

Lecture: Micromeritics

Course: Industrial Pharmacy

By: Dr. Ahmed Bassam Farhan

1. Introduction

Micromeritics is the science and technology of small particles. In industrial pharmacy, micromeritics deals with the characterization of solid drug particles and excipients, focusing on their size, shape, surface area, porosity, and density—all of which affect formulation, processing, and bioavailability.

2. Importance of Micromeritics in Pharmacy

- 1 Dissolution rate affects drug absorption.
- 2 Flow properties influence tablet and capsule manufacturing.
- 3 Mixing and uniformity of drug-excipient blends.
- 4 Compressibility and tablet hardness.
- 5 Suspension stability (sedimentation rate and uniformity).
- 6 Aerosol performance for inhalation products.

3. Fundamental Properties Studied in Micromeritics

- 1 Particle Size and Size Distribution
- 2 Particle Shape
- 3 Surface Area
- 4 Porosity
- 5 Density (True, Bulk, and Tapped Density)
- 6 Flow Properties

4. Particle Size and Size Distribution

Particle size affects dissolution, uniformity, and flow. Expressed as equivalent, volume mean, or number mean diameter.

Methods of determination include microscopy, sieving, sedimentation, Coulter counter, and laser diffraction.

Stokes' Law: $v = (2r^2(\rho_s - \rho_l)g) / 9\eta$

5. Particle Shape

Shape affects packing, flow, and surface area. Spherical particles flow better than irregular ones. Evaluated by microscopy or image analysis.

6. Surface Area

Surface area is related to dissolution rate and adsorption. Determined by gas adsorption (BET method) or air permeability method.

Specific Surface Area (SSA) = Surface area / Mass of particles.

7. Porosity

Porosity represents void spaces in a powder bed and affects flow, compressibility, and tablet density.

$$\text{Porosity } (\epsilon) = (V_b - V_t) / V_b \times 100$$

8. Density Types

True Density (ρ_t): excludes pores (pycnometer). Bulk Density (ρ_b): includes interparticle voids.

Tapped Density (ρ_{tapped}): after tapping.

$$\text{Carr's Index} = ((\rho_{\text{tapped}} - \rho_b) / \rho_{\text{tapped}}) \times 100$$

$$\text{Hausner Ratio} = \rho_{\text{tapped}} / \rho_b$$

9. Flow Properties

Flow properties ensure uniform die filling during tablet compression.

- 1 Angle of repose: $\tan\theta = h/r$ ($\theta < 30^\circ$ = excellent flow, $>40^\circ$ = poor flow).
- 2 Flow rate through orifice: measured as mass/time.
- 3 Compressibility tests: Carr's index and Hausner ratio.

10. Applications of Micromeritics in Pharmacy

- 1 Designing tablet and capsule formulations.
- 2 Improving bioavailability of poorly soluble drugs.
- 3 Controlling suspension stability.
- 4 Enhancing aerosol and powder inhaler performance.
- 5 Quality control during granulation and milling.

11. Summary

Micromeritics provides essential tools for understanding and controlling the physical behavior of powders in pharmaceutical processing. Control of particle size, surface area, porosity, and density is vital for ensuring uniform dosage, stability, and performance of pharmaceutical products.