SLOVENSKI STANDARD
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Trdna biogoriva ï Metode za doloļ evanje prostorninske mase

Solid biofuels - Methods for the determination of particle density

Feste Biobrennstoffe - Verfahren zur Bestimmung der Teilchendichte

Biocombustibles solides - Méthode de détermination de la masse volumique des particules

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English Version

Solid biofuels - Methods for the determination of particle density

Combustibles solides - Méthode de détermination de la masse volumique des particules

Feste Biobrennstoffe - Verfahren zur Bestimmung der Teilchendichte

This Technical Specification (CEN/TS) was approved by CEN on 4 June 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.

CEN members are required to announce the existence of this CEN/TS in the same way as for an EN and to make the CEN/TS available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the CEN/TS) until the final decision about the possible conversion of the CEN/TS into an EN is reached.

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Foreword

This Technical Specification (CEN/TS 15150:2005) 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.

1 Scope

This Technical Specification describes the method for determining the particle density of compressed fuels such as pellets or briquettes. Particle density is not an absolute value and conditions for its determination have to be standardised to enable comparative determinations to be made.

NOTE Particle density is subject to variation due to the susceptibility of organic material to environmental or technical impacts such as air humidity, vibration, abrasion or biodegradation. Particle density can therefore vary during time, thus the measured values should be regarded as a momentary fuel property.

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 determination of moisture content – Oven dry method - Part 1: Total moisture – Reference method*

CEN/TS 14774-2:2004 *Solid biofuels – Methods for 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 – Method for preparing sampling plans and sampling certificates*

prCEN/TS 14780, *Solid biofuels – Methods for sample preparation*

CEN/TS 14961:2005, *Solid biofuels – Fuel Specifications and Classes*

3 Terms and definitions

For the purposes of this Technical Specification, the terms and definitions given in CEN/TS 14588 shall apply.

4 Principle

Both mass and volume of an individual particle or a group of particles are determined. The volume is measured by determining the buoyancy in a liquid. This procedure follows the physical principle that the buoyancy of a body is equal to the weight of the displaced volume of a liquid. The apparent loss in weight between a measurement in air and a subsequent measurement in liquid marks its buoyancy. The volume of the sample body is calculated via the density of the applied liquid.

NOTE The particle density of briquettes could also be estimated by stereometric means (see informative Annex A). This estimation could also be made if pellets are cut to determine their volume by stereometric means. Be aware of a higher variability between the replications when applying the stereometric measuring principle.

5 Reagents

5.1 Water with low content of ions (e.g. drinking water quality) in a temperature range of 10 °C to 30 °C

5.2 A detergent named O-[4-(1,1,3,3-Tetramethylbutyl)-phenyl]-deca(oxyethylen, Octylphenoldecaethylen-glycolether, Polyethylenglycol-mono-[p-(1,1,3,3-tetramethylbutyl)-phenyl]-ether

NOTE The exclusive use of this specific detergent with given characteristics allows to apply a fixed value for the density of the liquid (mixture with water) and ensures constant properties as wetting agent. The detergent is, for example traded under the name Triton® X-100. The density at 20 °C is 1,07 g/l.

5.3 Paraffin with a melting point of 52 to 54 °C.

6 Apparatus

6.1 General apparatus requirements

6.1.1 Thermometer for liquids having a measuring accuracy of 1 °C

6.1.2 Facilities for moisture content determination according to CEN/TS 14774-1 or 14774-2

6.2 Apparatus for pellet testing

6.2.1 A balance, having sufficient accuracy to determine the weight to the nearest 0,001 g. Due to the high sensitivity of the balance the test rig shall be placed into a wind protection cabinet to allow undisturbed and immediate reading of the displayed values.

6.2.2 A transparent beaker glass of about 200 ml filling volume

6.2.3 A density determination rig which can be placed on the balance. The rig consists of a bridge which overstretches the weighing plate of the balance in order to prevent the balance from being loaded. The bridge is capable of carrying the beaker glass (clause 5.2.2). Through a supporting frame with suspension rods a weighing dish ("submergence dish") is hung into the beaker glass (Figure 1) which is filled with liquid. The dish shall be able to accommodate at least four pellets at once. Both, the supporting frame and the submergence dish are directly loaded on the balance plate. The submergence apparatus (the dish and the suspension) can be removed for being loaded with pellets. Through the dish suspension the submergence depth is always kept constant. The bottom of the submergence dish is perforated by openings which are smaller in diameter than the diameter of the pellets. This perforation allows the liquid to fill the dish from underneath when it is submerged. If sample material of low density shall be applied (below 1,0 g/cm^3) a modified suspension having an inverted submergence dish is required; this is to force the pellets underneath the liquid surface and prevent them from floating atop of the liquid. For the determination of the mass in air it is useful to use a combined test rig where an additional upper weighing dish is fixed to the suspension (Figure 1).

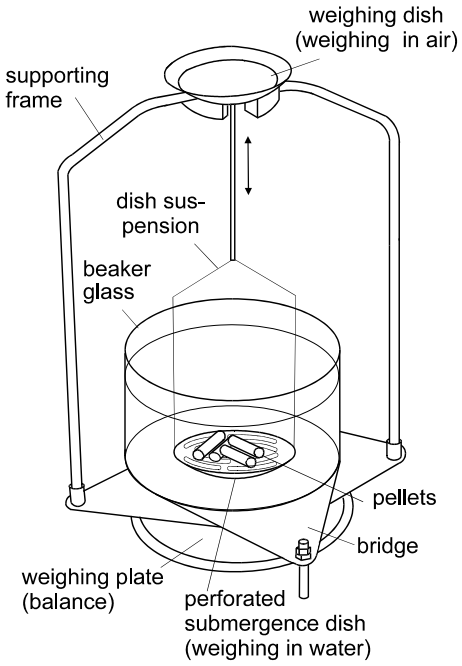

Figure 1: Buoyancy determination rig on a balance (method for pellets)

6.3 Apparatus for briquette testing

6.3.1 A balance, having sufficient accuracy to determine the weight to the nearest 0,01 g. If briquettes of more than 500 g each are tested the accuracy of the balance can be reduced to 0,1 g. The balance must have a connecting point for hanging a weight to its load cell.

6.3.2 A transparent container for liquids having a sufficient filling volume to accommodate the liquid and the submerged briquette.

NOTE A sufficient filling volume is usually achieved when the container's cross section is about 8 times larger than the cross section of the briquette. In this case any effects by level changes of the liquid caused by submersion of the briquette are negligible. Such error would be due to a larger part of the holding steel string (see 6.3.3) being submerged.

6.3.3 A non absorbent thin steel string which can be hung to the connecting point of the balance. The end of the string is equipped with a hook or a ring, which allows an easy appending of the sample.

6.3.4 A tripod where the balance can be placed on. The tripod must have a plate with an opening which allows the string to pass through unhindered while hanging to the balance (Figure 2).

6.3.5 A steel loop or any other steel support device which allows to fix the briquette to the lower connecting point of the string

6.3.6 If sample material of low density shall be tested (below 1,0 g/cm^3) a removable weight is required, which is positioned onto the sample in a way which prevents the briquette from floating atop of the liquid.

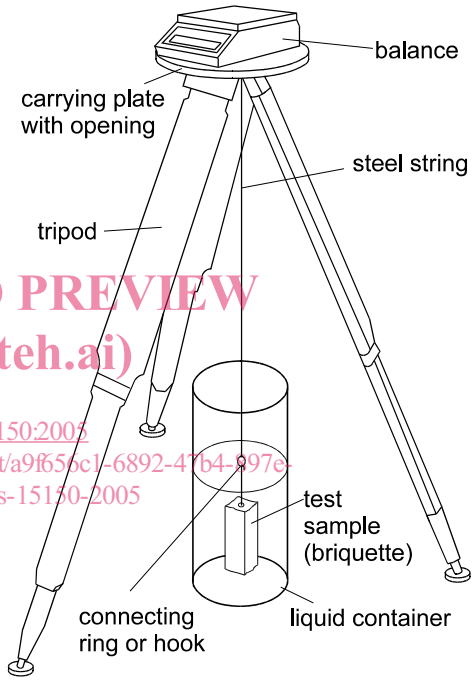

Figure 2: Buoyancy determination rig using a hanging load to a balance (method for briquettes)

7 Sample preparation

7.1 Sampling and sample preparation shall be done in accordance with prCEN/TS 14778-1, prCEN/TS 14778-2, prCEN/TS 14779 and prCEN/TS 14780.

7.2 A total sample weight of 500 g (pellets with a diameter equal to or below 12 mm) or 1000 g for pellets with a diameter above 12 mm or a minimum of 15 briquettes is required.

7.3 From the fuel a sub-sample of minimum 40 pellets or 10 briquettes is selected and stored in the room where the measuring will be conducted for at least two days.

7.4 For low density and coarse textured briquettes a rapid disintegration after submergence in the liquid may happen, thus the reading may be difficult to take. The sample can then be coated by submerging in liquid paraffin (clause 5.3), preferable at a temperature of 90 °C.

NOTE Be aware of the additional volume which reduces the density slightly.

8 Procedure

8.1 Procedure for pellets (up to a diameter of 25 mm according to CEN/TS14961)

8.1.1 Fill the beaker glass with water to a filling level which ensures that full submersion of all pellets on the submergence dish can be achieved.

8.1.2 Add 1,5 grams per litre of the detergent as described in Clause 5 to the water in the beaker glass and stir until full homogeneity of the liquid is achieved. Position the beaker glass with the liquid onto the bridge.

NOTE 1 At 1,5 grams per litre of the above detergent the critical miscelle concentration in water (xCMC=0,15 g/l) is exceeded by ten times. It is advised to use a magnetic stirring device for better homogeneity.

8.1.3 Check the temperature of the liquid within reasonable intervals.

8.1.4 Determine the total weight of a group of at least four pellets in air and record the measurement to the nearest 0,001 g.

8.1.5 Position the empty submergence apparatus onto the designated bracket of the supporting frame. The submergence apparatus shall not touch the bottom or the walls of the beaker glass.

8.1.6 Tare the balance to zero while the empty submergence dish is below liquid surface at maximum depth.

8.1.7 Remove the submergence apparatus and place the same four pellets as measured in clause 8.1.4 onto the submergence dish and carefully place it back onto the designated bracket of the supporting frame.

8.1.8 While the group of pellets is submerged in the liquid, read the total weight from the balance and record it to the nearest 0,001 g.

8.1.9 Remove the pellets from the liquid immediately after recording in order to avoid liquid contamination by dissolving pellets.

NOTE 2 The reading of the weight in liquid shall take place immediately after submersion of the pellets in order to prevent them from up taking any liquid or from decay. The reading can usually be conducted within the first 3 to 5 seconds when the displayed value on the balance is relatively constant.