



BSI Standards Publication

# Solid biofuels — Determination of elemental composition by X-ray fluorescence

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**National foreword**

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A list of organizations represented on this committee can be obtained on request to its secretary.

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**Solid biofuels — Determination of  
elemental composition by X-ray  
fluorescence**

*Biocarburants solides — Détermination de la composition  
élémentaire par fluorescence de rayons X*





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# Contents

Page

<b>Foreword</b> .....	<b>iv</b>
<b>Introduction</b> .....	<b>v</b>
<b>1 Scope</b> .....	<b>1</b>
<b>2 Normative references</b> .....	<b>1</b>
<b>3 Terms and definitions</b> .....	<b>1</b>
<b>4 Safety remarks</b> .....	<b>2</b>
<b>5 Symbols and abbreviated terms</b> .....	<b>3</b>
5.1 Symbols.....	3
5.2 Abbreviated terms.....	3
<b>6 Principle</b> .....	<b>3</b>
<b>7 Apparatus</b> .....	<b>4</b>
<b>8 Interferences and sources of error</b> .....	<b>4</b>
<b>9 Sample preparation</b> .....	<b>5</b>
9.1 Preparation principles.....	5
9.2 Drying of general analysis sample material.....	5
9.3 Preparation of pressed pellet.....	5
<b>10 Procedure</b> .....	<b>5</b>
10.1 Analytical measurement conditions.....	5
10.1.1 Wavelength dispersive instruments.....	5
10.1.2 Energy dispersive instruments.....	6
10.2 Calibration.....	7
10.2.1 General.....	7
10.2.2 General calibration procedure.....	8
10.2.3 Calibration procedure using the pressed pellet method (recommended method).....	8
10.3 Procedures for correcting matrix effect.....	9
10.3.1 Internal standard correction using Compton (incoherent) scattering method.....	9
10.3.2 Fundamental parameter approach.....	9
10.3.3 Fundamental theoretical influence coefficient method.....	9
10.3.4 Empirical alpha correction.....	10
10.4 Analysis of the samples.....	11
<b>11 Quality control</b> .....	<b>11</b>
11.1 Drift correction procedure.....	11
11.2 Reference materials.....	11
<b>12 Calculation of the result</b> .....	<b>11</b>
<b>13 Performance characteristics</b> .....	<b>12</b>
<b>14 Test report</b> .....	<b>12</b>
<b>Annex A (informative) Publicly available biomass reference materials</b> .....	<b>13</b>
<b>Bibliography</b> .....	<b>14</b>

## 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](http://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](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#).

The committee responsible for this document is ISO/TC 238, *Solid biofuels*.

## Introduction

X-ray fluorescence spectrometry can be used as a fast method for a qualitative overview of ash forming elements and impurities. When calibration is based on biomass reference materials, X-ray fluorescence spectrometry can be used for a quantitative analysis of the total content of the specified elements within different solid biofuels.

The quality of the results obtained depends very closely on the type of instrument used, e.g. bench top or high performance, energy dispersive or wavelength dispersive instruments. When selecting a specific instrument, several factors have to be considered, such as the matrices to be analysed, elements to be determined, detection limits required and the measuring time.

Due to the wide range of matrix compositions and the lack of suitable reference materials in the case of some biomass like olive residues, it is generally difficult to set up a calibration with matrix-matched reference materials.

Therefore, this Technical Specification describes two different procedures.

- Quantitative analytical procedure for major elements of biomass. The calibration is based on different biomass reference materials.

The elements described as major elements of solid biofuels are in fact major elements of the fuel ashes more than of the fuels. The determination of these elements may be helpful to predict the melting behaviour and slagging of the ashes. Moreover, contamination of fuel with sand or soil is indicated by high values of several elements.

- Total element characterization at a semi-quantitative level for major elements of biomass. The calibration is based on matrix-independent calibration curves, previously set up by the manufacturer.

In general, the sensitivity of X-ray fluorescence is not sufficient for a determination of the content of minor elements (trace metals) in solid biofuels. However, determination may be used to reveal excessive contents of minor elements in solid biofuels.

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# Solid biofuels — Determination of elemental composition by X-ray fluorescence

## 1 Scope

This Technical Specification specifies the procedure for a determination of major and minor element concentrations in biomass material by energy dispersive X-ray fluorescence (EDXRF) spectrometry or wavelength dispersive X-ray fluorescence (WDXRF) spectrometry using a calibration with biomass reference materials. A semi-quantitative determination may be carried out using matrix independent standards.

This Technical Specification is applicable for the following elements: Na, Mg, Al, Si, P, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Br, Mo, Cd, Sb, and Pb. Concentrations from approximately 0,000 1 % and above can be determined depending on the element, the calibration materials used and the instrument used.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

## 3 Terms and definitions

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

### 3.1

#### **absorption edge**

abrupt change in mass absorption coefficient at a specific wavelength or energy

### 3.2

#### **absorption of X-rays**

loss of intensity of X-rays through absorption by an isotropic and homogenous material as described by the Beer-Lambert law

### 3.3

#### **analytical line**

specific characteristic X-ray spectral line of the atom or ion of the analyte used for determination of the analyte content

### 3.4

#### **continuous radiation**

electromagnetic radiation produced by the acceleration of a charged particle, such as an electron, when deflected by another charged particle, such as an atomic nucleus

### 3.5

#### **compton-line**

spectral line due to incoherent scattering (Compton-effect), occurring when the incident X-ray photon strikes an atom without promoting fluorescence

Note 1 to entry: Energy is lost in the collision and therefore, the resulting scattered X-ray photon is of lower energy than the incident X-ray photon.