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Trdna biogoriva - Metode za doloļ evanje prostorninske mase

Solid biofuels - Methods for the determination of bulk density

Feste Biobrennstoffe - Bestimmung der Schüttdichte

Biocombustibles solides - Méthodes de détermination de la masse volumique apparente

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75.160.10	Trda goriva	Solid fuels

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Solid biofuels - Determination of bulk density

Biocombustibles solides - Détermination de la masse volumique apparente

Feste Biobrennstoffe - Bestimmung der Schüttdichte

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Foreword

This document (EN 15103:2009) has been prepared by Technical Committee CEN/TC 335 "Solid biofuels", the secretariat of which is held by SIS.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2010, and conflicting national standards shall be withdrawn at the latest by June 2010.

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This document supersedes CEN/TS 15103:2005.

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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 also facilitates the estimation of space requirements for transport and storage. This document 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 l or 50 l were chosen for the determination. Due to the limited volume of these containers, some fuels are therefore excluded from the scope of this document. This, for example, applies for chunk wood, uncomminuted bark or baled material and larger briquettes. The bulk density of such fuels can be calculated from their mass and the volume of the container or lorry used to transport them.

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

The here described method includes a defined shock exposure to the bulk material. The decision for this procedure was based on several reasons. It leads to a certain volume reduction which accounts for compaction effects occurring during the production chain. These compaction effects are mainly due to the fact that the fuel is usually transported and/or stored in containers or silos that are much larger than the measuring container as chosen for the here described method. Thus, in practice the higher mass load leads to an increased load pressure and to fuel settling, which can also be additionally enhanced by the vibrations during transportation. Furthermore, filling or unloading operations in practise usually apply a higher falling depth than the one chosen for the here performed test. This will also result in a respectively higher compaction due to the increased kinetic energy of the particles falling. A procedure which applies a controlled shock to the sample was thus believed to reflect the practically prevailing bulk density in a better way than a method without shock. This is particularly true when the mass of a delivered fuel has to be estimated from the volume load of a transporting vehicle, which is a common procedure in many countries. For a rough estimation on how susceptible the different solid biofuels are towards the shock exposure some research data are given in Annex A. The data show a compaction effect between 6 % and 18 % for biomass fuels.

1 Scope

This European Standard 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 CEN/TS 15149-1).

NOTE 2 Bulk density of solid biofuels is subject to variation due to several factors such as vibration, shock, pressure, biodegradation, drying and wetting. Measured bulk density can therefore deviate from actual 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.

prEN 14588:2009, *Solid biofuels — Terminology, definitions and descriptions*

EN 14774-1, *Solid biofuels — Determination of moisture content — Oven dry method — Part 1: Total moisture — Reference method*

EN 14774-2, *Solid biofuels — Determination of moisture content — Oven dry method — Part 2: Total moisture — Simplified method*

prEN 14778-1, *Solid biofuels — Methods for sampling*

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

CEN/TS 14779, *Solid biofuels — Sampling — Methods for preparing sampling plans and sampling certificates*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in prEN 14588:2009 apply.

4 Symbols and abbreviations

Abbreviations used in this document:

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

5 Principle

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

6 Apparatus

6.1 Measuring containers

6.1.1 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.

6.1.2 Large container

The large measuring container has a filling volume of 50 l (0,05 m³) volume. The volume may deviate by 1 l (= 2 %). It shall have an effective (inner) diameter of 360 mm and an effective (inner) height of 491 mm (see Figure 1). Deviations from these dimensions are tolerable, if the height-diameter-ratio remains as given in 6.1.1

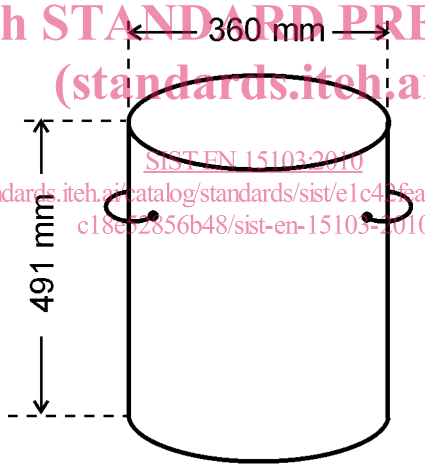

Figure 1 — measuring container, large

6.1.3 Small container

The small measuring container has a filling volume of 5 l (0,005 m³) volume. The volume may deviate by 0,1 l (= 2 %). It shall have an effective (inner) diameter of 167 mm and an effective (inner) height of 228 mm (see Figure 2). Deviations from these dimensions are tolerable, if the height-diameter-ratio remains as given in 6.1.1

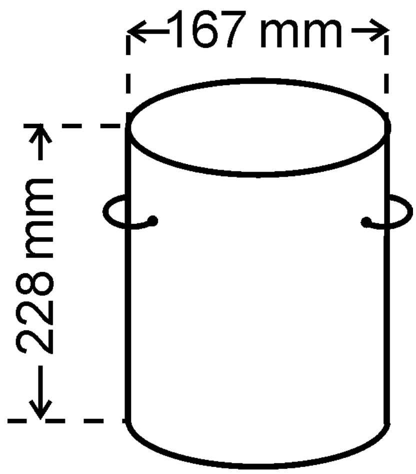

Figure 2 — measuring container, small

6.2 Balances

6.2.1 Balance 1

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

6.2.2 Balance 2

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

6.3 Scantlings

A small scantling, preferably made of hard wood, approximately 600 mm long and having a cross section of about 50 mm x 50 mm should be used for the removal of surplus material.

Advisable: A strong scantling of 150 mm height is used to indicate the falling height in the shock exposure.

6.4 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 should be used.

7 Sample preparation

Sampling shall be carried out in accordance with prEN 14778-1 and CEN/TS 14778-2. If necessary, the sample may be divided in mass in accordance with CEN/TS 14780. The sample volume should exceed the measuring container volume by maximum 30 %.

NOTE Precautions should be taken to ensure that the moisture is evenly distributed throughout the sample.