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Bulk Tapped and True Density with Derived Powder Properties

Experiment 8 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To determine powder densities, Hausner ratio, Carr index and bed porosity.

Principle

Bulk and tapped densities include voids between particles; true density measures solid material volume by the assigned displacement method. Tapping rearranges particles. Derived indices depend on the complete method and do not uniquely establish powder-flow behaviour.

Requirements

- Representative dry powder, calibrated cylinder and approved tapping apparatus.
- Balance and validated pycnometer/displacement method with a non-reactive, non-dissolving displacement medium.

Procedure

1. Bulk volume

Weigh the assigned powder mass and introduce it gently without intentional compaction. Read the initial bed volume V_0.

2. Tapped volume

Tap using the prescribed apparatus and current laboratory/compendial sequence until its endpoint criterion is satisfied. Record tap counts and final volume Vf.

3. True volume

Use the assigned calibrated displacement procedure, controlling temperature and removing trapped air without dissolving or reacting with the powder.

4. Densities

Calculate bulk m/V_0, tapped m/Vf and true m/Vsolid, retaining consistent units.

5. Indices

Calculate Hausner ratio, Carr compressibility index and bulk-bed porosity. State whether the true-density method includes or excludes internal accessible pores.

6. Compare

Report replicate spread and method conditions. Interpret flow-related indices alongside actual flow testing rather than assigning an unsupported universal grade.

Observations and Record

Record	Value
Mass / V_0 / Vf / tap endpoint	_____
Solid displacement volume / method	_____
Bulk / tapped / true density	_____
Hausner / Carr index / porosity	_____

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- For m = 50.0 g, V_0 = 100 mL and Vf = 80 mL: ρbulk = 0.500 g/mL; ρtap = 0.625 g/mL.
- Hausner = ρtap/ρbulk = V_0/Vf = 1.25. Carr index = 100(V_0-Vf)/V_0 = 20.0%.
- With assigned ρtrue = 1.50 g/mL, bulk-bed porosity = (1-ρbulk/ρtrue) × 100 = 66.7%.

Result

Record the observed outcome and calculated value, with units. State whether the stated laboratory specification was met; do not copy the worked example as your result.

Precautions

- Use the instructor's assigned material and apparatus; record actual temperature and units with every measured property.
- Check instrument calibration and use repeat readings rather than a single convenient result.
- Compare a marketed teaching formulation only under the same method and conditions; its excipients can change the property.

Viva Questions and Answers

1. Why is tapped density usually higher?

Tapping reduces interparticle void volume.

2. Does bulk density equal true density?

No. Bulk volume includes bed voids.

3. Why state the displacement method?

Different accessible pores and solvent interactions can affect the measured volume.

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