



SNS COLLEGE OF TECHNOLOGY
(An Autonomous Institution)

Approved by AICTE, New Delhi, Affiliated to Anna University, Chennai Accredited by NAAC-UGC with 'A++' Grade (Cycle III) Accredited by NBA (B.E - CSE, EEE, ECE, Mech & B.Tech.IT)

COIMBATORE-641 035, TAMIL NADU

23FTT202 FLUID MECHANICS FOR FOOD TECHNOLOGY

Unit I: PROPERTIES OF FLUIDS

Topic I: PROPERTIES OF FLUIDS IN FOOD TECHNOLOGY

In food technology, understanding the properties of fluids is crucial for designing processes, equipment, and packaging. Here are some key fluid properties and their relevance to food technology:

1. Viscosity

- **Definition:** Viscosity measures a fluid's resistance to flow. It reflects the internal friction of the fluid.
- **Relevance:** Viscosity affects how easily food products like sauces, soups, and beverages can be pumped, mixed, or processed. It also influences texture and mouth feel.

Mouth feel : **Mouthfeel** is a critical sensory attribute in food technology that describes the physical sensations and texture experienced in the mouth when consuming a food product. It encompasses a range of tactile and mechanical properties that contribute to the overall eating experience. Here's an in-depth look at mouthfeel:



Key Aspects of Mouthfeel

1. Texture:

- **Definition:** Texture refers to the physical characteristics of food as perceived by the touch and feel of the mouth. This includes attributes like smoothness, graininess, creaminess, and crunchiness.
- **Examples:** The creaminess of ice cream, the crispiness of a fresh apple, and the chewiness of bread.

2. Viscosity:

- **Definition:** Viscosity is a measure of a fluid's resistance to flow. It affects how a liquid feels in the mouth.
- **Examples:** The thickness of a smoothie or the runniness of a sauce. Higher viscosity liquids feel thicker and more substantial, while lower viscosity liquids feel lighter and more fluid.

3. Consistency:

- **Definition:** Consistency describes the uniformity of the food's texture.
- **Examples:** A creamy soup versus a lumpy soup. Consistency affects how easily the food can be spread, scooped, or chewed.

4. Adhesiveness:

- **Definition:** Adhesiveness is the extent to which a food sticks to the surfaces of the mouth or to itself.
- **Examples:** The stickiness of caramel or the tendency of peanut butter to adhere to the roof of the mouth.

5. Cohesiveness:

- **Definition:** Cohesiveness refers to how well the food holds together.
- **Examples:** The ability of a burger patty to stay intact or the crumb structure of a cake. High cohesiveness means the food remains stable and does not crumble or disintegrate easily.

6. Crunchiness/Crumblly Texture:

- **Definition:** Crunchiness is the texture characteristic that involves a crisp, breaking sensation when chewed. Crumbliness is related to the food breaking into small particles.
- **Examples:** Crispy potato chips or crumbly shortbread cookies.

7. Smoothness:

- **Definition:** Smoothness refers to the evenness of a food's surface and texture.
- **Examples:** The smooth texture of a well-emulsified sauce or a perfectly blended smoothie.

8. Creaminess:

- **Definition:** Creaminess is the sensation of richness and smoothness often associated with dairy products.
- **Examples:** The creamy texture of yogurt or cheese.

9. Astringency:

- **Definition:** Astringency is a puckering sensation caused by tannins or other compounds that cause proteins in the mouth to constrict.
- **Examples:** The drying sensation from eating unripe fruit or certain wines.

10. Fat Content:

- **Definition:** Fat contributes to mouthfeel by influencing the richness and smoothness of the food.
- **Examples:** The fatty, smooth mouthfeel of creamy cheeses or rich sauces.

Measuring and Evaluating Mouthfeel

- **Sensory Evaluation:** Trained panelists or consumer testers assess mouthfeel through sensory panels. They use descriptors to characterize the texture and sensations experienced.
- **Instrumental Analysis:** Tools such as texture analyzers and rheometers measure various physical properties related to mouthfeel. For example, a texture analyzer can measure hardness, cohesiveness, and chewiness.

Importance in Food Technology

1. **Product Development:** Understanding mouthfeel helps in creating desirable food textures and sensations, which are crucial for consumer satisfaction. For example, achieving the right level of creaminess in a dairy product or the perfect crunch in a snack.
2. **Quality Control:** Consistent mouthfeel is important for maintaining product quality and ensuring that each batch meets the desired sensory standards.
3. **Consumer Preference:** Mouthfeel significantly impacts consumer preference and perception. Products with a pleasing mouthfeel are often more enjoyable and can lead to higher consumer satisfaction and repeat purchases.
4. **Health and Nutrition:** Mouthfeel can influence how satisfying a food product is, which can affect portion sizes and overall calorie intake. For example, products designed to mimic the mouthfeel of higher-fat items can help in creating lower-fat alternatives that still feel satisfying.

In summary, mouthfeel is a complex and multifaceted aspect of food sensory experience that plays a crucial role in product development, consumer satisfaction, and overall food quality. Understanding and controlling mouthfeel is essential for food technologists to create appealing and enjoyable food products.

•

2. Density

- **Definition:** Density is the mass per unit volume of a fluid.
- **Units:** Kilograms per cubic meter (kg/m^3) or grams per cubic centimeter (g/cm^3).
- **Relevance:** Density is important for determining the correct formulation of food products, calculating nutritional content, and designing storage and handling systems. It affects buoyancy, sedimentation, and separation processes.

3. Specific Gravity

- **Definition:** Specific gravity is the ratio of the density of a fluid to the density of a reference substance (usually water).
- **Units:** Dimensionless.
- **Relevance:** Specific gravity helps in identifying and comparing fluids, assessing concentration, and ensuring consistency in products like syrups and beverages.

4. Surface Tension

- **Definition:** Surface tension is the force per unit length exerted along the surface of a liquid, causing it to contract to the smallest possible surface area.
- **Units:** Newtons per meter (N/m) or dynes per centimeter (dyn/cm).
- **Relevance:** Surface tension affects the behavior of liquids during processing and packaging. It influences phenomena like foaming, emulsification, and the formation of droplets.

5. Compressibility

- **Definition:** Compressibility measures how much a fluid's volume decreases under pressure.
- **Units:** Often expressed as a dimensionless compressibility factor (Z) or in terms of bulk modulus (Pa).
- **Relevance:** Compressibility is crucial for understanding how gases and liquids behave under pressure changes, which is important in processes like carbonation and gas infusion.

6. Thermal Properties

- **Specific Heat Capacity:** The amount of heat required to change the temperature of a unit mass of a substance by one degree Celsius.
 - **Units:** Joules per gram per degree Celsius (J/g·°C) or kilojoules per kilogram per Kelvin (kJ/kg·K).
 - **Relevance:** Specific heat capacity affects cooking, cooling, and heating processes. It's important for energy calculations in thermal processing.
- **Thermal Conductivity:** The ability of a fluid to conduct heat.
 - **Units:** Watts per meter per Kelvin (W/m·K).
 - **Relevance:** Thermal conductivity influences heat transfer rates in processes like pasteurization and refrigeration.

7. Elasticity and Deformation

- **Definition:** Elasticity refers to a fluid's ability to return to its original shape after deformation. Although fluids are generally not elastic, viscoelastic behavior can be observed in some food gels and pastes.
- **Units:** Young's modulus or bulk modulus (Pa) for solids and semi-solids.
- **Relevance:** Elastic and viscoelastic properties affect the texture and stability of products like gels, doughs, and emulsions.

8. Flow Behavior

- **Newtonian Fluids:** Fluids with a constant viscosity regardless of the applied shear rate (e.g., water, milk).
- **Non-Newtonian Fluids:** Fluids whose viscosity changes with the shear rate (e.g., ketchup, yogurt). They can be further classified into shear-thinning (pseudoplastic) and shear-thickening (dilatant) fluids.

- **Relevance:** Flow behavior affects processing, mixing, and pumping of food products. Understanding these properties helps in designing equipment and optimizing processing conditions.

9. Rheology

- **Definition:** Rheology is the study of the flow and deformation of matter, including both liquids and semi-solids.
- **Units:** Various, including viscosity, shear stress, and shear rate.
- **Relevance:** Rheological properties are critical in food formulation, texture analysis, and quality control. They influence how products like sauces, doughs, and creams are processed and perceived.

10. Solubility and Miscibility

- **Solubility:** The ability of a substance to dissolve in a solvent.
 - **Units:** Typically grams per liter (g/L) or percent by weight.
 - **Relevance:** Solubility affects ingredient mixing and stability in products like beverages and sauces.
- **Miscibility:** The ability of two liquids to mix together.
 - **Relevance:** Miscibility is important for emulsions and mixtures, such as salad dressings and dairy products.

Understanding these fluid properties helps food technologists optimize product formulation, processing conditions, and equipment design to ensure quality, efficiency, and consistency in food production.