The rest is plotted on excel

E

SUMMARY

2) After finding the new required depth at the 1/4 open valve (z = 58.92m) 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 different values

MATERIALS

- GASOLINE
- 1/2 open gate
- 1/4 open gate
- manometer
- DN 90 SCH 40 STEEL PIPE

ANALYSIS:

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