
Polimerni materiali - Določanje aerobne biorazgradljivosti neplavajočih materialov, izpostavljenih morskim sedimentom - Metoda z analizo sproščenega ogljikovega dioksida (ISO 22404:2019)

Plastics - Determination of the aerobic biodegradation of non-floating materials exposed to marine sediment - Method by analysis of evolved carbon dioxide (ISO 22404:2019)

Kunststoffe - Bestimmung des aeroben Bioabbaus von nicht-schwimmenden Materialien, die marinem Sediment ausgesetzt sind - Verfahren mittels Analyse des freigesetzten Kohlenstoffdioxids (ISO 22404:2019)

Plastiques - Détermination de la biodégradation aérobie des matériaux non flottants exposés aux sédiments marins - Méthode par analyse du dioxyde de carbone libéré (ISO 22404:2019)

Ta slovenski standard je istoveten z: prEN ISO 22404

ICS:

13.020.40	Onesnaževanje, nadzor nad onesnaževanjem in ohranjanje	Pollution, pollution control and conservation
83.080.01	Polimerni materiali na splošno	Plastics in general

oSIST prEN ISO 22404:2021

en,fr,de

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[oSIST prEN ISO 22404:2021](https://standards.iteh.ai/catalog/standards/sist/5e60df66-c4ff-4dea-98d3-f73214c597d8/osist-pren-iso-22404-2021)

<https://standards.iteh.ai/catalog/standards/sist/5e60df66-c4ff-4dea-98d3-f73214c597d8/osist-pren-iso-22404-2021>

INTERNATIONAL
STANDARD

ISO
22404

First edition
2019-09

**Plastics — Determination of the
aerobic biodegradation of non-
floating materials exposed to marine
sediment — Method by analysis of
evolved carbon dioxide**

*Plastiques — Détermination de la biodégradation aérobie des
matériaux non flottants exposés aux sédiments marins — Méthode
par analyse du dioxyde de carbone libéré*

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[oSIST prEN ISO 22404:2021](https://standards.iteh.ai/catalog/standards/sist/5e60df66-c4ff-4dea-98d3-f73214c597d8/osist-pren-iso-22404-2021)

[https://standards.iteh.ai/catalog/standards/sist/5e60df66-c4ff-4dea-98d3-
f73214c597d8/osist-pren-iso-22404-2021](https://standards.iteh.ai/catalog/standards/sist/5e60df66-c4ff-4dea-98d3-f73214c597d8/osist-pren-iso-22404-2021)



Reference number
ISO 22404:2019(E)

© ISO 2019

iTeh STANDARD PREVIEW (standards.iteh.ai)

[oSIST prEN ISO 22404:2021
https://standards.iteh.ai/catalog/standards/sist/5e60df6-c4ff-4dea-98d3-f73214c597d8/osist-pren-iso-22404-2021](https://standards.iteh.ai/catalog/standards/sist/5e60df6-c4ff-4dea-98d3-f73214c597d8/osist-pren-iso-22404-2021)



COPYRIGHT PROTECTED DOCUMENT

© ISO 2019

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

	Page
Foreword.....	iv
Introduction.....	v
1 Scope.....	1
2 Normative references.....	1
3 Terms and definitions.....	1
4 Principle.....	2
5 Test environment.....	2
6 Reagents.....	2
7 Apparatus.....	3
8 Procedure.....	3
8.1 Test material.....	3
8.2 Reference material.....	4
8.3 Preparation of the sediment.....	4
8.4 Test setup.....	4
8.5 Pre-conditioning phase.....	4
8.6 Start of the test.....	5
8.7 Carbon dioxide measurement.....	5
8.8 End of the test.....	6
9 Calculation and expression of results.....	6
9.1 Calculation.....	6
9.1.1 Amount of CO ₂ produced.....	6
9.1.2 Percentage of biodegradation.....	8
9.2 Expression and interpretation of results.....	8
10 Validity of results.....	9
11 Test report.....	9
Bibliography.....	10

ISO 22404:2019(E)

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).

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).

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 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 the following URL: www.iso.org/iso/foreword.html. (standards.iteh.ai)

This document was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 14, *Environmental aspects*.
oSIST prEN ISO 22404:2021

<https://standards.iteh.ai/catalog/standards/sist/5e60df66-c4ff-4dea-98d3-7321e541d6e6/iso-22404-2019>

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

Products made with biodegradable plastics and other biodegradable materials are designed to be recoverable by means of organic recycling in composting plants or in anaerobic digesters. The uncontrolled dispersion of biodegradable plastics in natural environments is not desirable. The biodegradability of products cannot be considered as an excuse to spread wastes that should be recovered and recycled. However, test methods to measure rate and level of biodegradation in natural environments (such as soil or the marine environment) are of interest in order to better characterize the behaviour of plastics in these very particular environments. As a matter of fact, some plastics are used in products that are applied in the sea (for example, fishing gear) and sometimes they can get lost or put willingly in marine environment. The characterization of biodegradable plastic materials can be enlarged by applying specific test methods that enable the quantitative assessment of biodegradation of plastics exposed to marine sediment and seawater. In order to carry out a proper product design, it is important to know whether a plastic material is inherently biodegradable when exposed to marine inocula.

This document provides a test method for calculating and reporting biodegradation level obtained under laboratory conditions using a marine inoculum. The marine inoculum is sediment sampled at the tidal zone. The plastic material is exposed to this environmental matrix and biodegradation is followed by measuring the evolved CO₂.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[oSIST prEN ISO 22404:2021](https://standards.iteh.ai/catalog/standards/sist/5e60df6-c4ff-4dea-98d3-f73214c597d8/osist-pren-iso-22404-2021)

<https://standards.iteh.ai/catalog/standards/sist/5e60df6-c4ff-4dea-98d3-f73214c597d8/osist-pren-iso-22404-2021>

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[oSIST prEN ISO 22404:2021](https://standards.iteh.ai/catalog/standards/sist/5e60df66-c4ff-4dea-98d3-f73214c597d8/osist-pren-iso-22404-2021)

<https://standards.iteh.ai/catalog/standards/sist/5e60df66-c4ff-4dea-98d3-f73214c597d8/osist-pren-iso-22404-2021>

Plastics — Determination of the aerobic biodegradation of non-floating materials exposed to marine sediment — Method by analysis of evolved carbon dioxide

1 Scope

This document specifies a laboratory test method to determine the degree and rate of aerobic biodegradation level of plastic materials. This test method can also be applied to other materials.

Biodegradation is determined by measuring the CO₂ evolved by the plastic material when exposed to marine sediments sampled from a sandy tidal zone and kept wet with salt-water under laboratory conditions.

This test method is a simulation under laboratory conditions of the habitat found in sandy tidal zone that, in marine science, is called eulittoral zone.

The conditions described in this document might not always correspond to the optimum conditions for the maximum degree of biodegradation to occur.

Deviations from the test conditions described in this document are justified in the test report.

2 Normative references (standards.iteh.ai)

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 10210, *Plastics — Methods for the preparation of samples for biodegradation testing of plastic materials*

3 Terms and definitions

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

3.1

tidal zone

borderline between sea and land that extends from the high tide line, which is rarely inundated with water, to the low tide line, which is typically always covered with water

Note 1 to entry: The tidal zone is frequently a sandy area that is kept constantly damp by the lapping of the waves.

Note 2 to entry: Stony and rocky shorelines also exist.

Note 3 to entry: They are also known as eulittoral zone, midlittoral zone, mediolittoral zone, intertidal zone, foreshore.

ISO 22404:2019(E)**3.2****theoretical amount of evolved carbon dioxide****ThCO₂**

maximum theoretical amount of carbon dioxide evolved after completely oxidising a chemical compound, calculated from the molecular formula or from determination of *total organic carbon (TOC)* (3.3) and expressed as milligrams of carbon dioxide evolved per milligram or gram of test compound

3.3**total organic carbon****TOC**

amount of carbon bound in an organic compound

Note 1 to entry: Total organic carbon is expressed as milligrams of carbon per 100 milligrams of the compound.

3.4**dissolved organic carbon****DOC**

part of the organic carbon in water which cannot be removed by specified phase separation methods, for example by centrifugation at 40 000 ms⁻² for 15 min or by membranes with pores of 0,2 µm to 0,45 µm diameter

3.5**pre-conditioning phase**

pre-incubation of an inoculum under the conditions of the subsequent test in the absence of test material, with the aim to consume potential organic matter present in excess that could disturb biodegradation measurement and to improve the acclimatization of the microorganisms to the test conditions

4 Principle

This test method is based on the determination of the evolved carbon dioxide and derives from ISO 19679. The testing medium is based on a sandy marine sediment laid in the bottom of a closed flask; the sediment is kept wet with natural sea water. The test material is preferably in the form of a powder.

The carbon dioxide evolved during the microbial degradation is determined by a suitable analytical method. The level of biodegradation is determined by comparing the amount of carbon dioxide evolved with the theoretical amount (ThCO₂) and expressed in per cent. The test result is the maximum level of biodegradation, determined from the plateau phase of the biodegradation curve. The principle of a system for measuring evolved carbon dioxide is given in ISO 14852:2018, Annex A.

5 Test environment

Incubation shall take place in the dark in an enclosure which is free from vapours inhibitory to microorganisms and which is maintained at a constant temperature, preferably between 15 °C to 25 °C, but not exceeding 28 °C, to an accuracy of ±2 °C. Any change in temperature shall be justified and clearly indicated in the test report.

NOTE Test results are obtained for temperature that can be different from real conditions in marine environment.

6 Reagents

6.1 Water, distilled or deionized water, free of toxic substances (copper in particular) and containing less than 2 mg/l of DOC.