CEN 205 MASS AND ENERGY BALANCES

Instructors: Assoc. Prof. Ayşe Karakeçili
Assoc. Prof. Berna Topuz

CHEMICAL PROCESSES and PROCESS VARIABLES

I. MASS and VOLUME

DENSITY; is defined as the mas per unit volume (kg/m^3, g/cm^3, etc)

SPECIFIC VOLUME; is defined as the volume per unit mass of the substance (inverse of density, m^3/kg, cm^3/g, etc.)

SPECIFIC GRAVITY; is defined as the ratio of the density of the substance to the density of reference substance. The most commonly used reference substance for solids and liquids is water at 4^{o}C.

YOUR TURN:

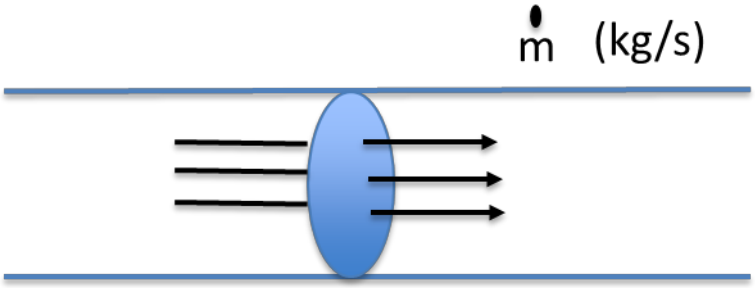
1. **Write the units of specific gravity.**
2. **If substance A and substance B each have a density of 2.3 g/cm^3, must 5 cm^3 of A has the same mass with 5 cm^3 of B? Discuss.**

II. FLOW RATE

The flow rate of a process stream is defined as the transported material through a process line.

MASS FLOW RATE (mass/time)

VOLUMETRIC FLOW RATE (volume/time)



The density can be used in the conversion of volumetric flow rate to mass flow rate or vice versa.

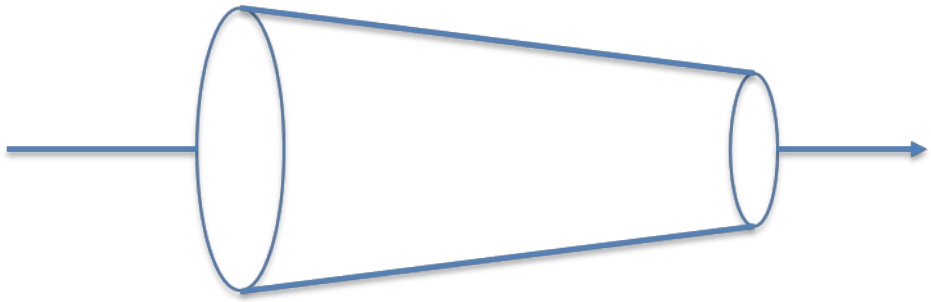
The common procedure for many provess calculations, is to measure the volumetric flow rate and calculate the mass flow rate by using the density of the flowing stream.

A flowmeter is used to measure the flow rate in a process line. Rotameter and orifice meter are the commonly used flowmeters.

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

YOUR TURN:

1. **Compare the mass flow rates of inlet stream and the outlet stream for a gas flowing through a conical shaped pipe as shown below.**



2. **Define the principle of an orifice meter.**