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Aim :-

Determination of Bulk density, Tapped density, Carr's compressibility index and Hausner ratio.

Reference :-

1. Dr. AA Hajare "Practical book of physical pharmaceutics II" first edition, Nirali Publication 2019, Page no. - 19-21.

2. Tanvir V. Shakib, Dr Bharat V. Jain Md. Rageeb Md Usman "A practical book of Physical Pharmaceutics II" first edition 2018, Page no - 18-21.

Requirement :-

Glasswares and apparatus - Measuring cylinder,
Weighing machine,
Spatulla,
Butter paper.

Theory :

Principle :-

Density of powder affect the performance and function of many pharmaceuticals materials. Density measurement involves measurement of mass and volume. Both active and inactive excipient compounds are used in the

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$$\text{Tapped density} = \frac{\text{Bulk Weight}}{\text{Tapped volume}}$$

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$$\text{Carr's Compressibility Index} = \frac{\text{Bulk volume} - \text{Tapped Volume}}{\text{Bulk volume}}$$

$$\text{Hausner Ratio} : \frac{\text{Bulk volume}}{\text{Tapped volume}}.$$

manufacturing of solid dosage formulation such as tablet and capsules. Measuring the volume of rigid solid material of simple geometry is simple. The measurement of volume of material with irregular shape is difficult.

Absolute density (True Density):

It is true density, real density, apparent or skeletal density. When the volume measured exclude the pores and voids space between particles in the sample powder. Helium pycometer is used to measure the volume. The mass of a particle divided by volume excluding opened and closed pores. True volumes includes volume of solid phase only with the closed pores not open to outside surface.

Bulk density:

It is also called as envelope density. It is determined for porous material. When pore spaces within the material particles are included in volume measurement. Bulk density is its mass divided by volume. It is determined ~~by~~ including that of pore spaces within materials. Volume includes interstitial space among the objects as well as pore spaces inside the objects. Bulk density of a powder is the ratio of the mass of powder sample to its volume including the contribution of interparticulate void.

Flow Properties	Carr's Compressibility Index	Hausner ratio
Excellent	1 - 10	1 - 1.11
Good	11 - 15	1.12 - 1.18
Fair	16 - 20	1.19 - 1.25
Passable	21 - 25	1.26 - 1.34
Poor	26 - 31	1.35 - 1.45
Very poor	32 - 37	1.46 - 1.59
Very very poor	> 38	> 1.59

volume. While measuring bulk volume the powder sample is untapped. The bulk density depends on arrangement of powder particles and density of powder particles. Light powders have high bulk volume while heavy material/powders have low bulk volume. Bulk volume includes interstitial space among objects as well as pore spaces inside objects.

Tapped density :-

The tapped density is an increased bulk density attained after mechanical tapping of container containing the sample. The interparticulate interaction influence bulking properties and interface with powder flow.

In free flowing powder the inter particulate interactions are less significant and bulk density and tapped ~~density~~ densities for them have closer value.

In poor flowing powder the interparticulate interaction are more so the bulk density and tapped density have difference.

Porosity :-

Porosity consists of volume of pores. The porosity of pharmaceutical powders can impact production flowing rate porosity determines hardness of tablet. Tablet porosity affects disintegration and dissolution.

ⓐ Bulk density = $\frac{\text{Bulk weight}}{\text{Bulk volume}} = \frac{B.W}{B.V}$

$= \frac{20}{36} = 0.55$

ⓑ Tapped density = $\frac{\text{Bulk weight}}{\text{Tapped vol.}} = \frac{B.W}{T.V}$

After tapped 500 times. $= \frac{20}{29} = 0.74.$

ⓒ Carr's Compressibility Index = $\frac{B.V - T.V}{B.V}$

$= \frac{36 - 29}{36} = \frac{9}{36} = 0.25$

Ⓓ Hausner ratio = $\frac{B.V.}{T.V} = \frac{36}{29} = 1.33$

Porosity is a measure of the void spaces in material and is a fraction of the volume of voids over the total volume between 0-1 or as a percentage between 0-100%. The porosity and voids is defined as the ratio of the void volume to bulk volume.

Flow properties :

Flow properties of powders are an important parameter in the production of pharmaceutical dosage forms. It may be free flowing or poor flowing. Cohesiveness between the particles, adhesion between the particles and the container wall and friction between particles are some of the reactions for poor flow.

Carr's compressibility Index :

It is the ratio of $\frac{(\text{Bulk volume} - \text{Tapped volume})}{\text{Bulk volume}}$.

% Carr's compressibility Index = (Carr's compressibility Index × 100)

Hausner Ratio :

It is the ratio of $\frac{\text{Bulk volume.}}{\text{Tapped volume.}}$

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Procedure:

a) Determination of Bulk Density:

- Take a clean and dry measuring cylinder.
- Weighed accurately 20g of powder.
- Note down the weighed as gram.
- Place it in dry graduated measuring cylinder and note down the volume as Vm.
- Read the volume of powder without compacting.
- Calculate the bulk density.

$$\text{Bulk density} = \frac{\text{Bulk weight}}{\text{Bulk volume}} = \frac{W}{V}$$

b) Determination of tapped density:

- Weigh 20g of sample and place it into a graduated cylinder.
- Carry out 500 tapping on same sample.
- Measure the tapped volume and calculate the tapped density.

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Tapped Density = $\frac{\text{Bulk Weight.}}{\text{Tapped volume}} = \frac{W}{V}$

c) Determination of carr's compressibility index

Carr's compressibility Index = $\frac{\text{Bulk volume - Tapped volume.}}{\text{Bulk volume.}}$

d) Determination of Hausner ratio:

Hausner ratio = $\frac{\text{Bulk volume.}}{\text{Tapped volume.}}$

Result:

The bulk density, tapped density, Carr's compressibility and hausner ratio was found to be 0.55, 0.74, 0.25 and 1.33 respectively.

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