

Chapter 2

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Introduction

Any characteristic of a system is called a **property**

- intensive properties: independent of the mass of the system
- extensive properties: depend on the the size of the system

2-1 Density and Specific Gravity

Definition

$$\rho = \frac{m}{V}$$
$$SG = \frac{\rho}{\rho_{H_2O}}$$

Density of Ideal Gases

$$PV = mRT$$

2-2 Vapor Pressure and Cavitation

Definition

the collapse of cavities of vapor in a liquid

is a violent process which can damage machinery and can cause structural vibrations

2-3 Compressibility

Coefficient of Compressibility

$$\kappa \cong -\frac{\Delta P}{\Delta v/v} \cong \frac{\Delta P}{\Delta \rho/\rho}$$

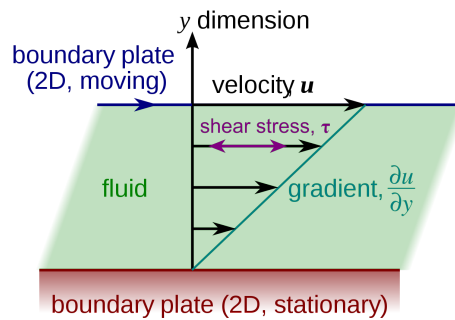
and for ideal gas, we have

$$\frac{\Delta P}{P} = \frac{\Delta \rho}{\rho}$$

2-4 Viscosity

Definition

A property that represents the internal resistance of a fluid to motion



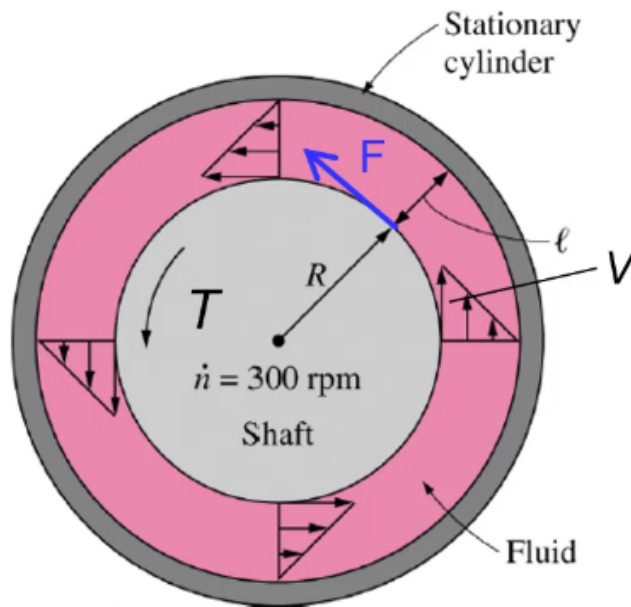
$$\tau = \mu \frac{du}{dy}$$

and the shear force acting on the fluid layer is

$$F = \tau A = \mu A \frac{du}{dy} = \mu A \frac{V}{l}$$

where the upper plate is at a constant speed while the lower plate remains **stationary**

Example - Cylindrical



Find the torque

$$\begin{aligned}
 T &= F \cdot R \\
 &= \mu A \frac{V}{l} \cdot R \\
 &= \mu \cdot 2\pi R L \cdot \frac{2\pi \dot{n} \cdot R}{l} \cdot R \\
 &= \mu \frac{4\pi^2 R^3 \dot{n} L}{l}
 \end{aligned}$$

2-5 Capillary Effect

Definition

the rise or fall of a liquid in a small-diameter tube inserted into a liquid

$$h = \frac{2\sigma_s}{\rho g R} \cos \phi$$

