International Standard

ISO 16994

Solid biofuels and pyrogenic biocarbon — Determination of sulfur and chlorine content

Biocombustibles solides et biocarbone pyrogène — Détermination de la teneur en soufre et en chlore

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Foreword

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

This third edition cancels and replaces the second edition (ISO 16994:2016), which has been technically revised.

The main changes are as follows:

— fluorine and bromine added to the scope and calculation in 9.2;

— normative references updated;

— detection methods updated and additional details about the techniques added;

— decomposition method with acid digestion and ICP analyses for chlorine removed.

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.

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Introduction

Sulfur and chlorine are present in solid biofuels and pyrogenic biocarbon in varying concentrations. During the combustion process, they are usually converted to sulfur-oxides and chlorides. The presence of these elements and their reaction products can contribute significantly to corrosion and to environmentally harmful emissions.

Chlorine can be present in different organic and inorganic compounds and can exceed or equal the water-soluble amount that can be determined by ISO 16995.

Fluorine and bromine can also be present in solid biofuels and pyrogenic biocarbon, but in detectable concentration only in specific types of biomass, like in aquatic biofuels (Br) or as contamination because of chemical treatment (F). Both elements can be analysed using the same techniques and equipment as for chlorine and sulfur described in this document.

Combustion in an oxygen atmosphere in a closed combustion vessel is the preferred method to digest biomass samples for a determination of sulfur, chlorine, fluorine and bromine content. An advantage of the method is that the digestion can be carried out in connection with the determination of the calorific value according to ISO 18125. Other analytical techniques may also be used for selected analytes. The determination of the resultant chlorine, sulfur, bromine and fluorine compounds can be done by different techniques.

Automatic equipment and alternative methods may also be used for selected analytes.

A list with typical sulfur, chlorine and fluorine contents of solid biofuels can be found in ISO 17225-1:2021, Annex B.

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Solid biofuels and pyrogenic biocarbon — Determination of sulfur and chlorine content

1 Scope

This document describes methods for the determination of sulfur and chlorine content in solid biofuels and pyrogenic biocarbon and specifies two methods for decomposition of the fuel and different analytical techniques for the quantification of the elements in the decomposition solutions. The determination of other elements such as fluorine and bromine are also possible with the methods in this document, however performance data for these elements are not provided. The use of automatic equipment is also included in this document, provided that a validation is carried out as specified and that the performance characteristics are similar to those of the method described 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 10304-1, *Water quality — Determination of dissolved anions by liquid chromatography of ions — Part 1: Determination of bromide, chloride, fluoride, nitrate, nitrite, phosphate and sulfate*

ISO 14780, *Solid biofuels — Sample preparation*

ISO 16559, *Solid biofuels — Vocabulary*

ISO 18125, *Solid biofuels — Determination of calorific value*

ISO 18134-3, *Solid biofuels — Determination of moisture content — Part 3: Moisture in general analysis sample*

CEN Guide 13:2008, *Validation of environmental test methods*

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

4.1 General

The determination of the analytes (sulfur, chlorine, fluorine and bromine) is performed in two steps (4.2 and 4.3) or by using automatic equipment (see 4.4).

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