

Size Separation

Size Separation

- Size separation, also known as sieving, sifting, or screening, is the process of separating particles into different size fractions.
- This is crucial in many industrial processes to ensure product quality and consistency.

Objectives of Size Separation

1. **Particle Size Control:** Ensure uniform particle size for consistent quality in product formulations.
2. **Improved Product Performance:** Optimize particle size for enhanced dissolution rates, bioavailability, and therapeutic efficacy.
3. **Efficient Processing:** Facilitate downstream processing steps such as mixing, granulation, and compaction.
4. **Quality Control:** Ensure compliance with regulatory standards and specifications.
5. **Waste Reduction:** Separate unusable fine or coarse particles to minimize waste.

Applications of Size Separation

1. Pharmaceutical Industry:

- **Tablet production:** Ensuring uniform particle size for consistent drug release.
- **Powder formulations:** Creating powders with specific particle size distributions.

2. Food Industry:

- **Ingredient separation:** Sorting of flour, sugar, and other ingredients based on size.
- **Quality control:** Ensuring uniform particle size in products like spices.

3. Chemical Industry:

- **Catalyst preparation:** Creating catalysts with precise particle sizes.
- **Raw material processing:** Separating raw materials for further processing.

4. Mining and Mineral Industry:

- **Ore processing:** Separating valuable minerals from waste.
- **Particle size control:** Ensuring consistent particle sizes for further processing.

5. Agriculture:

- **Seed sorting:** Separating seeds based on size for planting.
- **Grain processing:** Separating grains for milling and further processing.

Mechanism of Size Separation

1. **Sieve Analysis:** The most common method where a sample is passed through a stack of sieves with progressively smaller openings.
2. **Air Classification:** Uses a stream of air to separate particles based on size and density.
3. **Cyclone Separation:** Uses centrifugal forces to separate particles based on size and density.
4. **Sedimentation:** Separates particles in a liquid based on their settling rates.
5. **Elutriation:** Uses a rising current of fluid to separate particles based on size, shape, and density.
6. **Centrifugation:** Uses centrifugal force to separate particles based on their size and density, with larger particles sedimenting faster.

Classification of Powders According to Indian Pharmacopoeia (IP)

- The Indian Pharmacopoeia (IP) classifies powders based on their ability to pass through standard sieves.
- Each type of powder must comply with specific sieve mesh sizes.

IP Classification Table:

Type of Powder	Description	Sieve Size	Requirement
Coarse powder	Large, gritty particles	Passes through #10 (1.70 mm)	Not more than 40% passes through #44 (355 µm)
Moderately coarse powder	Medium-sized particles	Passes through #22 (710 µm)	Not more than 40% passes through #60 (250 µm)
Moderately fine powder	Smaller particles than moderately coarse	Passes through #44 (355 µm)	Not more than 40% passes through #85 (180 µm)
Fine powder	Smooth to touch	Passes through #60 (250 µm)	Not more than 40% passes through #120 (125 µm)
Very fine powder	Soft and very smooth	Passes through #80 (180 µm)	No upper limit
Micronized powder	Extremely fine	Passes through #120 (125 µm) or smaller	Usually made by jet milling; particle size often <10 µm

Cyclone Separator

Principles:

- Operates on the principle of centrifugal separation.
- Particles are separated from a gas stream by centrifugal forces generated within a cyclone chamber.

Construction:

1. **Cyclone Chamber:** A cylindrical or conical chamber with a tangential inlet.
2. **Inlet:** For the gas-particle mixture.
3. **Outlet:** For clean gas at the top and for separated particles at the bottom.
4. **Vortex Finder:** A tube extending into the cyclone to reduce turbulence and improve separation efficiency.

Working:

- The gas-particle mixture enters the cyclone tangentially, creating a spiral motion.
- Centrifugal forces push heavier particles toward the outer wall, where they lose momentum and fall to the bottom.
- Clean gas exits through the vortex finder at the top.

Uses:

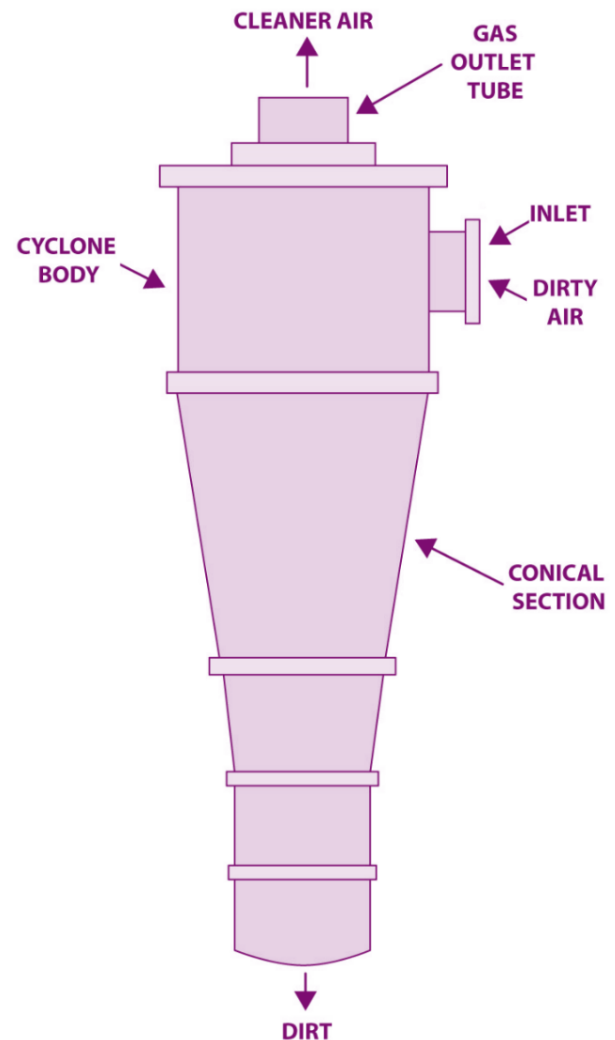
- Widely used in industrial dust collection systems.
- Pre-cleaning of gases in power plants, cement factories, and metal industries.

Merits:

- No moving parts, resulting in low maintenance.
- Capable of handling high dust loads.
- Efficient for separating coarse particles.

Demerits:

- Inefficient for very fine particles.



- Pressure drop can be significant, requiring energy to maintain flow.
- Not suitable for sticky or hygroscopic materials.

Sieves

Definition:

- Sieves are devices with mesh or perforated surfaces used to separate particles based on size.

Construction:

- Made from woven wire mesh, perforated metal plates, or electroformed mesh.
- Mesh number indicates the number of openings per linear inch. Higher mesh numbers have smaller openings.

Use in Size Separation:

- Particles are separated by being passed through a stack of sieves with progressively smaller openings.
- The process involves shaking or vibrating the sieves to facilitate particle movement and separation.

Common Mesh Sizes:

- **No. 8:** 2.36 mm
- **No. 20:** 850 μm
- **No. 40:** 425 μm
- **No. 60:** 250 μm
- **No. 80:** 180 μm
- **No. 100:** 150 μm

Sieve Shaker:

- A mechanical device that ensures consistent and repeatable shaking to improve the efficiency and accuracy of size separation.

Applications:

- Used in quality control and research laboratories for particle size distribution analysis.
- Common in industries like pharmaceuticals, food, chemicals, and construction.

Advantages:



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