Team 4

Aiden Pham, Nolan Donnelly, Richard Fox

Old Dominion University

Course: MET 330

Date: 09/07/2023

HW 1.1

MET 330 Hw1

Problem 48.) Given: F = 18,000 lb

$Area_{cylinder} = 2.50 in$

$$P_{oil} = \frac{F(lb)}{A(in^2)} = \frac{18{,}000\,lb}{(2.50)^2(\frac{\pi}{4})} = 3{,}667\ lb/in^2$$

or

$\boxed{3{,}667\,psi}$

Problem 58.) Given: Mercury Volume Decrease = 1.0% = ΔV

Mercury Bulk modulus $= 2.8 \times 10^{10}\ N/m^2$

or 2.8×10^4 Mpa

$$K = -V\frac{\Delta P}{\Delta V} \rightarrow \Delta P = -K \cdot \frac{\Delta V}{V}$$

$$\frac{\Delta V}{V} = \frac{1.00}{100} = -0.01$$

Decreasing

$$\Delta P = -2.8 \times 10^4(-0.01)$$

$\boxed{\Delta P = 280\ Mpa}$ 1 Mpa = 145.04 psi

$\boxed{\Delta P = 280(145.04) = 40{,}611\ psi}$

Problem 63.) Stiffness $= \frac{df}{dl}$, $K = \frac{dp}{dl/l}$ $\rightarrow dp = df/A$

$K_{machine\ Oil} = 188549.06\,psi$

Bulk Modulus

$$K = \frac{df/A}{dl/l} \rightarrow \frac{df}{dl} = \frac{K \cdot A}{l} \rightarrow \frac{(188549.06\ lb/in^2)(\pi(0.25_{in})^2)}{42\,in}$$

$\boxed{\text{Stiffness } \frac{df}{dl} = 881.5\ lb/in^2}$

Problem 76) Given: mass of meat = 1 lb-force

Conversion Way:

1 lb = 0.0311 Slugs

1 lb = 0.454 kg

1 lb = 4.448 N

Different Method:

$m = W/g = 1\text{lb} / 32.2 \text{ ft/s}^2$

$\boxed{m = 0.0311 \text{ Slugs}}$

1 Slug = 14.59 kg

$m = (0.0311)(14.59 \text{ kg})$

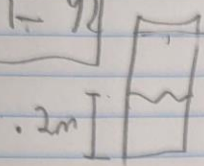
$\boxed{m = 0.454 \text{ kg}}$

$W = 1\cancel{\text{lb}}(4.448 \text{ N}/1\cancel{\text{lb}})$

$\boxed{W = 4.448 \text{ N}}$

HW 1.1

1-92



$W = 2.25N$ (empty)
$d = 150mm = 0.150 m$

$W_2 = 35.4N$ (filled .2m)

$\boxed{sg = ?}$

$\Delta_W = W_2 - W_1 = 33.15 N$

$m = \frac{33.15}{9.81} = 3.38 kg$

$$sg = \frac{\rho_{Oil}}{\rho_W} = \frac{\left(\frac{3.38kg}{\frac{\pi}{4}(.150m)^2 \times .2m}\right)}{1000\frac{kg}{m^3}} = \boxed{.956}$$

1-107 $sg_{Alc} = 0.79$

$$sg_{Alc} = \frac{\rho_{Alc}}{\rho_{w@4°C}}$$

$$\rho_{Alc} = sg_{Alc} \cdot \rho_w = 0.79 \times .001 \frac{g}{cm^3} = \boxed{7.9E-4 \frac{g}{cm^3}}$$

$$\rho_{Alc} = 7.9E-4 \frac{g}{cm^3} \cdot \frac{1.94032 \frac{slug}{ft^3}}{1 \frac{g}{cm^3}} = 1.53E-3$$

$$= \boxed{1.53E-3 \frac{slug}{ft^3}}$$

Homework 1.1 | Due 9-7-23

CH2: 17) Give 4 examples of types of fluids that are non-Newtonian.

1 Thixotropic fluids
2 Diatant fluids
3 Bingham fluids
4 Rheopetic fluids

18) Give the value of the viscosity for water @40°C using Appendix D.

↳ viscosity @40°C is roughly: $\boxed{6.2 \times 10^{-4}\ Pa \cdot s}$

27) Give the value of the viscosity for Hydrogen @40°F using Appendix D.

↳ viscosity @40°F is roughly: $\boxed{1.9 \times 10^{-7}\ \frac{lb \cdot s}{ft^2}}$

35) Give the value of viscosity for SAE 30 oil @210°F using Appendix D.

↳ viscosity @210°F is roughly: $\boxed{2.2 \times 10^{-4}\ \frac{lb \cdot s}{ft^2}}$

[illegible] in diameter is allow

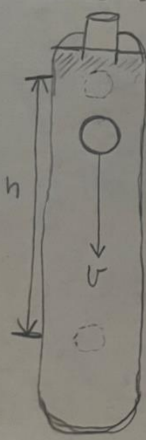
61) In a falling-ball viscometer, a steel ball 1.6 mm in diameter is allowed to fall freely in a heavy fuel oil having a specific gravity of 0.94. Steel weighs 77 kN/m³. If the ball is observed to fall 250 mm in 10.4 s, calculate the viscosity of the oil.

Given values: $D_{ball} = 1.6\,mm$ $\quad sg_{oil} = 0.94$ $\quad \gamma_s = 77\,kN/m^3$ $\quad h = 250\,mm$

$\Delta t = 10.4\,s$

taking 10.4 s to fall 250 mm means the oil is very viscous. it also means the velocity is low:

$$v = d/\Delta t = (250\,mm \cdot \frac{1\,m}{1000\,mm}) / 10.4\,s = .024\,m/s$$



$\Delta t = 10.4\,s$

this means the drag force is equal to:

$$F_d = 3\pi\eta v D \rightarrow \eta = \frac{(\gamma_s - \gamma_f)D^2}{18v}$$

$$sg = \frac{\gamma_f}{\gamma_w @ 4°C} \rightarrow \gamma_f = sg_f \cdot \gamma_w @ 4°C$$

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

$$\frac{kN \cdot m^2 \cdot s}{m^4} \rightarrow \frac{kN \cdot s}{m^2} \rightarrow$$

$$\eta = \frac{(\gamma_s - \gamma_f) \cdot D^2}{18v} = \frac{(77\,kN/m^3 - 9.22\,kN/m^3) \cdot [1.6\,mm \cdot 1\,m/1000\,mm]^2}{18 \cdot .024\,m/s}$$

$$\boxed{\eta = 0.402\,mPa \cdot s}$$