SLOVENSKI STANDARD
oSIST prEN ISO 21644:2020

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Trdna alternativna goriva - Metoda za določevanje biomase (ISO/DIS 21644:2019)

Solid recovered fuels - Methods for the determination of biomass content (ISO/DIS 21644:2019)

Feste Sekundärbrennstoffe - Verfahren zur Bestimmung des Gehaltes an Biomasse (ISO/DIS 21644:2019)

Combustibles solides de récupération - Méthode de détermination de la teneur en biomasse (ISO/DIS 21644:2019)

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Solid recovered fuels — Methods for the determination of biomass content

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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).

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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*.

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.

Introduction

The biomass content of solid recovered fuels is relevant for the evaluation of the impact of energy production on greenhouse gas emission. Instrumental methods, wet chemical and manual procedures are available for the calculation of the renewable energy fraction. Instrumental methods are based on the determination of ^{14}C content while manual procedures are based on separation of different fractions by visual inspection. The wet chemical procedure differentiate biomass from non-biomass materials as function of the acid dissolution behaviour.

The fraction of biomass is expressed:

— by weight;

— by energy content (gross or net calorific value);

— by carbon content.

This document is primarily intended for laboratories, producers, suppliers and purchasers of solid recovered fuels, but is also useful for the authorities and inspection organizations.

Solid recovered fuels — Methods for the determination of biomass content

1 Scope

This document specifies three methods for the determination of the biomass content in solid recovered fuels: the ^{14}C content method, the selective dissolution and the manual sorting methods.

A value of 10 % biogenic carbon can be considered as the lower range of application of ^{14}C method by LSC.

The SDM method is applicable for the biomass percentage content between 10 % and 90 %.

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/DIS 21637, *Solid recovered fuels — Terminology, definitions and descriptions*

ISO/CD 21645,[1)] *Solid recovered fuels — Methods for sampling*

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

ISO/DIS 21654, *Solid recovered fuels — Determination of calorific value*

ISO/DIS 21656, *Solid recovered fuels — Determination of ash content*

ISO/DIS 21663, *Solid recovered fuels — Methods for the determination of total carbon (C), hydrogen (H), nitrogen (N) and sulphur (S) by the instrumental method*

ISO/IEC 17025:2017, *General requirements for the competence of testing and calibration laboratories*

CEN/TS 15414-1:2010, *Solid recovered fuels — Determination of moisture content using the oven dry method — Part 1: Determination of total moisture by a reference method*

EN 15413:2011, *Solid recovered fuels — Methods for the preparation of the test sample from the laboratory sample*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/DIS 21637 and the following 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/

1) ISO/DIS 21645 is expected 03/2020.

2) ISO/DIS 21646 is expected 03/2020.

3.1
ash content
inorganic mass remaining after complete combustion of a solid recovered fuel under specified conditions expressed as a percentage of the mass of the dry matter in the solid recovered fuel

3.2
biogenic
produced in natural processes by living organisms but not fossilized or derived from fossil resources

3.3
biomass
material of biological origin excluding material embedded in geological formations and/or fossilized

[SOURCE: ISO 16559:2014, 4.32]

3.4
calorific value
energy amount per unit mass or volume released on complete combustion

3.5
gross calorific value
measured value of the specific combustion energy per mass unit of a solid recovered fuel burned in oxygen in calorimetric bomb under the conditions specified

Note 1 to entry: The results of combustion are assumed to consist of gaseous oxygen, nitrogen, carbon dioxide and sulphur dioxide, of liquid water (in equilibrium with its vapour) saturated with carbon dioxide under conditions of the bomb reaction, and of solid ash, all at the reference temperature and at constant volume.

3.6
isotope abundance
fraction of atoms of a particular isotope of an element

3.7
laboratory sample
sample sent to or received by the laboratory

Note 1 to entry: When the laboratory sample is further prepared (reduced) by subdividing, mixing, grinding, or by combinations of these operations, the result is the test sample. When no preparation of the laboratory sample is required, the laboratory sample is the test sample. A test portion is removed from the test sample for the performance of the test or for analysis.

Note 2 to entry: The laboratory sample is the final sample from the point of view of sample collection, but it is the initial sample from the point of view of the laboratory.

Note 3 to entry: Several laboratory samples may be prepared and sent to different laboratories or to the same laboratory for different purposes. When sent to the same laboratory, the set is generally considered as a single laboratory sample and is documented as a single sample.

3.8
moisture
water removable under specific conditions

3.9
net calorific value
calculated value of the specific energy of combustion for unit mass of a solid recovered fuel burned in oxygen in calorimetric bomb under such conditions that all the water remains as water vapor at 0,1 MPa

Note 1 to entry: The old term for net calorific value is lower heating value.

3.10
nominal minimum particle size
aperture size of the sieve used for determining the particle size distribution of solid recovered fuels through which no more than 5 % by mass of the material passes

3.11
nominal maximum particle size
aperture size of the sieve used for determining the particle size distribution of solid recovered fuels through which at least 95 % by mass of the material passes

3.12
percentage modern Carbon (pmC)
carbon mass fraction from biogenic origin (express in percentage)

Note 1 to entry: The internationally accepted radiocarbon dating reference value is 95 percent of the activity, in AD 1950, of this NBS oxalic acid SRM4990B.

Note 2 to entry: In 2015, the value of 100 % biogenic carbon was set at 102 pmC.

3.13
sample
quantity of material, representative of a larger quantity for which the property is to be determined

3.14
sample preparation
all actions taken to obtain representative analyses samples or test portions from the original sample

4 Symbols and abbreviations

For the purposes of this document, the following symbols and abbreviations apply.

C	symbol for element carbon
D	diameter (mm)
^{14}C	carbon isotope with an atomic mass of 14
*M*sort	manual sorting method
RES-E	directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001
RSD	relative standard deviation
SDM	selective dissolution method
SRF	solid recovered fuel
TC	total carbon content
X	mass fraction expressed as a percentage by weight
X^{cal}	content expressed as a percentage of the energy content
X^{TC}	content expressed as a percentage of the total carbon content

The different references used in this document are indicated by the following indices:

— $_{(ad)}$ for air dried
— $_{(ar)}$ for as received
— $_{(d)}$ for dry

— $_{(daf)}$ for dry and ash free, where appropriate.

EXAMPLE $x^{cal}_{NB(d)}$ means the fraction of energy content in the non-biomass fraction by calorific value, on dry basis.

5 Principle

The determination of the biomass content is based on selective dissolution, manual sorting or ^{14}C measurement of biomass in solid recovered fuel. The choice for the method to be used is described in the next clause. The biomass content gives an estimation of the content of the biodegradable/biogenic fraction in solid recovered fuel.

6 Determination of biomass content

6.1 Sampling

Sampling, transport, storage of the solid recovered fuel and sample preparation in the field shall be conducted according to ISO/CD 21645 and ISO/CD 21646.

6.2 Sample preparation

Preparation of the test sample for the ^{14}C or selective dissolution method shall be conducted according to EN 15413:2011. For the manual sorting method, no sample preparation is performed.

Since SRF is considered as a heterogeneous material, the minimum sample amount to be used for each test shall be:

— ^{14}C method: a quantity between 0,4 and 2 g of the material with a nominal maximum particle size of 1 mm or less, depending on the device used for combustion (bomb, combustion tube furnace or elemental analyser) or the quantity indicated by the constructor in the case of the use of a laboratory scale combustion apparatus;

— selective dissolution method: at least 5 g of the material with a nominal maximum particle size of 1 mm or less;

— manual sorting method: at least as big as the minimum sample size according to ISO/CD 21645 (as received), as calculated in EN 15413:2011.

6.3 Applicable methods

For the determination of biomass content three methods are available:

1) the instrumental 14C method. This method is based on the determination of the fraction of 14C to the total carbon content; the 14C is proportional to the biomass content of the SRF. This method is suitable for samples of all types of fuel and shall be according to Annex A;

2) the selective dissolution method (SDM) shall be according to Annex B. The determination of the biomass content by the selective dissolution method is based on the property of biomass that it can be dissolved in a sulphuric acid / hydrogen peroxide mixture;

3) the manual sorting method (Msort) shall be according to Annex C. The determination of the biomass content by the manual sorting method is based on the visual examination of fractions and their separation on the basis of their nature and origin. The method is suitable for samples with a particle size > 10 mm.

The selective dissolution method can give false results which may be caused by the following components in SRF. In case that these components are present in an amount defined below, the selective dissolution method is not applicable.

List of components giving false results:

— solid fossil fuels like hard coal, coke, brown coal, lignite and peat;

— charcoal;

— degradable plastics of fossil origin;

— non-degradable plastics of biogenic origin;

— oil or fat present as a constituent of biomass;

— natural and/or synthetic rubber residues;

— wool;

— viscose;

— nylon, polyurethane or other polymers containing molecular amino groups;

— silicon rubber.

If components in this list are expected to be present with an amount of less than 10 % by weight (for natural and/or synthetic rubber residues) or 5 % by weight (for the other mentioned components), an assessment is not necessary. If the components in this list are expected to be present in the sample with a higher amount, an assessment shall be made of the estimated influence of the presence of these components and the results of that assessment shall be mutually agreed between the parties involved. In case of conflicts the ^{14}C method shall be used to confirm the results of that assessment.

NOTE In typical residual and similar waste, the content of nylon, polyurethane, biodegradable plastics of fossil origin, wool, viscose, non-biodegradable plastics of biogenic origin and oil/fat is fairly low and the defect is negligible.

For the limitations of the three methods see Annex D.

6.4 Selection of methods for the determination of the biomass content

For the selection of the method the following aspects shall be considered:

1) What is the purpose of the biomass content determination? If the results are used according to renewable energy sources, then biomass content by weight and/or calorific value needs to be determined. If the results are used for greenhouse gas reduction related issues (CO_2 trading), then the biomass content by carbon and/or calorific value has to be determined;

2) Are the measurements parts of a regular routine control check for RES-E issues? In that case the SDM/Msort shall be used, provided that there is no restriction due to false results as described in 6.2. The SDM and Msort measurements are regarded as preferred methods as they can be performed in a typical laboratory by proficient analysis using simple standard equipment. Results can be available within 1 to 2 days and if the nature of the SRF is well known and constant, the SRF and Msort measurements are the most efficient options;

3) Are the measurements intended for CO_2 trading matters or accounting biomass content in CO_2 emissions? In that case the ^{14}C method or the SDM may be used. Validation studies show that there is a good agreement in the determination of the biomass content by carbon between the ^{14}C method and the SDM/Msort method in SRF materials.

Table 1 — Method selection

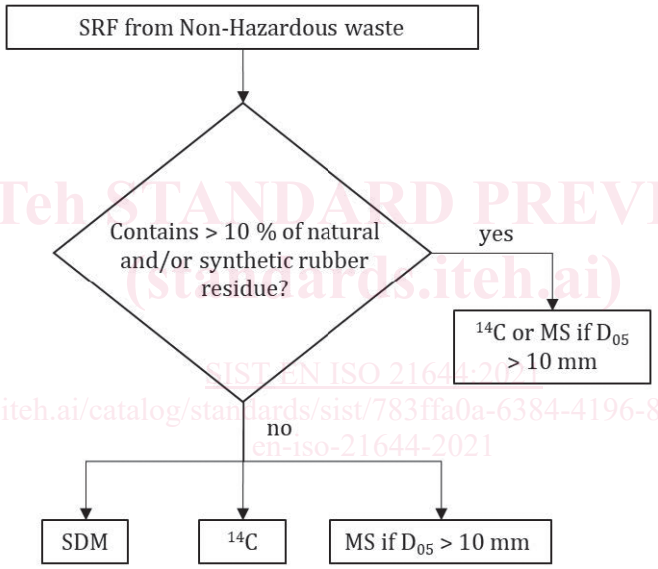
	[RES-E]	[CO_2 trading]
x_B	SDM / Msort	Msort
x_B^{cal}	SDM / Msort	^{14}C / SDM/ Msort
x_B^{TC}		^{14}C / SDM

NOTE 1 The determination of the biomass fraction with ^{14}C expressed by energy content has not been validated.

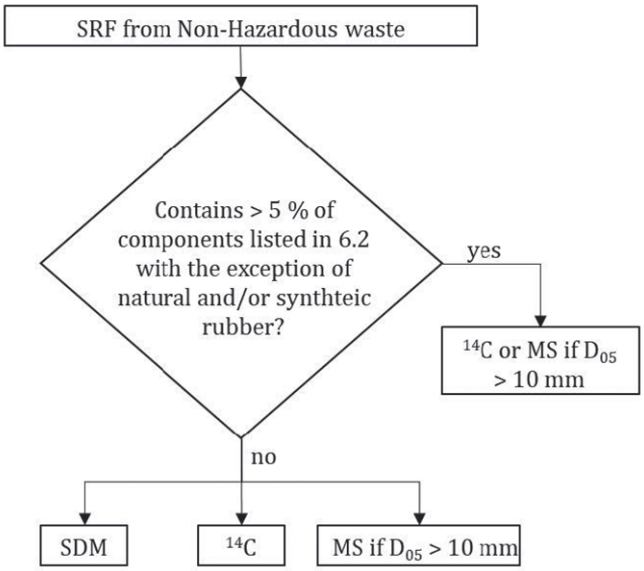
NOTE 2 The Msort combined with the calorific value determination or the TC determination of the biomass and the non-biomass fraction could be used for internal analyses.

In Table 1, [RES-E] refers to renewable energy sources and [CO_2 trading] refers to greenhouse gas reduction related issues.

Figure 1 a) and b) gives a decision tree for selection of the appropriate method for the determination.



a)



b)

Key

Msort	manual sorting
SDM	selective dissolution method
^{14}C	radiocarbon method
D_{05}	nominal minimum particle size

Figure 1 — Decision tree for the selection of determination method

7 Expression of results

Depending on the use of the results, three different dimensions are used to express the biomass content:

a) biomass in percent by weight x_B;

b) biomass in percent by calorific value x_B^{cal};

c) biomass in percent by carbon content x_B^{TC}.

The expression of results by ^{14}C method shall be according to Annex A.

The expression of results by SDS method shall be according to Annex B.

The expression of results by Msort method shall be according to Annex C.

8 Performance characteristics

External data for the calculation of the expanded uncertainty of measurements are presented in Annex E where results of round robin and validation studies are summarized. These values should be used in combination with individual laboratory performance characteristics and a desired coverage factor to get the overall uncertainty that is demanded by the customer.