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Solid biofuels — Determination of content of heavy extraneous materials larger than 3,15 mm

Biocombustibles solides — Dosage de la teneur en matériaux lourds exogènes de dimension supérieure à 3,15 mm

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 238, *Solid biofuels*.

Introduction

Determination of content of heavy extraneous materials larger than 3,15 mm top size is important when evaluating the suitability of using biomass as biofuel. Stones and other impurities contained in biomass from stumps, roots, mill residue and harvest and landscape management residues may cause problems during size reduction, as well as during combustion.

Impurities smaller than 3,15 mm are not considered as part of this testing method but may still contribute to the ash content.

Solid biofuels — Determination of content of heavy extraneous materials larger than 3,15 mm

1 Scope

This document specifies a method for the determination of content of heavy extraneous materials larger than 3,15 mm by the use of sink-and-float separation combined with elutriation. This document is applicable to woody biomass in accordance with ISO 17225-1:2014, Table 1.

NOTE 1 This method is designed to determine the level of impurities larger than 3,15 mm top size with a specific density >1 g/cm^3 such as stones, glass, rubber, metal and certain types of plastics.

NOTE 2 During the processing of the sample, hand sorting of light impurities with a specific density ≤1 g/cm^3 (e.g. plastic foil) can also be done.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 3310-2, *Test sieves — Technical requirements and testing — Part 2: Test sieves of perforated metal plate*

ISO 14780, *Solid biofuels — Sample preparation*

ISO 16559, *Solid biofuels — Terminology, definitions and descriptions*

ISO 18134-1, *Solid biofuels — Determination of moisture content — Oven dry method — Part 1: Total moisture — Reference method*

ISO 18134-2, *Solid biofuels — Determination of moisture content — Oven dry method — Part 2: Total moisture — Simplified method*

ISO 18135, *Solid biofuels — Sampling*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 16559 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
heavy extraneous material on dry basis
EM_d
mass of inorganic residue ≥3,15 mm with a specific density >1 g/cm^3 expressed as percentage of the mass of the dry matter in the fuel

3.2
sedimentation
tendency for particles in suspension to settle out of the fluid in which they are entrained due to gravity and come to rest against a barrier

3.3
elutriation
process for separating particles based on their size, shape and density using a stream of liquid flowing in a direction usually opposite to the direction of sedimentation

4 Principle

Heavy extraneous materials larger than 3,15 mm can be separated from the sample by using the sink-and-float separation combined with elutriation in water. The content of heavy extraneous materials is calculated by dividing the dry weight of the obtained material by the dry weight of the original sample and is thus expressed as a percentage on dry weight basis.

5 Apparatus

5.1 Water container.

The water container shall have a volume of at least 30 l (0,03 m^3) but shall be small enough to allow tilting of the water-filled container. The container shall be smooth surfaced and waterproof. The height-diameter-ratio shall be within 1,0 and 1,3. The container shall have a circular bottom to enable the free movement of the particles in the flow of water when stirred. The container shall be cylindrical or with conical sidewalls with a maximum inclination of 15° to facilitate the overflow of the biomass particles. The water container volume shall exceed the sample volume by minimum of 50 % to enable proper stirring of the sample.

NOTE Usually, off-the-shelf 30 l plastic buckets will be satisfactory.

5.2 Balances.

5.2.1 Balance 1, capable of reading to the nearest 1 g.

5.2.2 Balance 2, capable of reading to the nearest 0,1 g.

5.3 Sieve.

The sieve shall have a screen with 3,15 mm diameter round holes according to ISO 3310-2 and suitable for manual screening.

5.4 Drying oven.

Drying oven, capable of being controlled (manufacturers specifications) at a temperature within the range of (105 ± 2) °C and in which the air atmosphere changes between three and five times per hour. The air velocity should be such that the sample particles are not dislodged from their tray.

5.5 Dishes or trays.

Dishes or trays of non-corrodible and heat-resistant material. The surface of the trays shall be such that the possibility to adsorption/absorption is minimized (clean and even surface).

6 Sample preparation

The minimum test sample for the determination of the content of heavy extraneous materials shall be 20 l and shall be obtained in accordance with ISO 18135 and prepared in accordance with ISO 14780. The test sample shall be divided into four equal sub-portions.

One sub-portion shall be used for determination of the total moisture content, M_{ar}, in accordance with ISO 18134-1 or ISO 18134-2 and simultaneously with the determination of the content of heavy extraneous materials.

The remaining three sub-portions shall be unified to a test portion and used for determination of the content of heavy extraneous materials. Depending on the size of the container and the size of the test portion, the test portion may be divided into sub-portions again, which are processed sequentially.

7 Procedure

Weigh the test portion for the determination of the content of heavy extraneous materials to the nearest 1 g and record the mass (m_3).

Transfer the test portion into the water container and fill the container with water up to the brim. Stir the test sample in the water manually for at least 30 s to wet all materials and then let it rest for approximately 5 s to let the heavy material sink. After that, large biogenic particles shall be removed by hand. All other particles floating on the surface shall be poured out of the container slowly by tilting it. Leave enough water in the container that the sediment on the bottom of the container is not poured out. Refill the container at least two more times with clean water, stir the remaining sediment and tilt the container again until no more particles are floating on the water surface. After that, the container with the remaining sediment is emptied onto a 3,15 mm sieve. The sediment on the sieve is rinsed with clean water to remove all fine particles smaller than 3,15 mm.

Transfer the material retained on the sieve to a tray and place the tray in the drying oven controlled at (105 ± 2) °C. Heat the tray until constant mass has been achieved. Constant mass is defined as a change not exceeding 0,2 % by mass of the initial mass of the test portion (sediment) during a heating period of 60 min. Any discernible biogenic material has to be sorted out by hand after drying. If the sediment still contains fine particles, the sediment shall be sieved again with a 3,15 mm sieve. Weigh the tray with the remaining sediment after drying to the nearest of 0,1 g and record the mass (m_2). Use heat insulating material on the balance pan to avoid direct contact with the hot tray.

NOTE 1 The required drying time can be determined in pre-tests on similar fuel types with comparable particle size.

If the highest precision is not required, drying of the extraneous material before weighing may be omitted. This simplification should not be applied when the particles have porous surfaces or the material in the weighing tray contains significant amounts of biogenic material.

NOTE 2 If the solid biomass has high moisture content or is already partly decomposed, a high percentage of the particles will not float on the water surface but will sink to the bottom of the container. A separation of the biogenic from the inorganic sediment can then still be possible by means of elutriation. That means, the sediment is stirred by hand in a way that produces an upwards water flow taking the sediment with it. While stones and other heavy extraneous materials sink down again immediately, the biogenic material stays longer in suspension and can be poured out of the container by tilting while the water is still in movement. If no separation of the inorganic material is possible, it could be necessary to dry the sediment in a drying oven until the water content of the biogenic material is low enough to allow it to float on the water surface and wash it out a second time (see also Note 1).

8 Calculation

Calculate the content of heavy extraneous materials on dry basis (EM_d) in accordance with Formula (1):

$$EM_d = \frac{(m_2 - m_1) \times 100}{m_3} \times \frac{100}{(100 - M_{ar})} \quad (1)$$