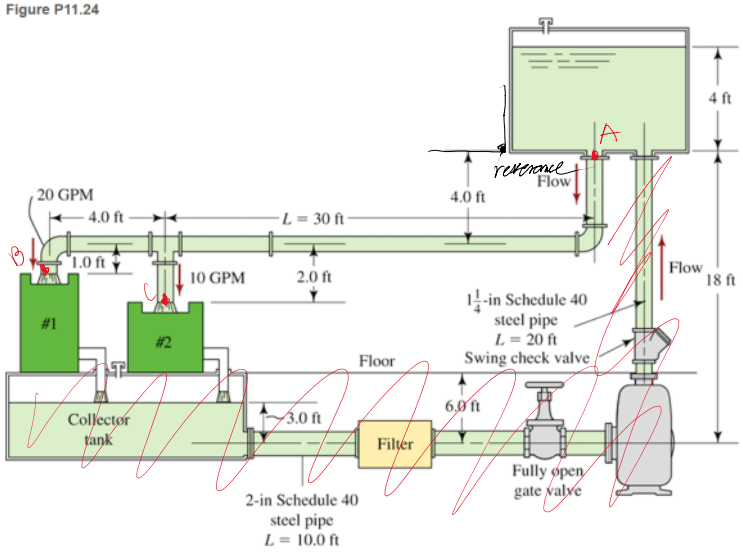
Homework 3.2 Chapter 11 Problem 26

Thursday, March 28, 2024 9:08 AM

11.26 For the system in Fig. P11.24, specify the size of Schedule 40 steel pipe required to return the fluid to the machines. Machine 1 requires 20 gal/min and Machine 2 requires 10 gal/min. The fluid leaves the pipes at the machines at 0 psig.

Figure P11.24



$S_g = 0.92$ $\quad 3.6 \cdot 10^{-5} \frac{lb \cdot s}{ft^2}$

$0.92 \cdot 62.4 \ lb/ft^3 = 57.408 \frac{lb}{ft^3} = \gamma$

$P_A = 4 ft \cdot 57.408 \frac{lb}{ft^3} = 1.594 \ psi$

$\frac{\Delta p}{\gamma} = h_L$

$\varepsilon = 1.5 \cdot 10^{-4} \ ft$

$\frac{\Delta p}{\gamma} = h_{Length} + h_{elbow} + h_T + h_{L2} + h_{ebow} - z$

$\frac{\Delta p}{\gamma} = h_L + h_{elbow} + h_T + h_{L3} - z$

$\frac{\Delta p}{\gamma} = \frac{V_1^2}{2g}\left(K\frac{L}{D} + K_{elbow}\right) + \frac{V_2^2}{2g}\left(K\frac{L}{D} + K_{elbow} + K_T\right) - z_B$

$\frac{\Delta p}{\gamma} = \frac{V_1^2}{2g}\left(K\frac{L}{D} + K_{elbow}\right) + \frac{V_3^2}{2g}\left(K\frac{L}{D} + K_T\right) - z_C$

excel time

Pressures										
a	229.632 lb/ft^3									
b	229.632 lb/ft^3									
c	229.632 lb/ft^3									
Specific Gravity										
	0.92									
	0.92				Q1		Q2		Zb	
	0.92	B Route		4	9.421883	-	2.237159	-	5	6.659042399
Density					Q1		Q3		Zc	
	1.7848 lb/ft^3	C Route		4	- 9.421883	-	0.579367	-	6	- 4.001249897
	1.7848 lb/ft^4									
	1.7848 lb/ft^5									
Specific Weight										
	57.408									
Diameter										
	0.3875 ft									
	0.3875 ft									
	0.3875 ft									
Flwo Rate										
	0.0668403 ft^3/s									
	0.0445602 ft^3/s									
	0.0222801 ft^3/s									
Velocity										
	0.566767705 ft/s									
	0.377845136 ft/s									
	0.188922568 ft/s									
Velocity head										
	5.171732659 ft									
	2.298547848 ft									
	0.574636962 ft									
Reynolds Number										
	10888.39478									
	7258.929855									
	3629.464927									
Friction factor										
	0.015472855									
	0.015472855									
	0.015472855									
LA										
	34 ft									
LB										
	5 ft									
LC										
	7 ft									

Based on this sheet a pipe diameter of 0.3875 ft is required. I just plugged in various values for D until both equations were satisfied.