SLOVENSKI STANDARD
SIST EN ISO 20049-1:2020

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Trdna biogoriva - Določanje samosegrevanja peletiziranih biogoriv - 1. del: Izotermalna kalorimetrija (ISO 20049-1:2020)

Solid biofuels - Determination of self-heating of pelletized biofuels - Part 1: Isothermal calorimetry (ISO 20049-1:2020)

Biogene Festbrennstoffe - Bestimmung der Selbsterhitzung von Pellets aus biogenen Brennstoffen - Teil 1: Isotherme Kalorimetrie (ISO 20049-1:2020)

Biocombustibles solides - Détermination de l'auto-échauffement des granulés de biocombustibles - Partie 1: Détermination calorimétrique isotherme (ISO 20049-1:2020)

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75.160.40	Biogoriva	Biofuels

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EUROPEAN STANDARD

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Solid biofuels - Determination of self-heating of pelletized biofuels - Part 1: Isothermal calorimetry (ISO 20049-1:2020)

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This European Standard was approved by CEN on 1 May 2020.

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Contents

Page

European foreword

This document (EN ISO 20049-1:2020) has been prepared by Technical Committee ISO/TC 238 "Solid biofuels" in collaboration with Technical Committee CEN/TC 335 “Solid biofuels” the secretariat of which is held by SIS.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2020, and conflicting national standards shall be withdrawn at the latest by November 2020.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

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INTERNATIONAL STANDARD

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Solid biofuels — Determination of self-heating of pelletized biofuels —

Part 1: Isothermal calorimetry

Biocombustibles solides — Détermination de l'auto-échauffement des granulés de biocombustibles —

Partie 1: Détermination calorimétrique isotherme

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Contents

Page

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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This document was prepared by Technical Committee ISO/TC 238, *Solid biofuels*.

A list of all parts in the ISO 20049 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.

Introduction

There is a continuous global growth in production, storage, handling, bulk transport and use of solid biofuels especially in the form of pelletized biofuels.

The specific physical and chemical characteristics of solid biofuels, their handling and storage can lead to a risk of fire and/or explosion, as well as health risks such as intoxication due to exposure to carbon-monoxide, asphyxiation due to oxygen depletion or allergic reactions.

Heat can be generated in solid biofuel by exothermic biological, chemical and physical processes. Biological processes include the metabolism of fungus and bacteria and occur at lower temperatures; the oxidation of wood constituents increases with temperature and dominates at higher temperatures; the heat production from biological and chemical processes leads to transport of moisture in the bulk material, with associated sorption and condensation of water, which both are exothermic processes. In, for example, a heap of stored forest fuel or a heap of moist wood chips, all of these processes can be present and contribute to heat production.

Solid biofuels such as wood pellets, however, are intrinsically sterile[1] due to the conditions during manufacturing (exposure to severe heat during drying, fragmentation during hammermilling and pressure during extrusion) but can attract microbes if becoming wet during handling and storage resulting in metabolism and generation of heat. Leakage of water into a storage of wood pellets can also lead to the physical processes mentioned above. Non-compressed wood like feedstock and chips typically have a fauna of microbes which under certain circumstances will result in heating. All the processes mentioned above contribute to what is called self-heating although oxidation is likely to be one of the main contributing factors in the temperature range under which most biofuels are stored. The heat build-up can be significant in large bulk stores as the heat conduction in the material is low. Under certain conditions the heat generation can lead to thermal runaway and spontaneous ignition.

The potential for self-heating seems to vary considerably for different types of solid biofuel pellets. The raw material used, and the properties of these raw materials have proven to influence the propensity for self-heating of the produced wood pellets. However, the production process (e.g. the drying process) also influences the potential for self-heating. It is therefore important to be able to identify solid biofuel pellets with high heat generation potential to avoid fires in stored materials.

Two intrinsically different types of tests methods can be used to estimate the potential of self-heating;

a) In the isothermal calorimetry method described in this document, the heat flow generated from the test portion is measured directly.

b) In basket heating tests, the temperature of the test portion is being monitored and the critical ambient temperature (CAT), where the temperature of the test portion just does not increase significantly due to self-heating, is used for indirect assessment of self-heating.

These two methods are applied at different analysis temperature regimes. The operating temperature for an isothermal calorimeter is normally in the range 5 °C to 90 °C whereas basket heating tests are conducted at higher analysis (oven) temperatures. For basket heating tests with wood pellets, CATs are found for a 1 l sample portion in the range 150 °C to 200 °C.

The application of the test data should thus be identified before selecting the appropriate analytical method.

NOTE 1 The two types of test methods referred to above do not measure heat production from physical processes such as transport of moisture.

NOTE 2 It is likely that oxidation reactions taking place in the low respective high temperature regimes for solid biofuel pellets are of different character and thus have different reaction rates and heat production rates. In such a case, extrapolation of the data from a high temperature test series can lead to non-conservative results and might not be applicable without taking the low temperature reactions into account. In the general case of two reactions with different activation energies, the high activation energy is “frozen out” at low temperatures and the low activation energy reaction is “swamped” at higher temperatures[2].

NOTE 3 It has been shown for a limited number of different types of wood pellets that the reaction rates in the lower temperature regime measured by isothermal calorimetry were higher compared to the reaction rate data determined from basket heating tests in the higher temperature regime[3].

Isothermal calorimetry is used for determination of the thermal activity or heat flow of chemical, physical and biological processes. The method described in this document is developed for the measurement of heat flow from the self-heating of solid biofuel pellets, but the technique is most commonly used in the fields of pharmaceuticals, energetic materials, and cement[3] to [7].

Data from the isothermal calorimetry screening test procedure included in this document is intended for comparison of the spontaneous heat generation (self-heating) of solid biofuel pellets (Annex B).

Guidance is additionally given on the use of isothermal calorimetry test data for the calculation of the overall reaction rate of the heat producing reactions (Annex C).

