Powder density

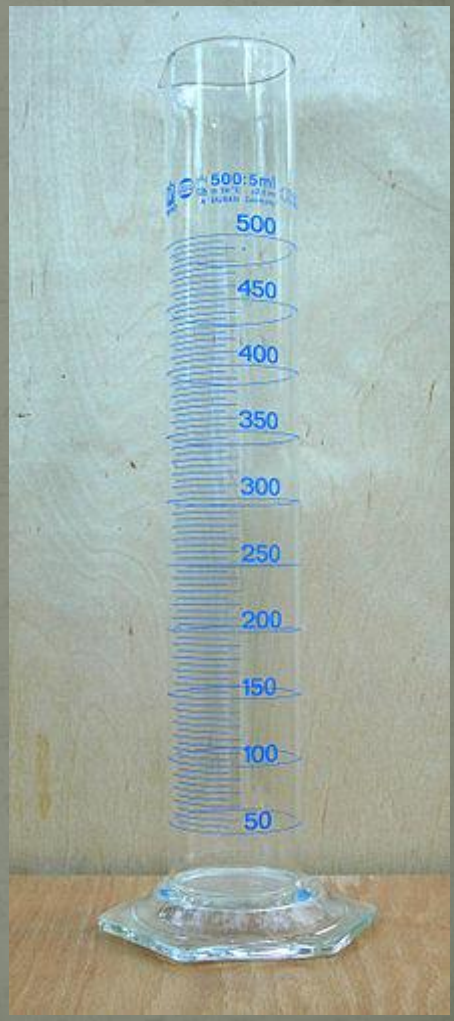
Lab4 Industrial pharmacy

Powder bulk density (method 1 USP)

It is simply expresses the amount (usually weight or mass) [100 g] of untapped powder in a specified interparticulate void volume (150-250 ml).

$$\rho o = \frac{\text{mass}}{\text{volume}} \text{ (unit in g/ml = 1000 kg/m}^3\text{)}$$

As international unit (because the measurements are made using cylinders. It may also be expressed in grams per cubic centimeter (g/cm^3).



Composition of powders and there relation with volume

- Powders are composed of: particles and voids.
- The volume occupied by a given number of particles depends on how closely they are packed.
- The packing of particles depends on:

A- shape & size

B- cohesiveness

C- short-range motion

D- external forces.

Tapped density (method 1 USP)

Describe the bulk-density of a powder (or granules) after consolidation/compression ("tapping“) the container (100 or 250 ml) of powder (1 min) a measured number of times (either 300 or 250 tap), usually from a predetermined height [14 or 3 mm] .

The method of "tapping" is best described as lifting and dropping.

Measuring Bulk density

Is determined by pouring **pre-sieved (≥1 mm) bulk drug** into a graduated cylinder (250 ml with 2 ml readable) via a large funnel and measuring the volume and weight.

Measuring tapped density

- Tapped density measured by tapping graduated glass measuring cylinder manually or by mechanical device.

Note: Devices that rotate the cylinder or vessel during tapping may be preferred to minimize any possible separation of the mass during tapping down.

Types of tapping:

1. Manual tapping
2. Mechanical tapping

1. Manual tapping:

The raising and lowering of the cylinder by hand is done either without reference to the height traversed and arbitrary acceleration in both upward and downward directions; the hand remaining in contact with the cylinder at all times (hand tapping).

(The cylinder containing the powder is tapped by repeatedly striking its base down onto a hard surface).

2. Mechanical tapping

Tap density analyzers (tap density testers) Use an electric motor to turn a cam under a specially constructed cylinder holder. The holder secures the cylinder to a vertical shaft which runs in a low friction bearing.

The tapping rate is expressed in taps per minute; the rate being typically a few hundred.

The actual rate is determined by the rotational speed of the cam under the shaft/platform.

- **Digital or electromechanical counters** are usually incorporated in the device to automatically stop the cam rotation after a predetermined (yet adjustable) number of taps.

(Carry out 10, 500, and 1250 taps on the same powder sample and read the corresponding volumes *V10*, *V500*, and *V1250* to the nearest graduated unit. If the difference between *V500* and *V1250* is ≤ 2 mL, *V1250* is the tapped volume. If the difference between *V500* and *V1250* > 2 mL, repeat in increments such as 1250 taps, until the difference between measurements ≤ 2 ml).

- The **height through which the container falls** is (drop height or stroke). It is set by the distance between the highest point on the cam and the striking surface.

How to correct the density problem:

1. Milling
2. Slugging
3. Formulation

Benefits of bulk density:

- Important in the consideration the size of high dose capsule product.
- The homogeneity of a low dose formulation in which there are large differences in drug and excipient densities.
- knowing the dose and formulation density to determine the appropriate size for a capsule formulation.

Tapped density and powder flowability

- **The change in tapped powder volume (related to flow properties of powders)**
- It can be determined by compressibility which is computed from powder density using the following equation:

% compressibility (carr's index) $= (\rho t - \rho o / \rho t) \times 100$

Hausner ratio $= \rho t / \rho o$

ρt- tapped density

ρo- bulk density

% compressibility (Carr's index)	Flowability	Hausner ratio
≤10	Excellent	1-1.11
11-15	Good	1.12-1.18
16-20	Fair	1.19-1.25
21-25	passable	1.26-1.34
26-31	Poor	1.35-1.45
32-37	Very poor	1.46-1.59
More than 38	Extremely poor	> 1.6

Please follow these links to watch the videos:

- https://www.youtube.com/watch?v=baFHheiG3Hc
- https://www.youtube.com/watch?v=-pEa8U4oPbA
- https://www.youtube.com/watch?v=72jUlIdhFcA
- https://www.youtube.com/watch?v=gDvEbkuhuvc


THANKS Y' ALL!
YOU ARE SO KIND!
HECK YEAH!
THANK YOU
YOU'RE THE BEST
1
and
ONLY