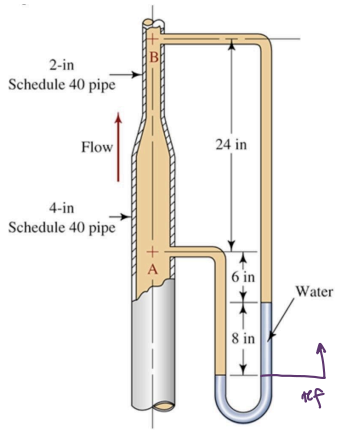
Hw2.1

quarta-feira, 2 de outubro de 2024 17:53

6.82



$\gamma_{oil} = 55\ lb/ft^3$

$Q = ?$

$Q = V \times A$

$$\frac{P_A}{\gamma} + \frac{V_A^2}{2g} + z_A = \frac{P_A}{\gamma} + \frac{V_A^2}{2g} + z_B + h_{L_{A-B}}$$ (energetic)

$$\frac{P_A - P_B}{\gamma} = \frac{V_B^2 - V_A^2}{2g} + (z_B - z_A)$$

$$\frac{P_A - P_B}{\gamma} = \frac{\frac{Q^2}{A_B^2} - \frac{Q^2}{A_A^2}}{2g} + (z_B - z_A)$$

$$Q = \sqrt{\frac{\frac{P_A - P_B}{\gamma} + (z_B - z_A)}{\frac{1}{2g}\left[\frac{1}{A_B^2} - \frac{1}{A_A^2}\right]}}$$

$$P_A + \gamma_{oil}(14) - \gamma_{H_2O}(8) - \gamma_{oil}(30) = P_B$$

$$P_A - P_B = \gamma_{oil}(30 - 14) + \gamma_{H_2O}(8)$$

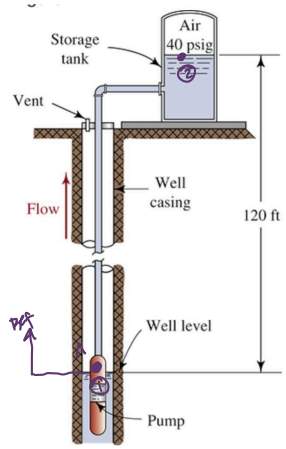
$$\frac{P_A - P_B}{\gamma_{oil}} = (30 - 14) + \gamma_{H_2O}(8) = 16 + 62.4(8)$$

$$\frac{P_A - P_B}{\gamma_{oil}} = 515.2$$

$$Q = \sqrt{\frac{\frac{P_A - P_B}{\gamma} + (z_B - z_A)}{\frac{1}{2g}\left[\frac{1}{A_B^2} - \frac{1}{A_A^2}\right]}} = \frac{515.2 + 24}{\frac{1}{2(32.17)}\left[\frac{1}{(\pi \cdot 2.045^2)^2} - \frac{1}{(\pi \cdot 1.033^2)^2}\right]}$$

$Q = -419711.58$

7.11



$Q = 745$ gal/h

1 in · schedule 40 pipe → $d = 1.049$

$h_L = 10.5$

$\mathcal{P} = \gamma Q h_A$

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

$$h_A = (z_2 - z_1) + \frac{P_2}{\gamma} + h_L$$

$$40 \frac{lb}{in^2}\left[\frac{144\ in^2}{ft^2}\right] = 5760$$

$$h_A = (120 - 0) + \frac{5760}{62.4} + 10.5$$

$$h_A = 120\ ft + \frac{5760}{62.4}\frac{lb}{ft^2}\frac{ft^3}{lb} + 10.5\ \frac{lb\text{-}ft}{lb} = 222.80\ lb\text{-}ft/lb$$

$$\mathcal{P} = \gamma Q h_A = 62.4 \times 0.2 \times 222.8 = 2877.09$$

$$\mathcal{P} = 2877.09\ ft\text{-}lb/s$$

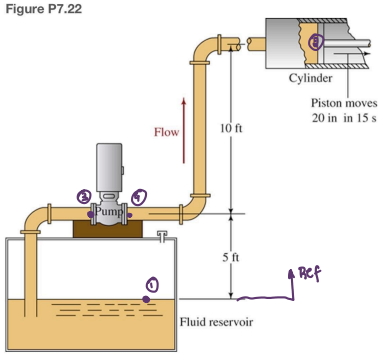
$$745 \frac{gal}{hr}\left[\frac{1\ hr}{3600\ sec}\right] = 0.20\ gal/sec$$

$$e_A = \frac{\mathcal{P}}{\mathcal{P}_{input}} \quad \text{if } \mathcal{P}_{input} = 1\ hp = 550\ ft\text{-}lb/s$$

$$e_A = \frac{2877.09}{550} = 5.23$$

7.22

Figure P7.22



$Sg = 0.90 \rightarrow \gamma_{oil} = 56.16$

$d = 5$ in

$V = \frac{20\ in}{15} = 1.33$ in/s

$F = 11000$ lb

$h_L = 11.5$ (suction pipe)

$h_L = 35$ (discharge pipe)

$d_{pipe} = 0.423$

$Q = V \times A \quad = 1.33 \times (\pi (.0423)^2)$

$Q = 0.748 \text{ in}^3/\text{s} \left[\frac{1 \text{ ft}^2}{1728 \text{ in}^3}\right] = 0.00043 \text{ ft}^3/\text{s}$

$P = F/A \quad = \frac{11000 \text{ lb}}{\pi (5)^2} = \frac{11000}{7854} \frac{\text{lb}}{\text{in}^2} \left[\frac{144 \text{ in}^2}{1 \text{ ft}^2}\right] = 20168.07 \frac{\text{lb}}{\text{ft}^2}$

$\frac{P_4}{\gamma} + \frac{V_4^2}{2g} + Z_4 = \frac{P_2}{\gamma} + \frac{V_2^2}{2g} + Z_2 + h_L$

$P_4 = \gamma \left[\frac{V_2^2}{2g} + \frac{P_2}{\gamma} + Z_2 - Z_4 + h_L\right]$

$P_4 = 56.16 \left[\frac{\frac{0.00043}{\pi 0.0002^2}}{2 \times 32.17} + \frac{20168.07}{56.16} + 15 - 5 + 35\right]$

$P_4 = 8765.75$

$\frac{P_1}{\gamma} + \frac{V_1^2}{2g} + Z_1 = \frac{P_3}{\gamma} + \frac{V_3^2}{2g} + Z_3 + h_L$

$\frac{P_3}{\gamma} = Z_1 - Z_3 - \frac{V_3^2}{2g} - h_L$

$P_3 = \gamma \left[Z_1 - Z_3 - \frac{V_3^2}{2g} - h_L\right]$

$P_3 = 56.16 \left[0 - 5 - \frac{\frac{.00043}{\pi 0.0002^2}}{2 \times 32.17} - 11.5\right]$

$P_3 = -9223.27$

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

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

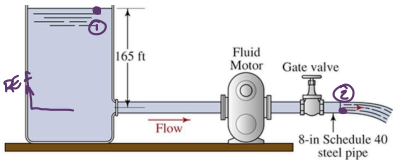
$h_A = \frac{20168.07}{56.16} + \frac{\frac{0.00043}{\pi 0.0002^2}}{2 \times 32.17} + 15 - 0 + 35 + 11.5$

$h_A = 568.35$

$HP = Q \gamma h_A = 0.00043 \times 56.16 \times 568.35$

$HP = 13.72$

7.30



$V = 1000\ gal/min = 2.23\ ft^3/s$

$P = 37\ hp$

$h_L = ?$

$d = 7.981\ in = 0.665\ ft$

$$Q = \frac{2.23}{\pi(0.3325)^2} = 6.42$$

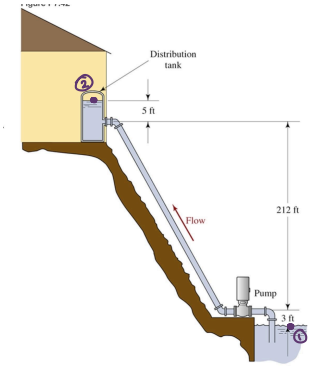
$$\frac{P_1}{\gamma} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{\gamma} + \frac{V_2^2}{2g} + z_2 + h_L$$

$$h_L = (z_1 - z_2) - \frac{V_2^2}{2g}$$

$$h_L = (165 - 0) - \frac{\frac{Q^2}{A^2}}{2g} = 165 - \frac{\frac{6.42^2}{(\pi(0.3325^2))^2}}{2 \times 32.17}$$

$$h_L = 159.68$$

7.42



$P_2 = 30\ psig = 30\ lb/in^2 = 4320\ lb/ft^2$

$h_L = 15.5$

$Q = 40\ gal/min = 0.089\ ft^3/s$

$P = \gamma Q h_A$

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

$$h_A = (z_2 - z_1) - \frac{P_1}{\gamma} + h_L$$

$$h_A = 220 - 0 - \frac{4320}{62.4} + 15.5 \qquad ft \ \frac{lb}{ft^3} \ \frac{ft^3}{lb} \ \frac{lb \cdot ft}{lb}$$

$$h_A = 304.73$$

$$P_A = \gamma Q h_A = 62.4 \times 0.089 \times 304.73$$

$$P_A = 1692.35$$

$$P = 3.077\ HP$$