



BSI Standards Publication

## Solid recovered fuels — Determination of the Recycling Index for co-processing

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## National foreword

This British Standard is the UK implementation of EN ISO 4349:2024. It is identical to ISO 4349:2024.

The UK participation in its preparation was entrusted to Technical Committee PTI/17, Solid biofuels.

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

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English Version

## Solid recovered fuels - Determination of the Recycling Index for co-processing (ISO 4349:2024)

Combustibles solides de récupération - Détermination de l'indice de recyclage pour le cotraitement (ISO 4349:2024)

Feste Sekundärbrennstoffe - Verfahren zur Bestimmung des Recycling-Index für Co-Processing (ISO 4349:2024)

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CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

## **European foreword**

This document (EN ISO 4349:2024) has been prepared by Technical Committee ISO/TC 300 "Solid recovered materials, including solid recovered fuels" in collaboration with Technical Committee CEN/TC 343 "Solid recovered materials, including solid recovered fuels" the secretariat of which is held by SFS.

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of an identical text or by endorsement, at the latest by November 2024, and conflicting national standards shall be withdrawn at the latest by November 2024.

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## **Endorsement notice**

The text of ISO 4349:2024 has been approved by CEN as EN ISO 4349:2024 without any modification.

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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 document 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)).

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This document was prepared by Technical Committee ISO/TC 300, *Solid recovered materials, including solid recovered fuels*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 343, *Solid recovered materials, including 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](http://www.iso.org/members.html).

## Introduction

When solid recovered fuels (SRFs) are co-processed mainly in the cement industry, simultaneous energy recovery and recycling of mineral components of waste material takes place because the ash is directly incorporated into the clinker. SRF co-processing therefore allows for the replacement of both mineral resources and fossil fuels.

SRF ashes contain various chemical components that are crucial raw materials for cement manufacturers, fulfil specific tasks in cement clinker production or represent clinker phases giving the clinker its specific properties. For example, a major part of SRF ashes from mixed municipal and commercial waste consists of the four main chemical components that are required for cement clinker production:  $\text{Al}_2\text{O}_3$ ,  $\text{CaO}$ ,  $\text{Fe}_2\text{O}_3$  and  $\text{SiO}_2$  (see [Annex A](#)). Additionally, minor ash constituents include  $\text{MgO}$  and  $\text{TiO}_2$ , both of which are present in or as clinker phases.  $\text{K}_2\text{O}$  and  $\text{Na}_2\text{O}$  are typical constituents of feldspars that are present in the clay used as a raw material for the process.  $\text{SO}_3$ , which is also present in SRF ash, or another sulfate carrier is needed in order to convert these alkali oxides into alkali sulfates, a clinker phase that alters the clinker's chemical reactivity with water.



# Solid recovered fuels — Determination of the recycling index for co-processing

## 1 Scope

This document specifies the determination of the share of material recovery in the case of energy recovery (i.e. co-processing) of solid recovered fuels (SRFs), for example, in a cement kiln. This share, called the recycling index (R-index), is calculated on the basis of the ash content and the ash composition.

## 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 3884:—<sup>1)</sup>, *Solid recovered fuels — Methods for the determination of the content of elements (Al, Ca, Fe, K, Mg, Na, P, S, Si, Ti, As, Ba, Be, Cd, Co, Cr, Cu, Hg, Mo, Mn, Ni, Pb, Sb, Se, Sn, Tl, V, Zn)*

ISO 11885, *Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES)*

ISO 21645, *Solid recovered fuels — Methods for sampling*

ISO 21646, *Solid recovered fuels — Sample preparation*

ISO 21656:2021, *Solid recovered fuels — Determination of ash content*

ISO 22940, *Solid recovered fuels — Determination of elemental composition by X-ray fluorescence*

EN 15309, *Characterization of waste and soil. Determination of elemental composition by X-ray fluorescence*

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions 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/>

### 3.1 recycling index

#### R-index

share of SRF that can be considered as recycled on a material level, expressed as a mass fraction in per cent of the dry matter

### 3.2 co-processing

use of SRF in manufacturing processes for energy recovery and simultaneously for material recovery of mineral components

1) Under preparation. Stage at the time of publication: ISO/DIS 3884:2024.

## 4 Symbols and abbreviated terms

|                         |                                      |
|-------------------------|--------------------------------------|
| $A_{\text{db}}$         | ash content at 815 °C on a dry basis |
| $\text{Al}_2\text{O}_3$ | aluminium(III) oxide                 |
| $\text{CaO}$            | calcium oxide                        |
| (d)                     | dry (dry basis)                      |
| $\text{Fe}_2\text{O}_3$ | iron(III) oxide                      |
| $\text{K}_2\text{O}$    | potassium oxide                      |
| $\text{MgO}$            | magnesium oxide                      |
| $\text{Na}_2\text{O}$   | sodium oxide                         |
| $\text{SiO}_2$          | silicon dioxide                      |
| $\text{SO}_3$           | sulfur trioxide                      |
| $\text{TiO}_2$          | titanium dioxide                     |

## 5 Reagents

Use only reagents of recognized analytical grade and only distilled water or water of equivalent purity.

**5.1 Water**, e.g. deionized ( $< 0,055 \mu\text{S}/\text{cm}$ ).

**5.2 Nitric acid ( $\text{HNO}_3$ )**, approximately 15 mol/l, mass fraction of 65 % to 70 %.

**5.3 Hydrofluoric acid ( $\text{HF}$ )**, approximately 23 mol/l, mass fraction of 40 % to 45 %.

**5.4 Hydrochloric acid ( $\text{HCl}$ )**, approximately 12 mol/l, mass fraction of 35 % to 37 %.

**5.5 Lithium metaborate ( $\text{LiBO}_2$ )**, solid.

**5.6 Binder**, solid or liquid, for example wax. Specifications are given in EN 15309.

## 6 Apparatus

The usual laboratory apparatus and, in particular, the following shall be used.

**6.1 Analytical balance**, with an accuracy of 1 mg or better.

**6.2 Muffle furnace**, for temperatures of 1 050 °C.

**6.3 Inductively coupled plasma**, normal commercial instrumentation with optical or mass spectrometric detector (ICP-OES, ICP-MS).

**6.4 X-ray fluorescence spectrometer**, an energy or wavelength dispersion system suitable for qualitative and (semi-)quantitative analysis of the elements listed in this document.

**6.5 Microwave unit**, in accordance with ISO 3884:—.