Chapter 2

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

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

$$\text{SG} = \frac{\rho}{\rho_{H_2O}}$$

and we could find the density of the ideal gas by the following equation

$$PV = mRT$$

2-2 Vapor Pressure and Cavitation

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 is introduced in the following equations

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

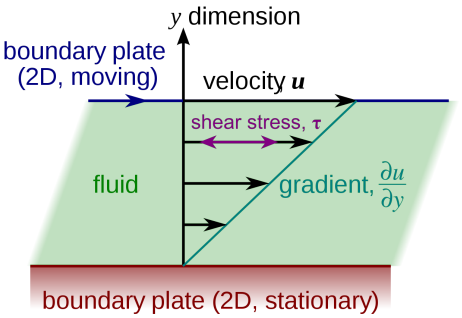
and for ideal gas, we have

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

2-4 Viscosity

Definition

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



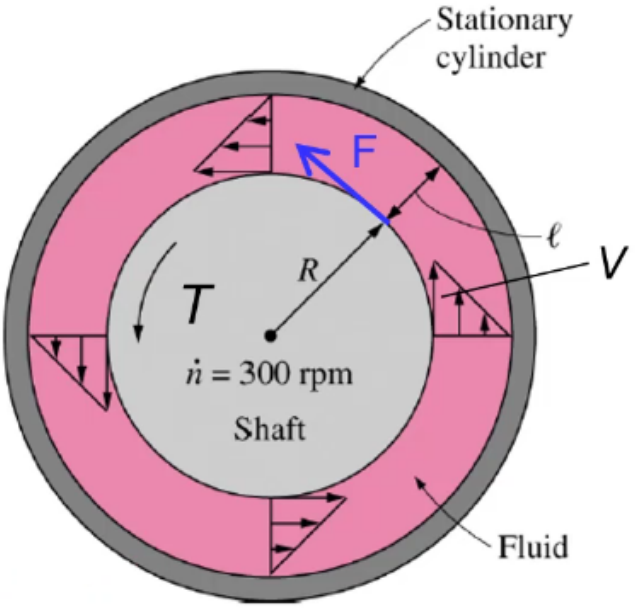
$$\tau = \mu \frac{\mathrm{d}u}{\mathrm{d}y}$$

and the shear force acting on the fluid layer is

$$F = \tau A = \mu A \frac{\mathrm{d}u}{\mathrm{d}y} = \mu A \frac{V}{l}$$

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

Example - Cylindrical



Find the torque

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

2-5 Capillary Effect

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

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