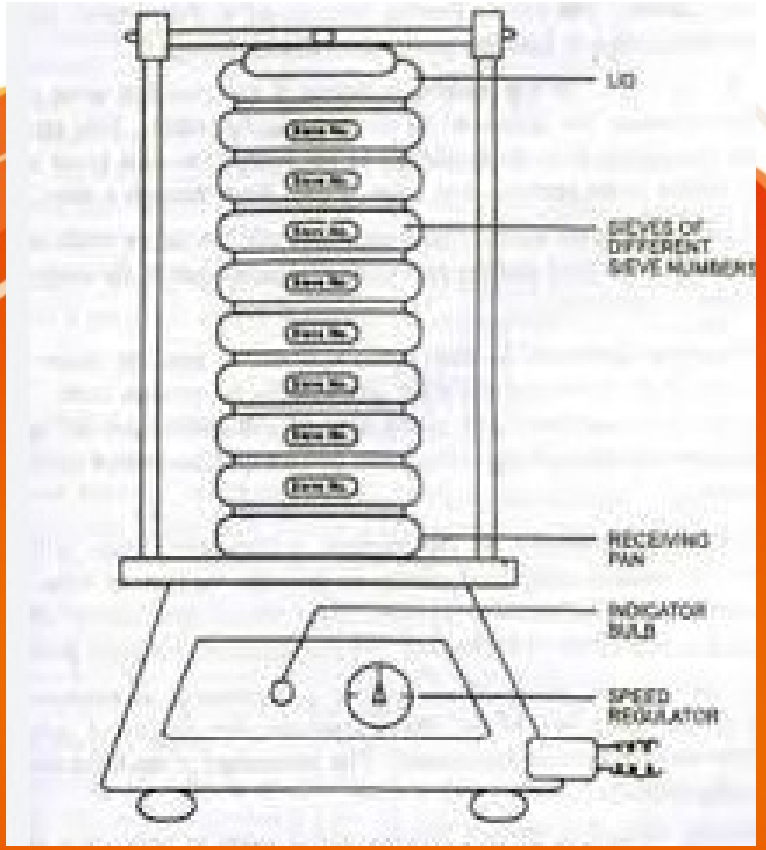
Determination of particle size and particle size distribution using sieving method.



Requirements:

- **Chemicals:** A sample of any granules or powder.

- **Glassware and apparatus:** Sieve set, mechanical sieve shaker, weighing balance etc.

References:

- Subrahmanyam CVS, Setty JT, Suresh S. Laboratory manual of pharmaceutical engineering (Unit operations). Delhi Vallabh Publications.

- Pharmaceutical Engineering by Sanbamurty K. (New Age International, New Delhi)Cooper and Gunn's Tutorial Pharmacy Edited by Carter SJ. (CBS Publishers, Delhi)

- Pharmaceutical Dosage forms by Aulton. (Churchill Livingstone, Edinburg).

Micromeritics

- Science and technology of small particles.
- The particle size of a drug can affect its release from dosage forms that are administered orally, parenterally, rectally and topically.
- Polydisperse.
- It is therefore necessary to know not only the size of a certain particle, but also how many particles of the same size exist in the sample.

- Thus, we need an estimate of the size range present and the number or weight fraction of each particle size.

- This is the particle-size distribution and from it we can calculate an average particle size for the sample.

- When the number or weight of particles lying within a certain size range is plotted against the size range or mean particle size, a so-called frequency distribution curve is obtained.

- This is important because it is possible to have two samples with the same average diameter but different distributions.

Methods for determining Particle Size

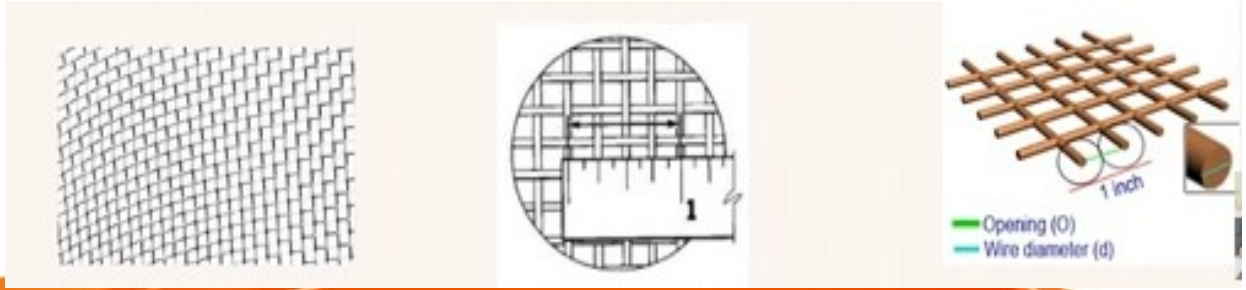
S.No.	Name of method	Instrument Used	Diameter measured
1.	Optical microscopy method	Microscope	Projected diameter, dp
2.	Sieving method	Sieve shaker	Sieve diameter, d sieve
3.	Sedimentation method	Andreasen Apparatus	Stokes diameter, dst
4.	Particle volume measurement method	Coulter counter apparatus	Volume diameter, dv

Five grades of powder as per I.P.

S. No.	Grade of powder	all particle must pass through Sieve No. /Nominal mesh aperture	Sieve through which 40% of the particles pass/ Nominal mesh aperture
1	Coarse powder	10 /(1.70 mm)	44 /(355 µm)
2	Moderately coarse powder	22 /(710 µm)	60/ (250 µm)
3	Moderately fine powder	44/(355 µm)	85/(180)
4	Find powder	85/(180 µm)	Not specified
5	Very fine powder	120/(125 µm)	Not specified

Sieve number:

- Sieve number: The sieve number denotes the number of holes present in the sieve within one inch length of the sieve mesh.
- For example, consider the Number 4 sieve which have a mesh opening of 4.76 mm.
- There will be 4 numbers of 4.76 mm opening present within the one inch length of mesh.
- A high mesh number corresponds to a small aperture size, since there is an inverse relationship between the two.



Designations and dimensions of sieves

Mesh	µm	Mesh	µm
4	4760	80	177
6	3360	100	149
8	2380	140	105
12	1680	200	74
16	1190	230	62
20	840	270	53
30	590	325	44
40	420	400	37
50	297	625	20
60	250	1250	10
70	210	2500	5

Sieving Method

- Sieve analysis is a technique

❖ Sieve method gives sieve diameter (dsieve)

❖ Sieve diameter : diameter of the sphere that passess through the sieve aperture as the asymmetric particle sieve method directly give weight distribution.

❖ Particles having size range from 50 and 1500 µm.

❖ Performed by sifting a powder sample through a stack of wire mesh sieves, separating it into discrete size ranges.

❖ Instrument used: Sieve shaker with set of sieves

Sieving Method

- Standard size sieves are available to cover a wide range of size.
- Sieves are designed to sit in a stack so that material falls through smaller and smaller meshes until it reaches a mesh which is too fine for it to pass through.
- Sieves for pharmaceutical testing are constructed from wire cloth with square meshes, woven from wire of brass, bronze, stainless steel or any other suitable material.
- The stack of sieves is mechanically shaken to promote the passage of the solids.
- The fraction of the material between pairs of sieve sizes is determined by weighing the residue on each sieve.
- The result achieved will depend on the dUration of the agitation and the manner of the agitation.

Sieving Method Applications

- The sieving method finds application in dosage and development of tablets and capsules.
- Normally 15 percent of fine powder (passed through mesh 100) should be present in granulated material to get a proper flow of material and achieve good compaction in tableting.
- Thus percent of coarse, moderate, fine powder is estimated by this method.
- A sieve analysis can be performed on any type of non-organic or organic granular materials including sands, crushed rock, clays, granite, feldspars, coal, soil, a wide range of manufactured powders, grain and seeds.

re for Sieving method

Weigh the mass of the sample to be used (50-100 g)

Arrange the sieves in order from largest (coarsest) at the top to smallest (finest), with the pan at the end below the smallest sieve

Add the powder sample to the top largest size sieve

Set the sieve shaker to vibrate for 15 to 20 minutes.

Carefully weigh the mass retained on each sieve and in the pan

Report the weights retained on each sieve in the table against corresponding sieve number

Factors influencing the sieving method

- **Weight of the sample : Sample mass should be between 25 and 100g.**

- **Temperature and humidity should be controlled such that the moisture content of the material remains constant.**

- **Duration of shaking: 15 to 20 minutes. A shorter time may be required for brittle assembly**

- **Type of motion:**

Vibratory motion,

Side tap motion,

Bottom pat motion,

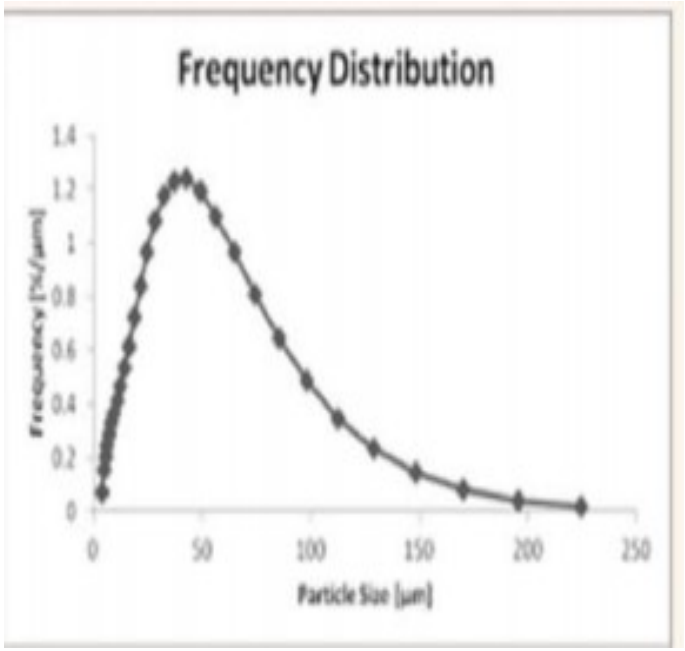
Rotary motion with tap Rotary motion.

Observation table:

Sr. No.	Sieve no.	Sieve size (µm)	Sieve No.Passed / retained	Sieve size.Passed /retained	Weight retained (gm)	% Weight retained	Cumulative % weight retained
01	10	2000					
02	20	840					
03	40	420					
04	60	250					
05	80	177					
06	100	149					
07	120	125					

Frequency Distribution Curve

- A frequency distribution derived from sieve analysis data consists of a plot of the frequency by mass of discrete size intervals (fmi) against the midpoint of the interval size (xmid).



- This plot can be represented either as a scatter plot or as a histogram.

Calculations

% Retained = W Sieve / W total *100%

- **The next step is to find the cumulative percent of aggregate retained in each sieve.**
- **To do so, add up the total amount of aggregate that is retained in each sieve and the amount in the previous sieves.**
- **The cumulative percent passing of the aggregate is found by subtracting the percent retained from 100%.**

%Cumulative Passing = 100% - % Cumulative Retained.

- **The values are then plotted on a graph with cumulative percent passing on the y axis and logarithmic sieve size on the x axis.**

Advantages and Disadvantages

Advantages:

1. It is in expensive method
2. Simple to use
3. Rapid with reproducible results.
4. Sieving method is useful when particles are having size range between 50 and 1500µm.

Disadvantages:

5. Lower limit of the particle size is 50µm.
6. If the powder is not dry apertures become clogged with particles leading to improper sieving.
7. During shaking, attrition occurs causing size reduction 01 particles.