SLOVENSKI STANDARD
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Trdna biogoriva ï Metode za doloļ evanje prostorninske mase

Solid biofuels - Methods for the determination of bulk density

Feste Biobrennstoffe - Verfahren zur Bestimmung der Schüttdichte

Biocombustibles solides - Méthodes de détermination de la masse volumique en vrac

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English Version

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Biocombustilbles solides - Méthodes de détermination de la masse volumique en vrac

Feste Biobrennstoffe - Verfahren zur Bestimmung der Schüttdichte

This Technical Specification (CEN/TS) was approved by CEN on 19 March 2005 for provisional application.

The period of validity of this CEN/TS is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the CEN/TS can be converted into a European Standard.

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Foreword

This Technical Specification (CEN/TS 15103:2005) has been prepared by Technical Committee CEN/TC 335 “Solid Biofuels”, the secretariat of which is held by SIS.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this CEN Technical Specification: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

Bulk density is an important parameter for fuel deliveries on volume basis and together with the net calorific value it determines the energy density. It allows conclusions on the required storage or transportation room demand. This Technical Specification describes the determination of the bulk density of pourable solid biofuels which can be conveyed in a continuous material flow.

For practical reasons two standard measuring containers with a volume of 5 litres or 50 litres were chosen for the determination. Due to the limited volume of these containers, some fuels are therefore excluded from the scope of this Technical Specification. This, for example, applies for chunk wood, uncomminuted bark or for baled material and larger briquettes. A bulk density determination of such fuels can be conducted by applying fuel quantities and transhipment containment (e.g. lorries, containers) as typical for the given site.

For conclusion on the actual storage room requirement of a solid biofuel the different storage conditions (e.g. height of heap, moisture content), which usually differ largely from the sample volume of the standard measuring container, have also to be taken into account.

1 Scope

This Technical Specification describes a method of determining bulk density of solid biofuels by the use of a standard measuring container. This method is applicable to all solid biofuels with a nominal top size of maximum 100 mm.

Bulk density is not an absolute value, therefore conditions for its determination have to be standardised in order to gain comparative measuring results.

NOTE 1 The nominal top size is defined as the aperture size of the sieve where at least 95 % by mass of the material passes (see normative reference 2a)

NOTE 2 Bulk density of solid biofuels is subject to variation due to several impacts such as vibration, shock, pressure, biodegradation, drying and wetting. Measured bulk density can therefore deviate from practice conditions during transportation, storage or transhipment.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

CEN/TS 14588:2003, *Solid biofuels – Terminology, definitions and descriptions*

CEN/TS 14774-1:2004, *Solid biofuels – Methods for the determination of moisture content – Oven dry method, Part 1: Total moisture – Reference method*

CEN/TS 14774-2:2004, *Solid biofuels – Methods for the determination of moisture content – Oven dry method, Part 2: Total moisture – Simplified procedure*

prCEN/TS 14778-1, *Solid biofuels – Sampling – Part 1: Methods for sampling*

prCEN/TS 14778-2, *Solid biofuels – Sampling – Part 2: Method for sampling particulate material transported in lorries*

prCEN/TS 14779, *Solid biofuels – Sampling – Methods for preparing sampling plans and sampling certificates*

3 Terms, definitions and abbreviations

For the purposes of this document, the terms and definitions given in CEN/TS 14588:2003 shall apply.

Abbreviations used in this Technical Specification:

D_{ar}	bulk density as received in kg/m³
M_{ar}	the moisture content, as received, as percentage by mass (wet basis)
m_1	the mass of the empty container in kg
m_2	the mass of the filled container in kg
V	the net volume of the measuring container in m³

4 Principle

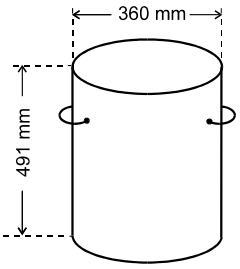
The test portion is filled into a standard container of a given size and shape and weighed afterwards. Bulk density is calculated from the net weight per standard volume and reported for the measured moisture content.

5 Apparatus

5.1 Measuring containers

5.1.1 General

The container shall be cylindrically shaped and manufactured of a shock resistant, smooth-surfaced material. The container shall be resistant to deformation in order to prevent any variation in shape and volume. The container has to be waterproof. For easier handling grips may be fixed externally. The height-diameter-ratio shall be within 1,25 and 1,50.



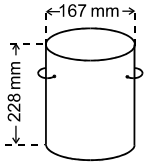
measuring container, large

5.1.2 Large container

The large measuring container has a filling volume of 50 litres (0,05 m³) volume. The volume may deviate by 1 litre (= 2 percent). It shall have an effective (inner) diameter of 360 mm and an effective (inner) height of 491 mm (see figure on right side). Deviations from these dimensions are tolerable, if the height-diameter-ratio remains as given in 5.1.1

5.1.3 Small container

The small measuring container has a filling volume of 5 litres (0,005 m³) volume. The volume may deviate by 0,1 litre (= 2 percent). It shall have an effective (inner) diameter of 167 mm and an effective (inner) height 228 mm (see figure on right side). Deviations from these dimensions are tolerable, if the height-diameter-ratio remains as given in 5.1.1



measuring container, small

5.2 Balances

5.2.1 Balance 1

A balance, having sufficient accuracy to enable the sample and container to be weighed to the nearest 10 g. This balance shall be used for measurements with the large container.

5.2.2 Balance 2

A balance, having sufficient accuracy to enable the sample and container to be weighed to the nearest 1 g. This balance shall be used for measurements with the small container.

5.3 Scantlings

A small scantling, preferably made of hard wood, approximately 600 mm long and having a cross section of about 50 x 50 mm

Advisable: A strong scantling, preferably made of wood, of 150 mm height

5.4 Wooden board

A flat wooden board (e.g. oriented strand board (=OSB)) with a thickness of approximately 15 mm and sufficient in size for the container to be dropped onto for shock exposure.

6 Sample preparation

Sampling shall be carried out in accordance with prCEN/TS 14778. If necessary the sample may be divided in mass in accordance with prCEN/TS 14780. The sample volume should exceed the measuring container volume by 30 %.

NOTE Precautions should be carried out to ensure that the moisture is evenly distributed within the sample.

7 Procedure

7.1 Determination of the container volume

Before use, the mass and filling volume of the container shall be determined. Weigh the empty, clean and dry container on the balance (5.2.1 or 5.2.2). Then fill the container with water and a few drops of wetting agent (e.g. liquid soap) until maximum capacity; then weigh it again. The water should be at a temperature between 10 and 20 degrees Celsius. Calculate the volume (V) of the container from the net weight of water and the density of the water (1 kg/dm^3) and record the result rounded to the nearest 0,00001 m^3 (for the large container) or 0,000001 m^3 (for the small container).

NOTE 1 The effect of temperature on the density of water is here neglected.

NOTE 2 The container volume should be checked regularly.

7.2 Container selection

All fuels that are within the scope of this Technical Specification can be used in the large container (5.2.1). For fuels with a nominal top size up to 12 mm and for pellets with a diameter equal or below 12 mm the small container (5.2.2) may be used (optional).

7.3 Measurement procedure

a) Fill the container by pouring the sample material from a height of 200 mm to 300 mm above the upper rim until a cone of maximum possible height is formed.

NOTE 1 Make sure that the container is dry and clean before being (re)filled.

b) The filled container is then shock exposed to allow settling. This is done by dropping it freely from 150 mm height onto a wooden board (5.4) which is lying on an even, horizontal and hard floor. Ensure that the board and the floor are in full contact. Before shock exposure remove particles on the wooden plate within the dropping area. Make sure that the container hits the ground in a vertical position. Repeat the