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It's Important to Know!

BP304T — Pharmaceutical Engineering

B.Pharm Semester 3 · Unit 1 — Flow of fluids, size reduction and size separation

Unit I: Flow of fluids, size reduction and size separation

Flow of fluids

Fluid flow may be steady or unsteady, uniform or non-uniform, and laminar or turbulent. A manometer measures pressure difference using a liquid column. Reynolds number relates inertial and viscous effects and helps classify flow, although the transition range depends on geometry and conditions.

Bernoulli's theorem expresses conservation of mechanical energy for an idealised flowing fluid. Real systems lose energy through friction, fittings and changes in area. Orifice meters and Venturimeters infer flow from pressure changes. A Pitot tube relates stagnation and static pressure to fluid velocity. A rotameter uses a float in a tapered tube and requires suitable calibration.

Size reduction

Size reduction increases surface area, improves mixing, supports extraction or dissolution and produces a required powder range. Particles may break by compression, impact, attrition, cutting or combined mechanisms. Kick, Rittinger and Bond relationships describe different idealised energy-size relationships. The useful law depends on material and size range.

Hammer mills use impact, ball mills use impact and attrition, fluid-energy mills use high-velocity gas, and edge-runner or end-runner mills use compression and shearing. Feed moisture, hardness, toughness, stickiness, speed and heat sensitivity affect performance.

Size separation

Size separation classifies particles by size or settling behaviour. Sieves provide a defined aperture range. Cyclone and air separators use fluid forces, while bag filters collect particles from air and elutriation uses an upward fluid stream. Powder standards and sieve terminology are set out in the applicable pharmacopoeia.

Unit I: Frequently asked questions

Q: What does Reynolds number help predict?

A: It compares inertial and viscous effects and helps indicate whether flow is likely to be laminar or turbulent in a defined system.

Q: Why does size reduction improve dissolution?

A: It can increase surface area, reducing the distance for mass transfer, although wetting and solid form still matter.

Q: How does a cyclone separate particles?

A: A rotating gas flow creates centrifugal effects that drive larger or denser particles toward the wall for collection.

Unit I: Key takeaways

- Fluid meters infer flow from pressure, velocity or float position.
- Real fluids lose energy through friction and fittings.
- Size reduction uses impact, compression, attrition or cutting.
- Equipment choice depends on material and target particle size.
- Separation method depends on particle and fluid properties.

Unit I: Practical correlation

Practical correlation: powder milling. A mill should be selected after considering heat generation, dust, contamination risk, feed properties and desired particle-size distribution. The appropriate equipment and screen setting are set out in the approved specification for the product.