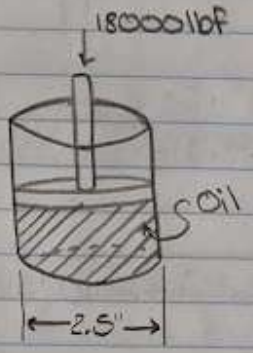
Robert Slade
MET 330
Homework 1

1.48

Purpose

Compute the required oil pressure for a coining press.

Drawing



Sources:

Mott, Robert L.; Untener, Joseph A., Applied Fluid Mechanics, 7th, -2015. Reprinted by permission of Pearson Education, Inc., New York, New York

Design Considerations:

The following must be assumed:

1. Incompressible fluid
2. Isothermal process

Data and Variables:

F = 18000lbf

D = 2.5in

Procedure:

The pressure is obtained using its definition

$$P = \frac{F}{A}$$

The force is given and the area can be computed from the corresponding geometric relation:

$$A = \frac{\pi}{4} \times D^2$$

Calculations:

$$A = \frac{\pi}{4} \times D^2 = \frac{\pi}{4} \times 2.5in^2 = 4.91in^2$$

$$P = \frac{f}{A} = \frac{18000lbf}{4.91in^2} = \boxed{3673.47\ PSi}$$

Summary:

The required oil pressure for the coining press is 3673.47 PSi

material:

Oil

Analysis:

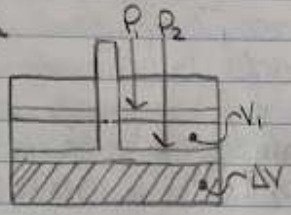
a) IF piston diameter increases, pressure reduces.

b) IF applied force increases, pressure increases.

Problem 1.58

Purpose:
Compute the pressure change required to cause a decrease in the volume of mercury by 1.00%.

Drawing:



Sources:
MoTT, Robert L; Untener, Joseph A., Applied Fluid Mechanics, 7th, -2015. Reprinted by permission of Pearson Education, Inc., New York, New York

Design Considerations:
The following must be assumed
1) compressible fluid
2) Isothermal process

Data and Variables
$\Delta V/V = 1.0\% \rightarrow 0.01$
E (mercury) = 3590000 psi / 24750 MPa

Procedure:
The pressure is obtained using bulk modulus definition

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

The required change in pressure is

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

calculations

$$\Delta P = -E\left(\frac{\Delta V}{V}\right) = -3590000\,Psi\,(0.01) = \boxed{-35900\,Psi}$$

$$\Delta P = -E\left(\frac{\Delta V}{V}\right) = -24750\,MPa\,(0.01) = \boxed{-247.5\,MPa}$$

Summary
The pressure change that caused the decrease in the volume of mercury by 1.0% is -35900 Psi / -247.5 MPa

material
mercury

Analysis
A significant increase in pressure will produce a small volume change due to the high value of mercury's bulk modulus.

Problem 2.17

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

Time-independant fluids
1. Pseudoplastic, blood plasma
2. Dilatant fluid, corn starch in ethylene
3. Bingham fluid, chocolate

Time-dependant fluids
4. Crud oils at low temperatures
- Printer's ink
- Some jellies

Problem 2.18

Purpose:
Give the value of viscosity for water at 40°C

Drawing: NA

Sources:
MoTT, Robert L. Untener, Joseph A., Applied Fluid Mechanics, 7th; -2015. Reprinted by permission of Pearson Education, Inc., New York, New York

Design Considerations:
The following must be assumed
1) Incompressible fluid
2) Isothermal process

Data and Variables:
Water temperature = 40°C

Procedure:
Use table in Appendix D to determine the viscosity of water at 40°C

Calculations: NA $\eta = 6.5\ N \cdot s/m^2$

Summary:
The viscosity of water at 40°C is approximately $6.5\ N \cdot s/m^2$.

Analysis:
After reviewing the variation of viscosity with temperature of water, it has been determined the the higher the temperature the lower the dynamic viscosity will become.