

Laboratory Method

Bulk Density		
Analytical Services - Milk Powder Laboratory		ASMP_001
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Approved by

Manager – Analytical Services

Purpose

Different steps during the production can influence the volume and hence the bulk density of milk powder. The most important parameters for changing the volume of milk powder are the dry matter content, the viscosity and the temperature of the concentrate. Also homogenisation of the concentrate and the spray conditions, such as inlet and outlet temperature and the peripheral velocity of the atomiser wheel or the pressure during nozzle atomisation are important steps. Special spray drying conditions, such as recirculation of the fines to the wet zone in the spray drier (straight through atomisation), two stage drying or rewetting for the production of instant milk powder, also have an influence on the volume.

In this context, however, the term “volume” of milk powder is strictly the bulk density.

Scope

This method may be used for milk powders and all other dried dairy products.

Reference

New Zealand Dairy Industry. *NZTM 4: Physical Methods Manual*. 2.3 Packed Bulk Density by the Niro Method for Milk Powders and Protein Products. Issue 13.1: March 2007.

New Zealand Dairy Industry. *NZTM 4: Physical Methods Manual*. 2.4 Poured Bulk Density for Milk Powders. Issue 5.0: June 2000.

New Zealand Dairy Industry. *NZTM 4: Physical Methods Manual*. 13.4 Bulk Density by the Niro 10 Tap Method. Issue 5.0: June 2000.

Validation Status

The validation status of NZTM 4.2.3 is unknown.

The origin of NZTM 4.2.4 is unknown and this method is not validated.

The use of NZTM 4.13.4 has been requested by customers, but the method has not been formally validated.

Test Principle

Powder density is related to powder composition and structure. It affects flowability, dispersability and packing characteristics of powder. Bulk density – the mass per unit of bulk volume including voids – is one of the three types of milk powder density that are recognised. It is determined by measuring the mass of a powder

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in a cylinder of known volume.

The bulk density can be expressed in two ways:

- The **poured bulk density** - the weight of powder after it has been transferred into a container of set volume.
- The **packed bulk density** - the weight of powder that has been compacted into a container of set volume after a specified number of tappings. The packed bulk density of the powder is determined by weighing the sample packed into a 100ml container after 100 taps by a stamp volumeter for milk powders and 35 taps for protein products. However, customers may also request the use of 10 taps for nutritional powders supplied to Bristol-Myers Squibb; or 1250 taps, as powders are thought to have reached their maximum bulk density after 1250 taps.

Risk of Serious Harm

High – see hazards section.

Hazards

HAZARD	RISK	EFFECTS OF HAZARD	MANAGEMENT OF HAZARD
Dust	High	May cause lung and breathing problems.	<ul style="list-style-type: none">• Reduce dust in the air by working in the fume cupboard.

Safety Precautions

To reduce noise ensure the door of the 'Sound Box' is shut as soon as possible after starting the stamp volumeter.

Apparatus

1. Balance weighing to 0.1 g.
2. Stainless steel cylinder with detachable top, as shown in Figure 1. The volume of the lower cylinder is 100.0 ± 0.5 mL.
3. Stamp volumeter, made by Engelsmann, Ludwigshafen, Germany, with a drop height of 3.0 ± 0.1 mm, measured with a micrometer.
4. Spoon or spatula
5. Straight edged spatula
6. Brush

EQUIPMENT CALIBRATION CHECKS

- Accuracy of the JEL Stampvolumeter STAV 2003 counters using 10 taps, 35 taps and 100 taps.
- The volume of the lower stainless steel cylinder is 100.0 ± 0.5 mL.
- JEL Stampvolumeter STAV 2003 drop height is 3.0 ± 0.1 mm.

These checks are done annually and are carried out by the M & D Department. Copies of the methods used

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by the M & D Department to perform these checks are located in the Milk Powder Calibration/Maintenance Records Folder.

Dimensions in millimetres

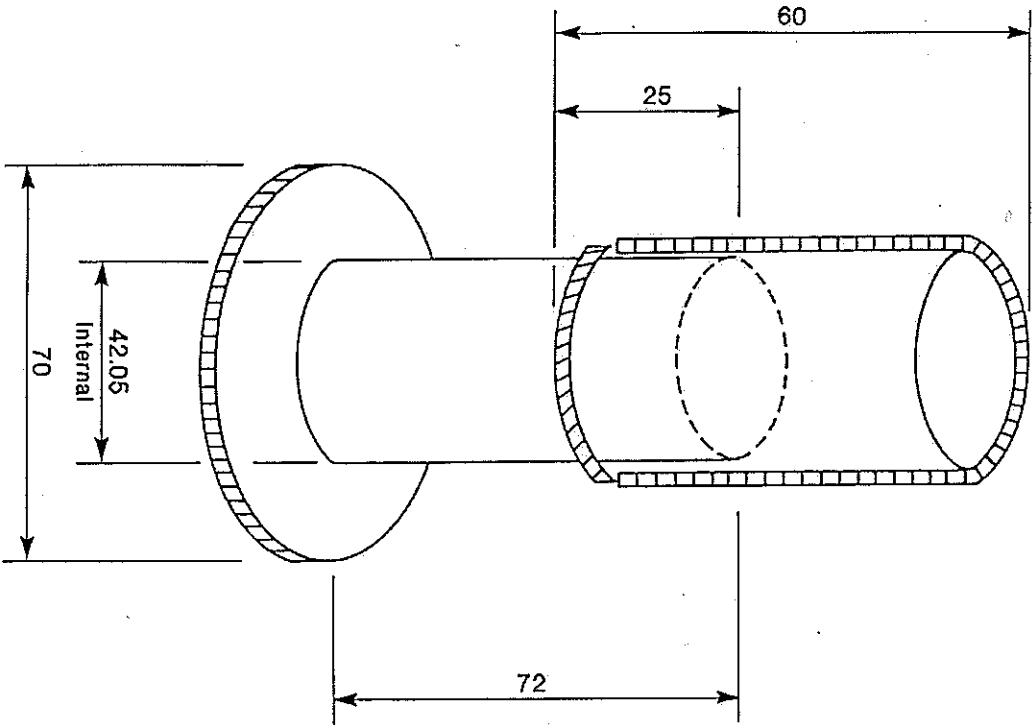


Figure 1. The 100.0 mL stainless steel cylinder.

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Chemicals/Media

N/A

Reagents/Media Preparation

N/A

Standards Preparation

N/A

Quality Control

A Proficiency Services Reference Material (PSRM) sample is to be analysed at the start of each batch/product type. The mean/median values for these QC samples are kept in the Milk Powder PSRM Certificate Folder. Analyse at least one sample in every 10 in duplicate throughout batches, or analyse at least one sample in duplicate if the batch size is less than 10 samples.

All bulk density results are checked for calculation and transcription errors before they are "approved" in LIMS by either another KTP, or designate. If this is not possible then the person who entered the results into LIMS may "approve" their own results on the following day after data entry.

Sample Preparation

Keep the sample at ambient temperature (20°C to 25°C). Thoroughly mix the sample by repeatedly rotating and inverting the container. If the container is too full to allow thorough mixing, transfer all the sample to a clean, dry, airtight container of adequate capacity and mix as described above. The mixing should be very gentle to avoid reducing the particle size of the powder as this alters the bulk density value.

Avoid adsorption or desorption of water before determination, as this will also alter the bulk density value.

Procedure

POURED DENSITY

1. Weigh the cylinder without the top (W_1).
2. Fit the cylinder and top together and carefully fill with powder using a spoon or spatula only. Avoid shaking or tapping the cylinder.
3. Remove the top carefully and scrape off the powder until it is flush with the rim of the cylinder with straight edged spatula. Care should be taken not to compress or vibrate the cylinder. Carefully brush off excess powder from the outside edge of the cylinder.
4. Reweigh the cylinder containing the transferred powder (W_2). The weight of the powder indicates "poured bulk density" (0 taps).

PACKED DENSITY

NOTE: Before each use the accuracy of the stamp volumeter counters must be checked at the relevant number of taps to the samples being tested.

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1. Weigh the cylinder without the top (W_1).
2. Place collar on cylinder. Fit the cylinder and top together and carefully fill with powder using a spoon or spatula only. Avoid shaking or tapping the cylinder.
3. Fix the cylinder with top to the stamp volumeter and tap the cylinder 10, 35, or 100 times.
4. Unfix the cylinder and top from the stamp volumeter, remove the top and collar and carefully scrape off the powder until it is flush with the rim of the cylinder with straight edged spatula. Care should be taken not to compress or vibrate the cylinder. Carefully brush off excess powder from the outside edge of the cylinder.
5. Reweigh the cylinder containing the packed powder (W_2). The weight of the powder indicates "packed powder bulk density" (10, 35, or 100 taps).

Waste Disposal

N/A

Calculations

$$\text{Poured or packed density (g/mL)} = \frac{W_2 - W_1}{100}$$

Where W_1 = the weight, in grams, of the empty cylinder without the top;

W_2 = the weight, in grams, of the cylinder without the top plus powder;

100 = volume of the cylinder in mL.

Report to the nearest 0.01g/mL.

Specifications

Repeatability

Duplicate determinations should agree to within 0.02 g/mL for tapped 0 times. (Source: NZTM 4.2.4).

Duplicate determinations should agree to within 0.01 g/mL for tapped 10, 35, and 100 times (Source: NZTM 4.2.3 & NZTM 4.13.4)

Reproducibility

Duplicate determinations should agree to within 0.05 g/mL for tapped 0 times (NZTM 4.2.4).

No reproducibility values are given for the Nitro 10, 35, and 100 tap methods in the NZTM methods. We have adopted the Proficiency Services' ILCP limit of ± 0.02 g/mL.

Definitions

Powder bulk density is the weight of the powder divided by the volume it occupies, as determined under the conditions described above, expressed as grams per millilitre (g/mL).

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Protein products casein, caseinates, WPC, and MPC ≥ 80 /MP are done at 35 taps.

Related Documents

JEL Stamp/volumeter STAV 2003 Operating and Maintenance Instructions

11.1 Stamp Volumeter – Volume Check. (Last updated 27/07/06). Retrieved from Fonterra Intranet/Policies & Procedures/Manufacturing/Laboratory/Instrument Calibration Manual.

11.2 Stamp Volumeter – Number of Taps. (Last updated 01/09/04). Retrieved from Fonterra Intranet/Policies & Procedures/Manufacturing/Laboratory/Instrument Calibration Manual.

11.3 Stamp Volumeter – Drop Check. (Last updated 17/10/07). Retrieved from Fonterra Intranet/Policies & Procedures/Manufacturing/Laboratory/Instrument Calibration Manual.

BIBLIOGRAPHY

GEA Niro Analytical Methods. (2008). *Powder Bulk Density, A 2 a*. Retrieved October 09, 2008 from the World Wide Web: <http://www.niro.com/niro/cmsdoc.nsf/WebDoc/ndkw6u9atz.htm>.

GEA Niro Milk Powder Technology. (2008). *Bulk Density*. Retrieved October 09, 2008 from the World Wide Web: <http://www.niro.dk/niro/cmsdoc.nsf/WebDoc/ndkw5y8fg9Llibrary.htm>.

ISO8967/IDF134: 2005. *Dried milk and dried milk products – Determination of bulk density*.

New Zealand Dairy Industry. NZTM 4: *Physical Methods Manual*. 2.0 Bulk Density. Issue 5.0: June 2000.

New Zealand Dairy Industry. NZTM 4: *Physical Methods Manual*. 13.16 Bulk Density by the Niro 1250 Tap Method. Issue 5.0: June 2000.

Lloyd, R. (1996). The testing of Milk Powders. In *Milk Powder DIGTP Course Manual* (pp. 15.1 -15.15). 2nd Edition. Palmerston North: New Zealand Dairy Research Institute.

Webby, P. (1996). Milk Powder Quality. In *Milk Powder DIGTP Course Manual* (pp. 10.1 -10.19). 2nd Edition. Palmerston North: New Zealand Dairy Research Institute.

Attachments

N/A

Document History

Version 1	22/10/08	M Bognuda (Change to AS format and review)
Version 2	01/10/09	M Bognuda (Change method code from ASMP_1500. Add stamp volumeter accuracy check before each use.

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Date of Next Review

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Filename and Path

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