HW 2.3 CHP 15

(4) $D = 10\,in$ (0.83 ft) $\quad Q = 25\,gal/min$ (0.056 ft³/s) $\quad SG_{AMONIA} = 0.83 \quad \mu = 2.5\times10^{-6}\ lb\text{-}s/ft^2$

$d_1 = 1.0\,in = 0.083\,ft$

$\gamma_A = SG(62.4) = 51.792\,lb/ft^3 \quad \rho_w = 1.94\ slugs/ft^3$

$d_2 = 7\,in$

$$V_1 = C\sqrt{\frac{2gh\left[(\gamma_m/\gamma_A)-1\right]}{(A_1/A_2)^2-1}} \qquad h = \left(\frac{V_1}{C}\right)^2 \frac{(A_1/A_2)^2-1}{2g\left[\gamma_m/\gamma_A\right)-1}$$

$$V_1 = \frac{Q}{A_1} \qquad A_1 = \frac{\pi D^2}{4} = \frac{\pi(0.83)^2}{4} = \boxed{0.541\,ft^2}$$

$$V_1 = \frac{0.056}{0.541} \qquad A_2 = \frac{\pi d^2}{4} = \frac{\pi(0.083)^2}{4} = \boxed{5.41\times10^{-3}\,ft^2}$$

$$\boxed{V_1 = 0.104\,ft/s} \qquad \nu = \frac{\mu}{\rho_A} = \frac{2.5\times10^{-6}}{(0.83)(1.94)} = \boxed{1.55\times10^{-6}\,ft^2/s}$$

$$N_R = \frac{V_1 D}{\nu} = \frac{(0.104)(0.83)}{1.55\times10^{-6}} = \boxed{N_R = 5.56\times10^4} \qquad \beta = \frac{1.0}{10} = 0.1$$

$\boxed{C_1 = 0.595}$ (FIGURE 15.7 GRAPH)

$$h = \left(\frac{V_1}{C_1}\right)^2 \frac{(A_1/A_2)^2-1}{2g(\gamma_m/\gamma_A)-1} = \left(\frac{0.104}{0.595}\right)^2 \frac{(0.541/5.41\times10^{-3})^2-1}{2(32.2)\left[(62.4/51.792)\right]-1}$$

$0.031 \times 758.054$

$\boxed{h = 23.5\,ft}$

b) $d_3 = 7\,in = 0.58\,ft \qquad \beta = \frac{7}{10} = 0.7$

$$A_3 = \frac{\pi d_3^2}{4} = \frac{\pi(0.58)^2}{4} = \boxed{0.264\,ft^2}$$

$\boxed{C_2 = 0.619}$ (FIGURE 15.7 GRAPH)

$$h_2 = \left(\frac{V_1}{C_2}\right)^2 \frac{(A_1/A_2)^2 - 1}{2g\left[(\gamma_m/\gamma_n) - 1\right]} = \left(\frac{0.104}{0.619}\right)^2 \frac{(0.541/0.264)^2 - 1}{2(32.2)\left[(62.4/51.792) - 1\right]}$$

$0.028 \times 0.243$

$$\boxed{h_2 = 0.007 \text{ ft}}$$

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(9) $D = 4.805$ in $= 0.400$ ft → TYPE K COPPER 5 in NOMINAL (APPENDIX H) $A = 0.126 \text{ ft}^2$

$$V_{MIN} = \frac{Q_{MIN}}{A}$$

700 GAL/MIN = 1.559 ft³/s  1000 GAL/MIN = 2.23 ft³/s

$$V_{MIN} = \frac{1.559}{0.126} = \boxed{V_{MIN} = 12.37 \text{ ft/s}}$$

$$N_R = \frac{V_{MIN} D}{\nu}$$

LINSEED OIL

$\nu = 3.84 \times 10^{-4} \text{ ft}^2/\text{s}$

$\gamma = 58 \text{ lb/ft}^3$

$$N_R = \frac{(12.77)(0.400)}{3.84 \times 10^{-4}} = \boxed{N_R = 12885.42}$$

$C_{MIN} = 0.95$

$$V_{MAX} = \frac{2.23}{0.126} = \boxed{V_{MAX} = 17.7 \text{ ft/s}}$$

$$N_{R_{MAX}} = \frac{(17.7)(0.400)}{3.84 \times 10^{-4}} = \boxed{N_{R_{MAX}} = 18437.5}$$

$C_{MAX} = 0.963$

$$V_{MAX} = C_{MAX}\sqrt{\frac{2gh(\gamma_m/\gamma) - 1}{(A/A_1)^2 - 1}}$$

$$A_1 = \frac{A}{\sqrt{\frac{2gh(\gamma_m/\gamma)(C_{MAX})^2}{V_{MAX}^2} + 1}}$$

$\gamma_{MERCURY} = 844.9 \text{ lb/ft}^3$

$\gamma_{LINSEED} = 58 \text{ lb/ft}^3$

$h = 8 \text{ in} = 0.667 \text{ ft}$

$$A_1 = \frac{0.126}{\sqrt{\frac{2(32.2)(0.667)(844.9/58)(0.963)^2}{(17.7)^2} + 1}}$$

$$\boxed{A_1 = 0.075 \text{ ft}^2} \qquad A = \frac{\pi d^2}{4} = \qquad d = \sqrt{\frac{0.075 \times 4}{\pi}} = 0.309 \times 12$$

$$\boxed{d = 3.708 \text{ in}}$$

(15) $T = 80°F$ $h = 0.24 in = 0.02 ft$ $V_1 = \sqrt{2gh(\gamma_w - \gamma)/\gamma}$

$\gamma = 0.0736 lb/ft^3$ (APPENDIX E - E.2)

$\gamma_w = 62.4 lb/ft^3$

$V_1 = \sqrt{2(32.2)(0.02)(62.4 - 0.0736)/0.0736}$

$\boxed{V_1 = 33.03 ft/s}$