Tai Booker
HW 1.1
Chapter 1

48. A coining press is used to produce commemorative coins with the likenesses of all the U.S. presidents. The coining process requires a force of 18,000 lb. The hydraulic cylinder has a diameter of 2.50 in. Compute the required oil pressure.

Given:

$F = 18{,}000 \text{ lb}$ $\qquad$ $\text{lb/in}^2 = \text{psi}$

piston diameter $D = 2.50 \text{ in}$

$$p = \frac{F}{A} \qquad A = \frac{\pi}{4} D^2$$

$$A = \frac{\pi}{4}(2.50)^2$$

$$A = 4.909 \text{ in}^2 \Longrightarrow p = \frac{18{,}000 \text{ lb}}{4.909 \text{ in}^2} = 3.666.73 \text{ lb/in}^2$$

$\boxed{\therefore \text{The required oil pressure is } p = 3666.73 \text{ psi}}$

58. Compute the pressure (Δp) change required to cause a decrease in the volume of mercury by 1%. Express the result in both psi & MPa.

$$E = \frac{-\Delta p}{(\Delta V)/V} \qquad E_{mercury} = 3{,}590{,}000 \text{ psi} \qquad E_{mercury} = 24{,}750 \text{ MPa}$$

$$\Delta P = -E(\Delta V/V)$$

$$\frac{\Delta V}{V} = 1\% \text{ or } 0.01$$

$$\Delta P = (-3{,}590{,}000 \text{ psi})(-0.01)$$

$$\boxed{\Delta P = 35{,}900 \text{ psi}}$$

$$\Delta p = (-24{,}750 \text{ MPa})(-0.01)$$

$$\boxed{\Delta p = 247.5 \text{ MPa}}$$

Tai Booker

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Chapter 2

17. Give four examples of the types of fluids that are non-Newtonian.

- Binham fluids
- Liquid polymer
- Rheopectic fluids
- Thixotropic fluids

18. Use Appendix D to find the dynamic viscosity for water at 40°C.

$$\boxed{\eta_w @ 40°C = 6.5 \times 10^{-4} N \cdot s/m^2}$$

HW#1.1 CH.1 #63, 76 CH.2 #27, 35 | Team 7 | Chris Betton

63. Given: .5 in = D, 42 in = L, E_{mo} = 189,000 psi

Find: Stiffness = $\frac{F}{\Delta L}$

Solution:

$$E_{mo} = \frac{-P}{(\Delta V)/V} \quad \text{where,} \quad \bullet P = \frac{F}{A} \quad \bullet \Delta V = -A \cdot (\Delta L) \quad \bullet V = L \cdot A$$

$$E_{mo} = \frac{-\frac{F}{A}}{(-A \cdot \Delta L)/A \cdot L}$$

$$E_{mo} = \cancel{-}\frac{F}{A} \cdot \frac{\cancel{A} \cdot L}{(\cancel{-}A \cdot \Delta L)}$$

$$E_{mo} = \frac{F \cdot L}{(A \cdot \Delta L)} \Rightarrow E_{mo} \cdot (A) = \frac{F \cdot L}{\Delta L} \Rightarrow \boxed{\frac{E_{mo}(A)}{L} = \frac{F}{\Delta L}}$$

$$A = \frac{\pi}{4} \cdot D^2 = \frac{\pi}{4} \cdot .5\,in^2 = .196349541\,in^2$$

$$\text{So, Stiffness} = \frac{F}{\Delta L} = \frac{189{,}000\,lb}{\cancel{in^2}} \cdot \frac{.1963...\cancel{in^2}}{42\,in} = \boxed{883.57\,\frac{lb}{in}}$$

76. Given: 1.00 lb-f = weight

Find: mass in slugs, mass in kg, & weight in N

Solution:

- mass in slugs $\left(\frac{lbf \cdot s^2}{ft}\right)$

$$W = m \cdot g \Rightarrow m = \frac{W}{g} = \frac{1\,lb\text{-}f \cdot s^2}{32.2\,ft} = \frac{1}{32.2}\,\frac{lbf\,s^2}{ft} = \boxed{.031\,slugs}$$

- weight in N $\left(\frac{kg\,m}{s^2}\right)$

$1\,lb\text{-}f = \boxed{4.448N}$ conversion factor

- mass in kg

$$W = m \cdot g \Rightarrow m = \frac{W}{g} = \frac{4.448\,kg\,\cancel{m}}{\cancel{s^2}} \cdot \frac{\cancel{s^2}}{9.81\,\cancel{m}} = \boxed{.453\,kg}$$

27. Given: Hydrogen @ 40°F

Find: viscosity using appendix D

Solution:

H_2 @ 40°f, $\boxed{\eta = 1.8 \times 10^{-7}\,\frac{lb \cdot s}{ft^2}}$

35. Given: SAE 30 oil @ 210°f

Find: viscosity using appendix D

Solution:

SAE 30 @ 210°f, $\boxed{\eta = 2.2 \times 10^{-4}\,\frac{lb \cdot s}{ft^2}}$

HW 1.1 | TEAM 7 | MELANIE CRUZ CONTEE

CH. 1: 92, 107
CH 2: 61

92. A CYLINDRICAL CONTAINER IS 150mm IN DIAMETER AND WEIGHS 2.25N WHEN EMPTY. WHEN FILLED TO A DEPTH OF 200mm WITH A CERTAIN OIL, IT WEIGHS 35.4N. CALCULATE THE SPECIFIC GRAVITY OF THE OIL.

GIVEN:

$D = 150\,mm = 0.15m$

$W_{TOT} = 35.4N$

$W_{EMP} = 2.25N$

$h = 200\,mm = 0.2m$

$V = \frac{\pi D^2 h}{4}$ $\quad \gamma = \frac{W}{V}$

APPENDIX A (γ WATER)

SOLUTION:

① $V = \frac{\pi D^2 h}{4}$

$= \frac{\pi (0.15^2 m)(0.2m)}{4}$

$V = 3.53 \times 10^{-3} m^3$

② $W_{OIL} = W_{TOT} - W_{EMP}$

$= 35.4 - 2.25$

$W_{OIL} = 33.15N = 0.03315\,kN$

③ $\gamma_{oil} = \frac{W_{OIL}}{V}$

$= \frac{33.15\,N}{3.53 \times 10^{-3} m^3}$

$= 9380.31\,N/m^3$

$\gamma_{OIL} = 9.38\,kN/m^3$

④ $S.G = \frac{\gamma_{OIL}}{\gamma_w @ 4°C}$

$= \frac{9.38\,kN/m^3}{9.81\,kN/m^3}$

$\boxed{SG = 0.956}$ ANSWER

107. ALCOHOL HAS A SPECIFIC GRAVITY OF 0.79. CALCULATE ITS DENSITY BOTH IN slugs/ft³ AND g/cm³.

GIVEN:

$SG = 0.79$

$sg = \frac{\rho_s}{\rho_w @ 4°C}$

APPENDIX A (ρ_{WATER})

APPENDIX K (CONVERSION)

SOLUTION:

$s.g = \frac{\rho_s}{\rho_w @ 4°C}$

$\rho_w @ 4°C \times sg = \rho_s$

ANSWER

$(1000\,kg/m^3)(0.79) = \boxed{790\,kg/m^3\ ,\ 1.533\,slug/ft^3\ ,\ 0.79\,g/cm^3}$

CONVERSION:

$kg/m^3 \times slug/ft^3 \rightarrow 790\,kg/m^3 = \boxed{\frac{515.4\,kg/m^3}{slug/ft^3}}$

$\rightarrow = \frac{790\,kg/m^3}{515.4\,kg/m^3} = slug/ft^3$

$kg/m^3 \times g/cm^3 \rightarrow 790\,kg/m^3 = \boxed{\frac{1000\,kg/m^3}{gram/cm^3}}$

$\rightarrow \frac{790\,kg/m^3}{1000\,kg/m^3} = g/cm^3$

61. IN A FALLING-BALL VISCOMETER, A STEEL BALL 1.6 mm IN DIAMETER IS ALLOWED TO FALL FREELY IN A HEAVY FUEL OIL HAVING A SPECIFIC GRAVITY OF 0.94. STEEL WEIGHS 77 kN/m³. IF THE BALL IS OBSERVED TO FALL 250 mm in 10.4 s, CALCULATE THE VISCOSITY OF THE OIL.

GIVEN:

$D = 1.6\,mm = 1.6\times10^{-3}\,m$

$sg = 0.94$

$\tau = 10.4\,s$

$\gamma_s = 77\,kN/m^3$

$l = 250\,mm = 0.25\,m$ (measured distance)

APPENDIX A (γ_{WATER})

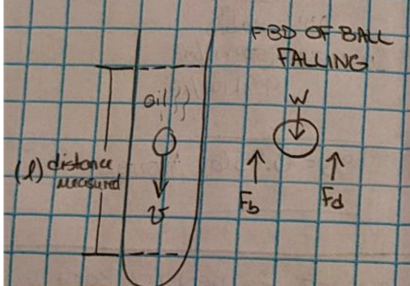
$sg = \dfrac{\gamma_f}{\gamma_{WATER\,@\,4°C}}$ $\quad V = \dfrac{\pi D^3}{6}$ $\quad W = \gamma_s V$

$F_d = 3\pi\eta v D$ $\quad W - F_b - F_d = 0$ $\quad F_b = \gamma_f V$

☆ SPECIFIC WEIGHT SPHERE, γ_s

SPECIFIC WEIGHT OIL, $\gamma_{f\,oil}$

SOLUTION:



① $sg = \dfrac{\gamma_f}{\gamma_{w@4°C}}$

$\gamma_f = SG \times 9.81\,kN/m^3$

$= 0.94 \times 9.81\,kN/m^3$

$\gamma_f = 9.22\,kN/m^3$

② $V = \dfrac{\pi D^3}{6}$

$= \dfrac{\pi(1.6\times10^{3})^3}{6}$

$V = 2.14\times10^{-9}\,m^3$

③ FBD EQNS.

$W - F_b - F_d = 0$

$W = \gamma_s V$

$= \gamma_s \pi D^3/6$

$= 77\,kN/m^3 \times 2.14\times10^{-9}\,m^3$

$W = 1.65\times10^{-7}\,kN$

$F_b = \gamma_f V_s$

$= 9.22\,kN/m^3 \times 2.14\times10^{-9}\,m^3$

$F_b = 1.97\times10^{-8}\,kN$

$W - F_b - F_d = 0$

$1.65\times10^{-7}\,kN - 1.97\times10^{-8}\,kN - F_d = 0$

$1.45\times10^{-7} - F_d = 0$

$F_d = 1.45\times10^{-7}\,kN$

④ $v = \dfrac{l}{\tau} = \dfrac{0.25\,m}{10.4\,s}$

$v = 0.024\,m/s$

SOLVE 1ST

⑤ $F_d = 3\pi\eta v D$

$\eta = \dfrac{F_d}{3\pi v D}$

$= \dfrac{1.45\times10^{-7}\,kN}{3\pi(0.024\,m/s)(1.6\times10^{-3}\,m)}$

$\eta = 4.014\times10^{-4}\,kN\cdot s/m^2$

ANSWER

$\boxed{\eta = 0.4015\,Pa\cdot s}$