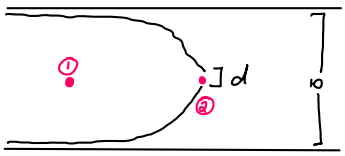
Hw 2.4

quarta-feira, 23 de outubro de 2024 13:47

15.4



ammonia

$Q = 25\ gal/min = 96.25\ in^3/s$

$Sg = 0.83$

$D. = 2.5 \times 10^{-6}\ lb\,s/ft^2$

$g = 32.17\ ft/s^2 = 386.04\ in/s^2$

$Sg = \gamma_A/\gamma_{w@4c} \rightarrow 0.83 = \gamma_A/1000$

$\gamma_{ammonia} = 830$

$Q = VA \rightarrow V = Q/A = 96.25/\pi r^2 = 96.25/\pi 5^2 = 1.225\ in/s$

$A_1 = \pi r^2 = \pi 5^2 = 78.54\ in^2$

a) If d is 1 in $(A = \pi r^2 = \pi\, 0.5^2 = 0.79\ in^2)$

$Re = \frac{VD}{\nu} = \frac{1.225 \times 10}{2.5 \times 10^{-6}} = 4.9 \times 10^6$

$\frac{d}{D} = \frac{1}{10} = 0.1$ → based on the table: $C = 0.591$

$Q = CA_1\sqrt{\frac{2g(P_1 - P_2)/\gamma}{(A_1/A_2)^2 - 1}} \rightarrow 0.591 \times 78.54\sqrt{\frac{2 \times 386.04(P_1 - P_2)/830}{(78.54 - 0.79)^2 - 1}} = 96.25$

$P_1 - P_2 = \frac{(Q/CA_1)^2 (A_1 - A_2)^2}{2g}$

$P_1 - P_2 = 27937.62$

b) in d is 7 in $(A_2 = \pi r^2 = \pi\, 3.5^2 = 38.48\ in^2)$

$Re = \frac{VD}{\nu} = \frac{1.225 \times 10}{2.5 \times 10^{-6}} = 4.9 \times 10^6$

$\frac{d}{D} = \frac{7}{10} = 0.7$ → based on the table: $C = 0.611$

$Q = CA_1\sqrt{\frac{2g(P_1 - P_2)/\gamma}{(A_1/A_2)^2 - 1}} \rightarrow 0.611 \times 78.54\sqrt{\frac{2 \times 386.04(P_1 - P_2)/830}{(78.54 - 38.48^2) - 1}} = 96.25$

$P_1 - P_2 = \frac{(Q/CA_1)^2 (A_1 - A_2)^2}{2g}$

$P_1 - P_2 = 6935.92$

15.9

$T = 77°F$

$Q = 700$ to $1000\ gal/min \rightarrow 1.56\ ft^3/s - 2.23\ ft^3/s$

$h_{manometer} = 0$ to $8\ in \rightarrow 0$ to $0.66\ ft$

manometer

Sin Type W copper tube → $D = 4.805\ in = 0.4\ ft$

$A = 1.259 \times 10^{-1}\ ft^2$

linseed oil : $\gamma = 58\ lb/ft^3$

$\rho = 1.8\ slugs/ft^3$

$\nu = 3.84 \times 10^{-4}$

$Re = \frac{VD}{\nu}$

worst scenario → $Q = 2.23\ ft^3/s$

$h = 0.66\ ft$

$$A_2 = A_1 \Big/ \sqrt{\frac{2gh\left(\gamma_m/\gamma_0 - 1\right)}{\left(Q/A_1 \times C\right)^2} + 1}$$

$$A_2 = 0.1259 \Big/ \sqrt{\frac{2(32.2)(0.66)\left(\frac{844.9}{58} - 1\right)}{\left(2.23/0.1259(C)\right)^2} + 1}$$

if $C = 0$

$A_2 = 0.097 \rightarrow 0.097 = \pi r^2 \rightarrow r = 0.175\ ft$

$d = 0.35\ ft$

$\frac{d}{D} = \frac{0.35}{0.4} = 0.875$

$V = \frac{2.23}{0.097} = 22.99$ $\quad Re = \frac{VD}{\nu} = \frac{22.99 \times 0.35}{3.84 \times 10^{-4}} = 2.09 \times 10^4$

so C is actually 0.65

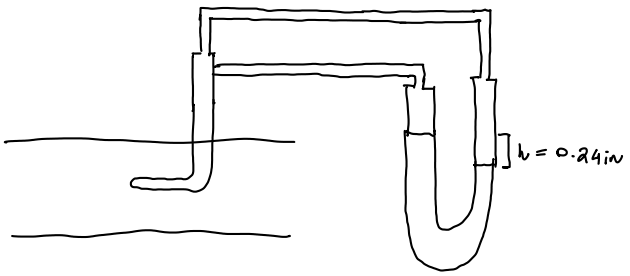
So

$$A_2 = 0.1259 \Big/ \sqrt{\frac{2(32.2)(0.66)\left(\frac{844.9}{58} - 1\right)}{\left(2.23/0.1259(0.65)\right)^2} + 1} = 0.045\ ft^2$$

$0.045 = \pi r^2 \rightarrow r = 0.11 \rightarrow d = 0.22$

$d/D = 0.22/0.4 = 0.55$

15.15



Using $T = 60°F \rightarrow \gamma_w = 62.4\ lb/ft^3$

$\gamma_{air} = 0.0764\ lb/ft^3$

$h = 0.24 \text{ in} = 0.02 \text{ ft}$

$g = 32.17 \text{ ft/s}^2$

$$V_1 = \sqrt{2gh\left(\gamma_w - \gamma_{Air}\right)/\gamma_{air}} = \sqrt{\frac{2(32.17)(62.4 - 0.0764)}{0.0764}}$$

$V_1 = 229.09 \text{ ft/s}$