Fluid Mechanics Fundamentals and Applications (3rd Edition)

Chapter 2, Problem 16P | Bookmark | Show all steps: ON

Problem

A cylindrical tank of methanol has a mass of 40 kg and a volume of 51 L. Determine the methanol's weight, density, and specific gravity. Take the gravitational acceleration to be 9.81 m/s2. Also, estimate how much force is needed to accelerate this tank linearly at 0.25 m/s2.

Step-by-step solution

Step 1 of 4

Calculate the weight of the methanol.

$$W = mg$$

Here, m is the mass of methanol and g is the acceleration due to gravity.

Substitute $40\,\text{kg}$ for m and $9.81\,\text{m/s}^2$ for g.

$$W = 40 \times 9.81$$
$$= 392.4\,\text{N}$$

Therefore, the weight of the methanol is $\boxed{392.4\,\text{N}}$.

Comment

Step 2 of 4

Convert the units for 1L to m^3.

$$1\text{L} = \left(\frac{1}{10}\right)^3 \times \text{m}^3$$
$$= 0.001\,\text{m}^3$$

Calculate the density of methanol.

$$\rho = \frac{m}{V}$$

Here, m is the mass of methanol and V is the volume of a methanol.

Substitute $40\,\text{kg}$ for m and $51 \times 0.001\,\text{m}^3$ for V.

$$\rho = \frac{40}{51 \times 0.001}$$
$$= 784.31\,\text{kg/m}^3$$

Therefore, the density of methanol is $\boxed{784.31\,\text{kg/m}^3}$.

Comment

Calculate the specific gravity of the methanol.

$$\text{S.P} = \frac{\rho}{\rho_{\text{water}}}$$

Here, ρ is the density of methanol and ρ_{water} is the density of water.

Substitute $784.31\,\text{kg/m}^3$ for ρ and $1000\,\text{kg/m}^3$ for ρ_{water}.

$$\text{S.P} = \frac{784.31}{1000}$$
$$= 0.784$$

Therefore, the specific gravity of the methanol is $\boxed{0.784}$.

Comment

Step 4 of 4

Calculate the force require to accelerate the tank.

$$\text{F} = ma$$

Here, m is the mass of methanol and a is the acceleration of the tank.

Substitute $40\,\text{kg}$ for m and $0.25\,\text{m/s}^2$ for V.

$$\text{F} = 40 \times 0.25$$
$$= 10\,\text{N}$$

Therefore, the forces require to accelerate the tank is $\boxed{10\,\text{N}}$.

Comment

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Recommended solutions for you in Chapter 2

Chapter 2, Problem 10P

A mass of 1-lbm of argon is maintained at 200 psia and 100°F in a tank. What is the volume of the tank?

See solution

Chapter 2, Problem 153P

Write an essay on the oils used in car engines in different seasons and their viscosities.

See solution

See more problems in subjects you study