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Solid recovered fuels — Determination of moisture content using the oven dry method —

Part 3: Moisture in general analysis sample

Combustibles solides de récupération — Détermination de l'humidité par la méthode de séchage à l'étuve —
Partie 3: Humidité de l'échantillon pour analyse générale

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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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 300, *Solid recovered fuels*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 343, *Solid recovered fuels,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

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 recovered fuels — Determination of moisture content using the oven dry method —

Part 3: Moisture in general analysis sample

1 Scope

This document specifies a method for the determination of moisture in a general analysis sample by drying the sample in an oven. This method is suitable for use for general analysis samples in accordance with CEN/TS 15414-1[3][1)]. It is applicable to all solid recovered fuels.

If solid recovered fuels contain large amounts of oil-fractions the Karl-Fischer-Method (for example ISO 760) is advisable. Otherwise, a lower temperature is recommended (e.g. 50 °C ± 10 °C) and a longer drying time until constant mass is achieved.

NOTE The term moisture content, when used with recovered materials, can be misleading since solid recovered materials, e. g. biomass, frequently contain varying amounts of volatile compounds (extractives) which can evaporate when determining the moisture content of the general analyses sample by oven drying.

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 21637, *Solid recovered fuels — Vocabulary*

ISO 21646[2)], *Solid recovered fuels — Sample preparation*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21637 apply.

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

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

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

4 Principle

The analysis sample of solid recovered fuels is dried at a temperature of 105 °C under air atmosphere or nitrogen atmosphere. The percentage of moisture is calculated from the loss in mass of the test sample. If the sample material is susceptible to oxidation (at 105 °C), drying in nitrogen atmosphere is performed.

1) The adoption of the standard series EN 15414 as standard series ISO 21660 is planned. ISO 21660-3 is published in parallel at CEN level as EN 21660-3.

2) Under preparation. Stage at the time of publication: ISO/DIS 21646:2021.

Automatic equipment (such as gravimetric analysers) may be used as long as the equipment is validated by parallel measurements to the reference method. The automatic equipment shall fulfil all the requirements regarding sample size, heating procedure, temperature, atmosphere and weighing accuracy. Deviations from this paragraph shall be reported and justified.

For information about environmental aspect see Annex B.

5 Apparatus

5.1 Drying oven, capable of being controlled at (105 ± 2) °C (refer to the manufacturer's manual) and in which the air atmosphere changes between three and five times per hour. The air velocity shall be such that the sample particles are not dislodged from their weighing dish (5.2).

5.2 Weighing dish, of glass or corrosion resistant and temperature resistant material, with a well-fitting lid and of such a size that the sample layer does not exceed 0,2 g/cm^2.

5.3 Balance, with a resolution of 0,1 mg.

5.4 Desiccator, with desiccant (e.g. silica gel) to avoid absorption of moisture from the atmosphere to the sample.

6 Sample preparation

The sample used for the determination shall be the general analysis test sample with a particle size ≤1 mm prepared in accordance with ISO 21646.

Before commencing the determination, mix the analysis sample, preferably by mechanical means.

7 Procedure

A minimum of two determinations shall be carried out on the test sample.

Dry an empty weighing dish (5.2) with its lid at (105 ± 2) °C until constant mass is reached and allow it to cool to room temperature in the desiccator (5.4).

NOTE 1 Several weighing dishes can be handled at the same time.

Weigh the weighing dish (5.2) with its lid to the nearest 0,1 mg.

Add minimum 1 g of the analysis sample into the weighing dish (5.2) in an even layer and weigh the weighing dish with its lid plus sample to the nearest 0,1 mg.

Heat the uncovered weighing dish (5.2) and its lid together with the sample at (105 ± 2) °C until constant mass is reached. Constancy in mass is defined as a change not exceeding 1 mg in mass during a further period of 60 min of heating at (105 ± 2) °C. If the sample material is susceptible to oxidation at the given temperature use nitrogen atmosphere for drying. The drying atmosphere used has to be mentioned in the test report.

NOTE 2 The drying time needed is usually between 2 h to 3 h.

WARNING — For some materials present in solid recovered fuels there can be a risk of self-ignition when drying at 105 °C.

While still in the drying oven (5.1), put the lid on the weighing dish (5.2). Transfer the weighing dish and its contents to the desiccator (5.4). Allow it to cool to room temperature.

Weigh the weighing dish (5.2) and its lid with the sample to the nearest 0,1 mg. Since small particle size recovered fuels are very hygroscopic, weigh rapidly once the sample is cooled.

NOTE 3 Since solid recovered fuels in small particle size are very hygroscopic, their moisture content will vary with change of humidity of the atmosphere and therefore, the moisture of the analysis sample is always determined simultaneously when portions are weighed out for other analytical determinations, for example, calorific value, carbon, nitrogen.

8 Calculation

For each determination, the moisture content, M_{ad}, in the analysis sample, as analysed, expressed as mass fraction in percent, shall be calculated using Formula (1):

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

where

m_1 is the mass of the empty weighing dish (5.2) plus lid, in grams;

m_2 is the mass of the weighing dish (5.2) plus lid plus sample before drying, in grams;

m_3 is the mass of the weighing dish (5.2) plus lid plus sample after drying, in grams.

The test result for each individual determination shall be calculated on analysed basis to two decimal places and for reporting purposes, the mean value of the individual test results shall be calculated and rounded to the nearest 0,1 %.

9 Precision

9.1 Repeatability

The maximum difference to be expected between two independent single test results of one laboratory at a confidence level of 95 % will not exceed the repeatability limit in more than 5 % of cases when measuring the same measurand in the same medium, using the same facilities and fulfilling all requirements of the test method (interlaboratory testing).

Precision data derived from an interlaboratory test in Europe from 2008 are given in Annex A.

9.2 Reproducibility

The maximum difference to be expected between two independent single test results of different laboratories at a confidence level of 95 % will not exceed the reproducibility limit in more than 5 % of cases when measuring the same measurand in the same medium, each laboratory using their own facilities and fulfilling all requirements of the test method (interlaboratory testing).

Precision data derived from an interlaboratory test in Europe from 2008 are given in Annex A.

10 Test report

The test report shall include at least the following information:

a) identification of the laboratory and the testing date;

b) identification of the product or sample tested;

c) a reference to this document, i.e. ISO 21660-3:2021;

d) any deviation from this document;

e) drying atmosphere used;

f) test results on as analysed basis as specified in Clause 8;

g) any unusual features observed during the test procedure which may have affected the test result.

Annex A
(informative)

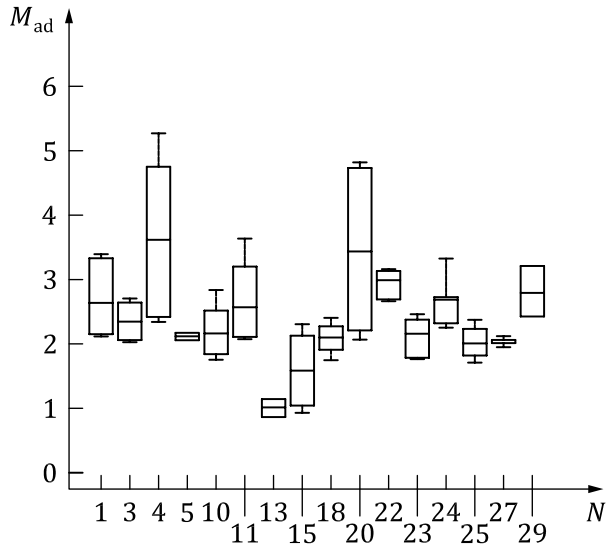
Interlaboratory test results

The statistic evaluation of the interlaboratory test results from an interlaboratory test in Europe from 2008 was carried out in accordance with ISO 5725-5. The precision data obtained are shown in Table A.1.

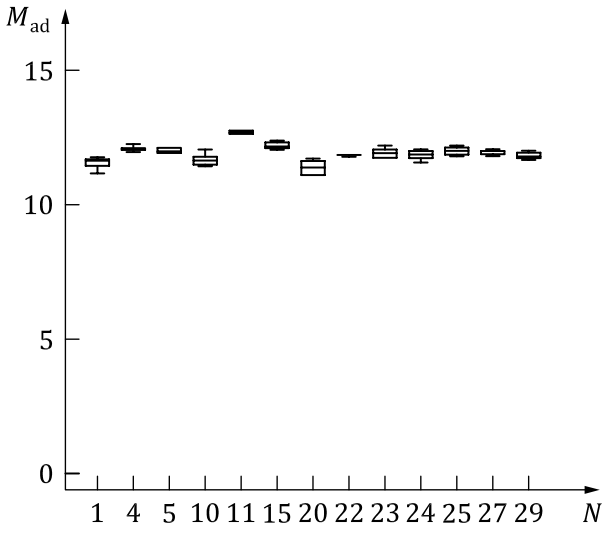
Table A.1 — Precision data

Designation	Shredded tyre	Demolition wood	Dried sludge	Municipal waste	Plastic/ paper fluff
Number of laboratories participated	16	13	16	15	16
Total number of values (without outliers)	50	50	50	52	50
Mean value, in % mass fraction	2,48	11,79	2,13	5,96	6,49
Laboratory effect, in % mass fraction	0,11	—	0,43	0,45	0,18
Sample effect, in % mass fraction	0,47	—	0,14	0,16	0,25
Repeatability standard deviation, s_r, in % mass fraction	0,19	0,29	0,08	0,14	0,14
Repeatability limit, r: ($r = 2{,}8 \times s_r$) in % mass fraction	0,53	0,81	0,22	0,39	0,39
Reproducibility standard deviation, s_r in % mass fraction	0,22	0,29	0,44	0,47	0,23
Reproducibility limit, R: ($R = 2{,}8 \times s_r$) in % mass fraction	0,62	0,81	1,23	1,32	0,64

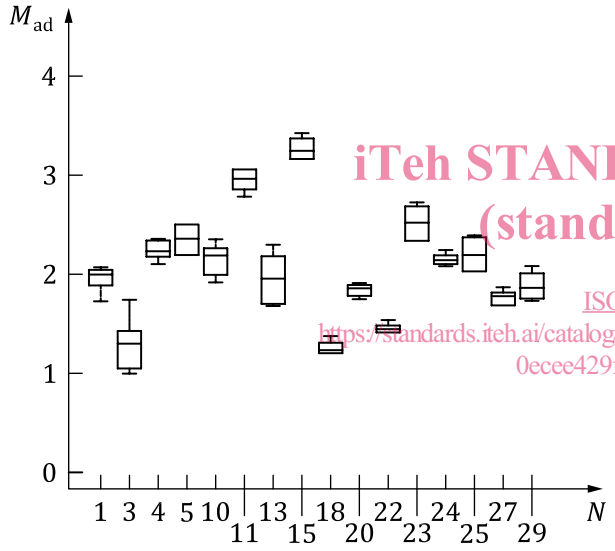
The deviations of the test results between the individual laboratories for each sample type are shown in Figures A.1 a) to e).



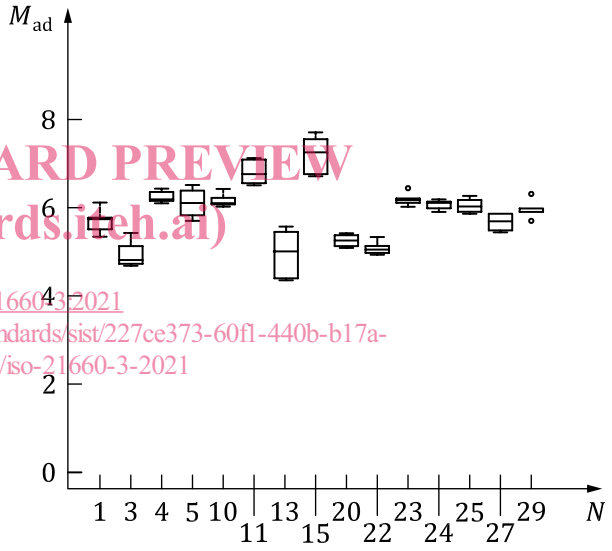
a) Shredded tyre



b) Demolition wood



c) Dried sludge



d) Municipal waste