Test 2- Fluids Amira Lucas Elson Edmonds II Professor Ayala December 8, 2024

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# Purpose

The purpose of the first question is to redesign a pipeline system to deliver at least 50% more of the original flow rate and account for all minor losses. Also, to resign with two options; increasing the pump to a larger one and using that same pump but increasing the pipe sizes.

#### **Drawings & Diagrams**

 Test 3. Fluids	
$Q + 50\% = 5.081 \text{ s}^{-3}        $	R
11=0.6 V=1.21×10-5 FF-	(volde)
$L_{d} = 2500 \text{ FL}$ $g = 32.2 \frac{11}{52}$	hmp
$\varepsilon = 1.5 \times 10^{-4} \text{ Ft}$	
7.0	TREF (6)
	d = 4Q = 33 = 9.842 ft
	VTT V
	$d = \frac{4(5.081 \text{ ft})}{\pi(a \times 42 \text{ ft})} \approx 9.73 \text{ in }$

#### Sources

- My notes
- Applied Fluid Mechanics 8th Edition, Robert L. Mott & Joseph A. Untener
- Canvas Module slides

# **Design Considerations**

- 50% more flow rate
- Suction pipe length = 11 ft
- Discharge pipe length 2500 ft
- Water at 60F

# **Data and Variables**

Volumetric Flow Rate	$Q = 5.081 \text{ ft}^3/\text{s}$
Velocity	V = 14.6 ft/s
Change in Pressure	$\Delta P$
Density of Water	$ \rho_{w} = 62.4  \text{lb/ft}^{3} $
Area	A= 0.3472 ft^2
Gravity	$g = 32.2 \text{ ft/s}^2$
Pump Head	hA= 260 ft
Energy loss due to friction	$hL = h_{L_{sution}} + 3 \cdot h_{L_{elbows}} + h_{L_{valve}} + h_{L_{disrchage}}$
Reynolds Number	Re= 802397
Friction Factor	f= 0.0152
Friction Coefficient	fT= 0.014
Length Suction	11 ft

Length Discharge 2500 ft
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#### Procedure

- 1. First I calculated Q+50%, then I used an 8-in schedule 40 steel pipe like test 2.
- Next, I used Bernoulli's equation to account for all the minor losses and solved for the pump head.
- 3. I had to calculate the  $\frac{D}{\varepsilon}$ , Reynolds number, friction factor and friction coefficient to solve for hL.
- 4. After finding all my minor losses, then I could calculate the hA and use the to solve for pump power.

For the redesign:

- A. We replaced our pump with a large one that can compensate for the increased pump power and kept the diameter the same and adjusted our excel sheet.
- B. We used the pump power calculated in test 2, and increased our pipe diameters and determined a better size pipe for the increased flow using an iteration process.