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Solid biofuels — Determination of moisture content —

Part 1: Reference method

Biocombustibles solides — Dosage de la teneur en humidité —

Partie 1: Méthode de référence

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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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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 238, *Solid biofuels*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 335, *Solid biofuels*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 18134-1:2015), which has been technically revised.

The main changes are as follows:

— title revised;

— a warning notice to avoid gain or loss of moisture during sample preparation added in 6.1;

— references updated;

— minor editorial corrections;

— more specific sample preparation information provided.

A list of all parts in the ISO 18134 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Solid biofuels — Determination of moisture content —

Part 1: Reference method

1 Scope

This document describes the method of determining the moisture content of a test sample of solid biofuels by drying in an oven and can be used when high precision of the determination of moisture content is necessary. The method described in this document is applicable to all solid biofuels. The moisture content of solid biofuels (as received) is always reported based on the total mass of the test sample (wet basis).

NOTE Biomass materials can contain small amounts of volatile organic compounds (VOC) which can evaporate when determining moisture content by oven drying (see References [1] and [2]). The release of such compounds is quite small relative to the overall moisture content as determined by this method and is disregarded in this document.

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 14780, *Solid biofuels — Sample preparation*

ISO 16559, *Solid biofuels — Vocabulary*

ISO 18135, *Solid Biofuels — Sampling*

ISO 21945, *Solid biofuels — Simplified sampling method for small scale applications*

3 Terms and definitions

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

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

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

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

4 Principle

The test portion of solid biofuel shall be dried at a temperature of 105 °C in air atmosphere until constant mass is achieved. The percentage moisture shall be calculated from the loss in mass of the test portion and includes a procedure for correction of the buoyancy effects.

5 Apparatus

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

It is important that drying ovens maintain a consistent temperature throughout the heated chamber. The temperature tolerance provided is intended for all locations within the oven.

5.2 Dishes and trays, of non-corrodible and heat-resistant material and of dimensions such that they will hold the total test portion in an even, thin layer. The surface of the trays shall be such that the possibility of adsorption or absorption is minimised (very clean and even surface).

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

6 Sample preparation

6.1 Sample reduction

Test samples for the determination of moisture content shall be obtained in accordance with ISO 18135 or ISO 21945 and shall be received in the laboratory in sealed airtight containers or bags. A test portion shall be prepared in accordance with ISO 14780 so that all particles have at least one dimension less than 31,5 mm.

WARNING — Solid biofuels readily gain or lose moisture to the atmosphere when the sample moisture and ambient humidity are not at equilibrium. Wet samples lose moisture in a drier environment and dry samples gain moisture in a wet environment. Additionally, grinding often generates heat and air currents that result in moisture loss. If biofuel materials require handling and/or size reduction, it is important that sample preparation be conducted in such a way that moisture within the sample is preserved to the largest possible extent. To avoid loss of moisture during particle size reduction, samples with high moisture content should be pre-dried according to ISO 14780.

6.2 Pre-dried test sample

During the course of its preparation, it is possible that the test sample has been pre-dried (see ISO 14780), in which case Formula (2) detailed in 8.3 shall be used to calculate the moisture content of the original sample on a wet basis.

6.3 Mass of test portion

The minimum mass of the test portion shall be 300 g.

NOTE For fine particulate solid biofuels (e.g. sawdust and fuel powder), the test portion can be reduced to 100 g.

7 Procedure

7.1 Handling of test portion

Weigh an empty and clean drying tray to the nearest 0,1 g.

If visible condensation is seen on the inside surfaces of the package, shake the package to allow the material to reabsorb the moisture prior to emptying the package. Transfer the test portion from the package (container or bag) in which it is delivered to the empty and clean drying tray and spread the material evenly in a thin layer.

In the case of samples with smaller particles sizes (e.g. sawdust, pellets, olive stones or fine wood chips), it is recommended that the sample layer remains thin and does not exceed 1 g of material per 1 cm^2 of surface area.

7.2 Weighing of test portion and correction of buoyancy of trays

Weigh the tray with the test portion to the nearest 0,1 g before heating.

Weigh an identical empty and clean tray (reference tray) to the nearest 0,1 g before heating.

NOTE 1 A reference tray is included in the procedure for the purpose of correction of buoyancy. The weight of a tray when still hot is less than the weight of the cold tray due to buoyancy. The magnitude of the buoyancy effect depends on the size and weight of the tray.

Thereafter, place the tray with the test portion together with the reference tray in the temperature-controlled oven at (105 ± 2) °C. Heat the trays until constant mass has been achieved. Constant mass is defined as a change not exceeding 0,2 % absolute of the initial mass of the test portion during a heating period of 60 min. The drying time required will depend on particle size of the material, rate of atmospheric change in the oven and thickness of the layer of material.

Remove the two trays from the oven and weigh each when they are still hot to the nearest 0,1 g within 10 s to 15 s in order to avoid absorption of moisture. Use heat-insulating material on the balance pan to avoid direct contact with the hot tray.

NOTE 2 The required drying time can be determined in pre-tests on similar fuel types with comparable particle size.

Do not overload the drying oven. The space above the trays and between the trays shall allow the free flow of air and moisture.

To prevent unnecessary losses of volatile compounds, the drying time should generally not exceed 24 h.

The moisture content determination shall be conducted in duplicate.

8 Calculation

8.1 General

The moisture content shall be calculated on a wet basis in accordance with Formula (1), detailed in 8.2. The determination of moisture content for pre-died test sample is detailed in 8.3. The result shall be reported on a wet basis and reported in accordance with Clause 10.

8.2 Moisture content on a wet basis

The moisture content, M_{ar}, of the test portion, as received, expressed as a percentage by mass, shall be calculated in accordance with Formula (1):

$$M_{ar} = \frac{(m_2 - m_3) - (m_4 - m_5)}{(m_2 - m_1)} \times 100 \quad (1)$$

where

m_1 is mass of the empty tray used for the test portion, in g;

m_2 is mass of the tray and test portion before drying (weight at room temperature), in g;

m_3 is mass of the tray and test portion after drying (weight when still hot), in g;

m_4 is mass of the reference tray before drying (weight at room temperature), in g;

m_5 is mass of the reference tray after drying (weight when still hot), in g.

The result shall be calculated to two decimal places and the mean value of both determinations shall be rounded to the nearest 0,1 % for reporting.

8.3 Moisture content for pre-dried material

If the test sample has been pre-dried before this moisture determination (according to 6.2), the moisture, M_{ar}, expressed as a percentage by mass is given by Formula (2):

$$M_{ar} = M_p + M_r * \left(1 - M_p / 100\right) \quad (2)$$

where

M_p is the moisture loss of pre-drying, expressed as a percentage by mass of the original test sample;

M_r is the residual moisture determined in the pre-dried test sample by this procedure, expressed as a percentage by mass.

9 Performance characteristics

Because of the varying nature of the solid biofuels covered by this document, it is not possible to give a precision statement (repeatability or reproducibility) for this test method.

10 Test report

The test report shall include at least the following information:

a) identification of the laboratory performing the test;

b) date of the test;

c) identification of product (or sample) tested;

d) reference to this document, i.e. ISO 18134-1:2022;

e) results of the test on wet basis;

f) any unusual features noted during the determination which might have affected the result;

g) any deviation from this document or operations regarded as optional.

Bibliography

[1] Samuelsson, R., Burvall, J., Jirjis, R. Comparison of different methods for the determination of moisture content in biomass. *Biomass Bioenergy*. 2006, 30, 929–934

[2] Samuelsson, R., Nilsson, C., Burvall, J. Sampling and GC-MS as a method for analysis of volatile organic compounds (VOC) emitted during oven drying of biomass materials. *Biomass Bioenergy*. 2006, 30, 923–928

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