John Vasquez

HW #1 Process requires $F = 18000\,lb$, Cylinder diameter $= 2.50\,in$

48 Coin pressed $= F = 18000\,lb$, Cylinder $= d = 2.50\,in$ Find - pressure

① $P = \frac{F}{A} = \frac{18000\,lb}{A} \Rightarrow \frac{18000\,lb}{4.909\,in^2} = \boxed{P = 3666.73\ psi}$

*pg 10

② Area of circle $= A = \pi r^2 \Rightarrow A = \frac{\pi}{4} D^2 = \frac{\pi}{4}(2.50\,in)^2 = 4.909\,in^2$

58 Mercury is to be decreased by 1%, find in PSI + Mpa pressure change

① * Bulk modulus values $=$ Mercury $= 3590\,000\ psi$

pg 10 & 11 Chpt 1 $= 24750\ Mpa$

Compressibility

$E = \frac{-\Delta P}{\frac{\Delta V}{V}}$

② 1% volume change $= \frac{\Delta V}{V} = \frac{1.00}{100} = -.01$ volume decreased

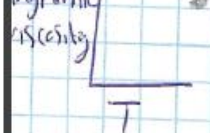
③ $\Delta P_{PSI} = -E\left(\frac{\Delta V}{V}\right) = -3590000(-.01)$

$\boxed{= 35900\ PSI}$

$\Delta P_{MPA} = -E\left(\frac{\Delta V}{V}\right) = 24750(.01)$

$\boxed{= 247.5\ MPa}$

35 Using Appendix D pg 495, find value of SAE 30 @ 210°F



* Follow curve line, looks to be about

$\boxed{2.2 \times 10^{-4}\ lb \cdot s/ft^2 \text{ or } 2.5 \times 10^{-4}\ lb \cdot s/ft^2}$

HWK 1.1 | MET 330 | Carroll, Shaunmark

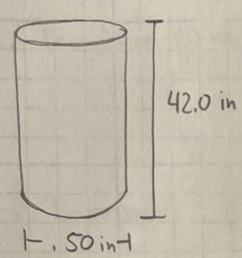
1.63) A measure of the stiffness of a linear actuator system is the amount of force required to cause a certain linear deflection (ΔL). For an actuator that has an inside diameter of 0.50 in and length of 42.0 in that is filled with machine oil, compute the Stiffness in lb/in.

Bulk modulus

$$E = \frac{-\Delta P}{(\Delta V)/V}$$

$$\text{Stiffness} = \frac{F}{\Delta L}$$ Force, linear deflection

$$P = F/A$$



$$E = \frac{-(F/A)}{\frac{(-A\Delta L)}{(AL)}} \rightarrow E = -\frac{F}{A} \times \frac{AL}{-A\Delta L}$$

$$\rightarrow E = \frac{FL}{A\Delta L} \rightarrow \frac{EA}{L} = \frac{F}{\Delta L}$$

E for machine oil = 189,000 psi

$E = 189{,}000\ lb/in^2$

$A = \frac{\pi}{4} d^2$

$$\text{Stiffness} = \frac{EA}{L} \rightarrow \frac{189000\left(\frac{\pi}{4}(0.5)^2\right)}{42} \rightarrow 883.57\ \frac{lb}{in}$$

1.76 In the united states, hamburger, and other meats are sold by the pound. Assuming 1.00 lb-force, compute the mass in slugs, the mass in kg and the weight in N.

$W = 1.00\ lbf$

$$m = \frac{W}{g} \rightarrow 1.00/32.2\ ft/s^2 \rightarrow .03106\ lbf \cdot \frac{s^2}{ft}$$

$1\ Slug = 1\ lbf \cdot \frac{s^2}{ft}$

$$m = .03106\ lbf \cdot \frac{s^2}{ft}\left(\frac{1\ slug}{lbf \cdot \frac{s^2}{ft}}\right) \rightarrow m = .03106\ slug$$

$1.00\ lbf = 4.448\ N$ $\rightarrow$

$$W = 1.00\ lbf \left(\frac{4.448\ N}{1\ lbf}\right) \rightarrow W = 4.448\ N$$

$W = 4.448\ N$

$$m = \frac{W}{g} \rightarrow \frac{4.448\ N}{9.81\ m/s^2} \rightarrow .4534\ N \cdot \frac{s^2}{m}$$

$1\ kg = 1\ N \cdot \frac{s^2}{m}$

$$m = .4534\ N \cdot \frac{s^2}{m}\left(\frac{kg}{N \cdot \frac{s^2}{m}}\right) \rightarrow m = .4534\ kg$$

HWK 1.1 | Met 330 | Carroll, Shaunmar K

2.17) Give four examples of the types of fluids that are non-newtonian

- A fluid that does not follow Newton's law of viscosity

$$\tau = \eta(\Delta v / \Delta y)$$

- Bingham fluid → Toothpaste

  a viscous fluid that possesses a yield strength which must be exceeded before the fluid will flow

- Thixotropic → Honey

  Viscosity decreases with stress over time

- Rheopectic → Cream

  Viscosity increases with stress over time

- Dilatant → oobleck

  Viscosity increases with increased stress

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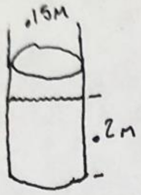
MET 330
HW 1
9/8/2021

1.92)



Given

$W_{container} = 2.25 \text{ N}$

$W_{oil} = 35.4\text{ N} - 2.25\text{ N} = 33.15\text{ N}$

$r = .075\text{ m}$

$V_{oil} = \pi r^2 h = \pi (.075)^2 (.2) = .0035 \text{ m}^3$

$$\gamma_{oil} = \frac{W_{oil}}{V_{oil}} = \frac{33.15}{.0035} = 9{,}471.43 \text{ N/m}^3 = 9.47 \text{ kN/m}^3$$

$$sg_{oil} = \frac{\gamma_{oil}}{\gamma_{water @ 4°C}} = \frac{9.47 \text{ kN/m}^3}{9.81 \text{ kN/m}^3} = \boxed{.97}$$

1.107)

Given $\boxed{sg_a = .79}$

$$sg_a = \frac{\rho_a}{\rho_{w @ 4°C}} \Rightarrow .79 = \frac{\rho_a}{1.94 \text{ slugs/ft}^3}$$

$$\Rightarrow \boxed{\rho_a = 1.53 \text{ slug/ft}^3}$$

$$sg_a = \frac{\rho_a}{\rho_{w @ 4°C}} \Rightarrow .79 = \frac{\rho_a}{1000 \text{ kg/m}^3}$$

$$\Rightarrow \rho_a = 790 \text{ kg/m}^3 \Rightarrow \boxed{.79 \text{ g/cm}^3}$$

2.27) Hydrogen at 40°F from Appendix D

$$\boxed{\eta = 1.9 \times 10^{-7} \text{ lb-s/ft}^2}$$

"Appendix D gives dynamic viscosity for a variety of fluids as a function of temperature. Using this appendix, give the value of the viscosity for the following fluids:

2.18 Water at 40°C."

The viscosity of water at 40°C = 6.5 x 10^{-4} N*s/m^2; as approximated from Appendix D in the course text.

"2.61 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."

The viscosity of the oil is 2.5 x 10^{-1} kN * s/m^2

(see attached sheets for solution)

Kevin Smith (1)
HW 1.1
9/7/2021

2.61

variables:

η = viscosity

γ_f = specific weight of fluid = $9.22\ kN/m^3$

V = volume of the sphere = $2.145 \times 10^{-9}\ m^3$

D = diameter of the sphere = $0.0016\ m$

SG_f = specific gravity of the fluid = 0.94

v = fluid velocity = $0.024\ m/s$

γ_s = specific weight of steel ball = $77\ kN/m^3$

$w_s = 77\ kN/m^3$

Find γ_f:

$$SG_f = 0.94 = \frac{\gamma_f}{\gamma_{H_2O}} = \frac{\gamma_f\ kN/m^3}{9.81\ kN/m^3}$$

$$\gamma_f = 0.94 \cdot 9.81\ kN/m^3$$
$$\gamma_f = 9.22\ kN/m^3$$

Find V:

$$V = \frac{4}{3}\pi r^3 = \frac{4}{3}\pi \cdot 0.8^3 = 2.145\ mm^3$$

$$2.145\ mm^3 \longrightarrow 2.145 \times 10^{-9}\ m^3$$

Find v:

$$v = \frac{250\ mm}{10.4\ s} = \frac{0.25\ m}{10.4\ s} = 0.024\ m/s$$

2.61 continued

Find η, where:

$$\eta = \frac{(\gamma_s - \gamma_f) D^2}{18 v}$$

$$\eta = \frac{(77\ kN/m^3 - 9.22\ kN/m^3) \cdot 0.0016 m^2}{18(0.024\ m/s)}$$

$$\eta = \frac{67.78\ kN/m^3 \cdot 0.0016\ m^2}{0.432\ m/s}$$

$$\eta = \frac{0.108\ kN/m}{0.432\ m/s}$$

$$\boxed{\eta = 2.5 \times 10^{-1}\ kN \cdot s/m^2}$$