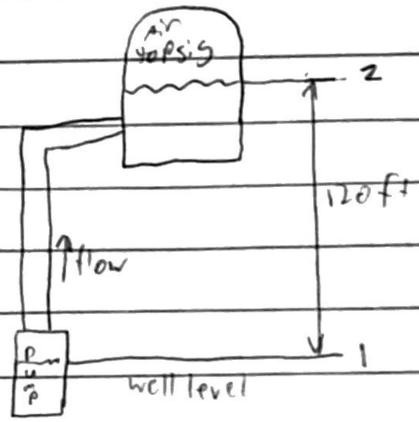
Homework 1.4 MET330 Hunter Yang



7.11 1 in schedule 40 pipe = $D_{in} = 1.05$

energy loss: $h_L = 10.5$ lbft/lb

745 gal/h = Q = .02766 ft³/s

$$h_A + \cancel{\frac{P_1}{\gamma}} + \cancel{\frac{v_1^2}{2g}} + z_1 = \frac{P_2}{\gamma} + \cancel{\frac{v_2^2}{2g}} + z_2 + \cancel{h_R} + h_L$$

$$h_a = \frac{P_2}{\gamma} + z_2 - z_1 + h_L$$

$$h_a = \frac{40\ \text{lb/in}^2}{62.4\ \text{lb/ft}^3} + 120\ \text{m} + 10.5\ \text{lb·ft/lb}$$

$$\cancel{h_a = \frac{5760\ \text{lb/ft}^2}{62.4\ \text{lb/ft}^3} + 120\ \text{m} + 10.5\ \text{lb·ft/lb}}$$

$$h_a = 222.4\ \text{lb·ft/lb}$$

$$P_A = \gamma Q h_A = 62.4\ \text{lb/ft}^3 \cdot .02766\ \text{ft}^3\text{/s} \cdot 222.81\ \text{lb·ft/lb}$$

$$P_A = 384.56\ \text{lbft/s} \cdot \frac{1\ \text{hp}}{550\ \text{lb·ft/s}} = 0.699\ \text{hp}$$

$$\text{efficiency} = \frac{\text{Actual}}{\text{theoretical}} = \frac{.699}{1.0} = \underline{69.9\%}$$

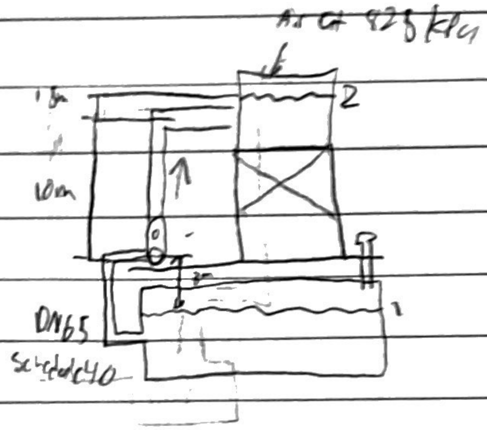
7.16

$Q = 840\ L/min = .014\ ^{ks}/_{s}$

Oil $sg = .85$, $\gamma_{oil} = 8313\ kn/m^3$

$h_L = 4.2\ N\cdot m/N$

$P_A = \gamma Q h_A$



$$h_A + \cancel{\frac{p_1}{\gamma}} + \cancel{\frac{v_1^2}{2g}} + z_1 = \frac{p_2}{\gamma} + \cancel{\frac{v_2^2}{2g}} + z_2 + \cancel{h_R} + h_L$$

$$h_A = \frac{p_2}{\gamma} + z_2 - z_1 + h_L$$

$$h_A = \frac{828\ kN/m^2}{8313\ kn/m^3} + 14.5m + 4.2\ N\cdot m/N$$

$$h_A = \frac{828000\ N/m^2}{8313\ N/m^3} + 14.5m + 4.2\ Nm/N$$

? $h_A = 99.24m + 14.5m + 4.2\ N\cdot m/N$

$h_A = 117.94$

$P_A = 8.313\ kN/m^3 \cdot .014\ ^{ks}/_{s} \cdot 117.94\ N\cdot m/N$

$.85 = \frac{\rho_{oil}}{997}$

$\rho_{oil} = 847.45\ kg/m^3$

$\gamma_{oil} = 847.45 \cdot$

$\gamma_{oil} = 8.313\ kN/m^3$

8.33 Darcy's energy loss: $h_L = f \cdot \frac{L}{D} \cdot \frac{v^2}{2g}$

6in schedule 40 = D_{in} = 6.07in = .505 ft

L = 550 ft, η @ 60° = $9.25 \cdot 10^{-6}$ ft²/s, Q = 2.5 ft³/s

$V_2 = \frac{Q}{A} = \frac{2.5\,ft^3/s}{\pi(.2525)^2}$

$V_2 = 12.481$ ft/s

$Re = \frac{VD}{\eta} = \frac{12.48\,ft/s \cdot .505\,ft}{9.25 \cdot 10^{-6}\,ft^2/s}$

$Re = 681340.54 = 6.81 \cdot 10^5$

$RR = \frac{\epsilon}{d} = \frac{8.2 \cdot 10^{-5}}{.505} = 1.62 \cdot 10^{-4}$

$f \approx .014$ according to moody chart

$h_L = .014 \cdot \frac{550\,ft}{.505} \cdot \frac{(12.481\,ft/s)^2}{2g}$

$h_L = 36.88$ lb·ft/ft

$\gamma = \rho g$

$P_2 = \rho_w \cdot h$

$h = Z_2$

$h_A + \frac{P_1}{\gamma} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{\gamma} + \frac{V_2^2}{2g} + Z_2 + h_R + h_L$

?

$Z_1 = \frac{V_2^2}{2g} + h_L$

$Z_1 = \frac{12.481^2}{2(32.2)} + 36.88 = \underline{39.29\,ft}$