Analytical Method #012
Determination of Powder Bulk Density

#012a: "Loose" or "Poured" Bulk Density
#012b: "Packed" or "Tapped" Bulk Density

1.0 Purpose

This Analytical Method defines the ADPI standard operating procedures for determining the bulk density of a dairy powder.

2.0 Scope

This SOP is applicable to the determination of bulk density for any dairy powder.

3.0 Definitions

3.1 **Density** is the mass of a substance per unit volume. Density for dairy powders is most often expressed in units of grams per cubic centimeter or grams per milliliter, though any equivalent units can be achieved via the application of standard conversion factors.

3.2 **Loose** or **poured bulk density** is the apparent density of a powder as determined without employing any means of settling or compaction to increase the mass of powder that is contained in a given volume.

3.3 **Packed** or **tapped bulk density** is the apparent density of a powder as determined after causing the settling or compaction of the powder via mechanical means under consistent conditions, to increase the mass of powder that is contained in a given volume.

4.0 Principle

Density is a basic physical characteristic of a material, and for powder ingredients it can have implications such as for handling, packaging, transportation, and shelf life. Dairy powder density is most often expressed in either loose or poured bulk density, where no compaction means are employed; or packed or tapped bulk density, where deliberate mechanical action is utilized to increase the density by causing settling and compaction. The application of controlled conditions for either determination improves the consistency of the measurements.

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5.0 Reagents and Materials

5.1 Laboratory balance, with adequate capacity for typical weights of dairy powders over the testing volume, with sensitivity of 0.1 g or better;

5.2 Bulk density tester (method #012b only), “stamp” or “jolting” type, compatible with the testing cylinder and capable of programming up to 100 cylinder taps;

5.3 Testing cylinder, 100 cc, or equivalent, compatible with the bulk density tester;

5.4 Spoon, or equivalent, suitable for gently transferring dairy powder to the testing cylinder;

5.5 Straightedge, or equivalent, suitable to level the powder with the rim of the testing cylinder.

6.0 Personal Safety Precautions

In all cases, the practitioner’s company’s internal policies and procedures regarding personal safety supersede the following ADPI recommendations:

6.1 Milk (dairy) is globally classified as an allergen and should be properly handled with personal safety needs in mind.

6.2 Read and understand all precautions for safe handling and disposal shown in the various reagents’ Safety Data Sheets (SDSs), including use of any prescribed Personal Protective Equipment (PPE).

6.3 Dairy ingredients are foods and as such are exempt from U.S. requirements regarding Safety Data Sheets (SDSs), where ingredient-specific safe handling instructions would be provided. Despite this exemption, many dairy ingredients are manufactured and marketed in powder form, and powders should be recognized as potential physical irritants, such as to the eyes, nose, and if inhaled.

6.4 Inspect any fragile apparatus such as the powder cylinder before use and replace any items which are compromised.

6.5 Tester noise may be considerable. Consult the user’s manual; locate the tester appropriately, such as in an unoccupied room, and wear hearing protection if still warranted.

7.0 General Considerations

Use of a mechanical apparatus for bulk density can improve consistency while reducing the time commitment, monotony, and physical stress on the analyst. However, reasonable results can be achieved without the use of a lab instrument by substituting readily available, basic lab apparatus such as volumetric containers along with an analytical balance.

8.0 Method #012a: Loose or Poured Bulk Density

8.1 Accurately record the weight of the empty testing cylinder.

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8.2 Gently fill the cylinder to its full capacity with powder using a spoon or similar implement. Take care not to permit voids, filling the cylinder completely and evenly while avoiding mechanical disruption that would cause settling or compaction.

8.3 Scrape any excess powder away, leveling the powder to the filled mark.

8.4 Accurately record the weight of the filled cylinder.

8.5 The difference between the weight of the filled cylinder and the tare weight, divided by 100 cc, equals the loose or poured bulk density of the powder in units of g/cc or g/mL.

9.0 Method #012b: Packed or Tapped Bulk Density

9.1 Begin as described in 8.1 through 8.4 above, accurately recording the tare weight of the testing cylinder and the weight of the cylinder loosely filled with powder.

9.2 Start the density tester cycle, tapping 100 times.

9.3 When the tapping cycle is complete, read the final volume of the compacted powder in units of cc or mL.

9.4 The difference between the weight of the filled cylinder and the tare weight, divided by the final volume of the compacted powder in units of cc or mL, equals the packed or tapped bulk density of the powder in units of g/cc or g/mL.

10.0 External References

No external references are cited.

11.0 ADPI Document Linkages

Analytical Method #001: *Sampling Dry Powders.*

12.0 Revision History

Version	Effective Date	Notes
1.0	indeterminate	First officially approved version of this Standard Operating Procedure.
2.0	10/30/2023	Migrated this analytical method to the new modernized Standard Operating Procedure format as established by the ADPI Vice President of Technical Services.

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