SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

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COIMBATORE-641 035, TAMIL NADU

23FTT202 FLUID MECHANICS FOR FOOD TECHNOLOGY

Unit I: PROPERTIES OF FLUIDS

Topic IV: THERMODYNAMIC PROPERTIES

1. Mass Density:
   - **Definition:** Mass density refers to the mass of a substance per unit volume. It indicates how much mass is contained in a given volume.
   - **Units:** The most common units are grams per cubic centimeter (g/cm^3) or kilograms per cubic meter (kg/m^3).
   - **Example:** The density of water is approximately 1 g/cm^3.
2. Specific Weight:
   - **Definition:** Specific weight is the weight of a substance per unit volume. It is related to mass density but takes into account gravitational force.
   - **Units:** Typically measured in newtons per cubic meter (N/m^3) or pounds per cubic foot (lb/ft^3).
   - **Example:** The specific weight of water is about 9.81 kN/m^3 (at standard gravity).

3. Specific Volume:
    - **Definition**: Specific volume is the volume occupied by a unit mass of a substance. It is the reciprocal of density.
    - **Units**: Commonly expressed in cubic meters per kilogram (m^3/kg) or cubic centimeters per gram (cm^3/g).
    - **Example**: The specific volume of water is 1 m^3/1000 kg, or 1 cm^3/g.
4. Specific Gravity:
    - **Definition**: Specific gravity is the ratio of the density of a substance to the density of a reference substance, usually water. It is a dimensionless quantity.
    - **Units**: Dimensionless (it's a ratio).
    - **Example**: The specific gravity of milk is typically around 1.03.

5. Viscosity:
    - **Definition**: Viscosity measures a fluid's resistance to flow. It describes how thick or thin a liquid is.
    - **Units**: The SI unit is the pascal-second (Pa·s), but centipoise (cP) is also common. 1 cP = 0.001 Pa·s.
    - **Example**: Water at 20°C has a viscosity of about 1 cP, while honey has a much higher viscosity.
6. Thermodynamic Properties:
    - **Definition**: These include various properties related to heat and energy, such as temperature, heat capacity, and enthalpy.
    - **Units**:

- Units:
  - **Temperature**: Degrees Celsius (°C) or Kelvin (K).
  - **Heat Capacity**: Joules per Kelvin (J/K) or calories per degree Celsius (cal/°C).
  - **Enthalpy**: Joules (J) or calories (cal).
- **Example**: The specific heat capacity of water is about 4.18 J/g·°C.

7. **Compressibility**:
   - **Definition**: Compressibility measures how much a substance can decrease in volume under pressure.
   - **Units**: Typically expressed as a dimensionless coefficient, such as the bulk modulus (Pa) or as a compressibility factor (Z), which is dimensionless.
   - **Example**: Gases are highly compressible compared to liquids and solids.
8. **Elasticity**:
   - **Definition**: Elasticity refers to a material's ability to return to its original shape after deformation.
   - **Units**: The modulus of elasticity, or Young's modulus, is typically measured in pascals (Pa).