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Plastics - Determination of the aerobic biodegradation of plastic materials exposed to seawater - Part 2: Method by measuring the oxygen demand in closed respirometer (ISO 23977-2:2020)

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Plastics - Determination of the aerobic biodegradation of plastic materials exposed to seawater - Part 2: Method by measuring the oxygen demand in closed respirometer (ISO 23977-2:2020)

Plastiques - Détermination de la biodégradation aérobie des matières plastiques exposées à l'eau de mer - Partie 2: Méthode par mesure de la demande en oxygène dans un respiromètre fermé (ISO 23977-2:2020)

Kunststoffe - Bestimmung des aeroben Bioabbaus von Meerwasser ausgesetzten Kunststoff-Materialien - Teil 2: Verfahren mittels Messung des Sauerstoffbedarfs in einem geschlossenen Respirometer (ISO 23977-2:2020)

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European foreword

The text of ISO 23977-2:2020 has been prepared by Technical Committee ISO/TC 61 "Plastics" of the International Organization for Standardization (ISO) and has been taken over as EN ISO 23977-2:2021 by Technical Committee CEN/TC 249 "Plastics" the secretariat of which is held by NBN.

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**Plastics — Determination of the
aerobic biodegradation of plastic
materials exposed to seawater —**

**Part 2:
Method by measuring the oxygen
demand in closed respirometer**

*Plastiques — Détermination de la biodégradation aérobie des
matières plastiques exposées à l'eau de mer —*

*Partie 2: Méthode par mesure de la demande en oxygène dans un
respiromètre fermé*



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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 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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For an explanation of 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 www.iso.org/iso/foreword.html.

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

A list of all parts in the ISO 23997 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

According to the United Nations Environment Program (UNEP), one of the most notable properties of synthetic polymers and plastics is their durability which, combined with their accidental loss, deliberate release and poor waste management has resulted in the ubiquitous presence of plastic in oceans (UNEP, 2015^[15]).

It is well known and documented that marine litter can pose risks and a negative impact on living marine organisms and on human beings. Degradability of plastic materials exposed to the marine environment is one of the factors affecting impact and strength of effects. 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 are of interest in order to better characterize the behaviour of plastics in these very particular environments. Thus, the degree and rate of biodegradation is of major interest in order to obtain an indication of the potential biodegradability of plastic materials when exposed to different marine habitats.

ISO/TC 61/SC 14 has established several test methods for biodegradation testing of plastic materials under laboratory conditions covering different environmental compartments and test conditions, as shown in [Table 1](#).

Table 1 — Test methods for biodegradation testing of plastics

Conditions		Test methods
Environmental compartment	Presence/absence of oxygen	
Controlled composting conditions	Aerobic conditions	ISO 14855-1
		ISO 14855-2
High-solids anaerobic-digestion conditions	Anaerobic conditions	ISO 15985
Controlled anaerobic slurry system	Anaerobic conditions	ISO 13975
Soil	Aerobic conditions	ISO 17556
Aqueous medium	Aerobic conditions	ISO 14851
		ISO 14852
	Anaerobic conditions	ISO 14853
Seawater/sandy sediment interface	Aerobic conditions	ISO 18830 ^a
		ISO 19679 ^a
Marine sediment	Aerobic conditions	ISO 22404 ^a
Seawater	Aerobic conditions	ISO 23977-1 ^a
		ISO 23977-2 ^a

^a Test method for measuring biodegradation of plastic materials when exposed to marine microbes.

All marine biodegradation test methods are based on exposure of plastic materials to marine samples (seawater and/or sediment) taken from shoreline areas. By a quantitative viewpoint, these methods are not equivalent, because, for example, the microbial density in seawater is generally lower compared to the density determined in sediment. In addition, the microbial composition and diversity can be different. Moreover, as a rule, the nutrient concentration found in sediment is normally higher compared to the concentration in seawater.

This document provides a test method for determining the biodegradation level of plastic materials exposed to the microbial population present in seawater from a pelagic zone under laboratory conditions. The biodegradation is followed by measuring the oxygen demand in a closed respirometer.

The test is performed with either seawater only (“pelagic seawater test”) or with seawater to which little sediment was added (“suspended sediment seawater test”).

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The pelagic seawater test simulates the conditions found in offshore areas with low water currents and low tidal movements, whereas the suspended sediment seawater test simulates conditions which might be found in coastal areas with stronger water currents and tidal movements.

Plastics — Determination of the aerobic biodegradation of plastic materials exposed to seawater —

Part 2: Method by measuring the oxygen demand in closed respirometer

1 Scope

This document specifies a laboratory test method for determining the degree and rate of the aerobic biodegradation level of plastic materials. Biodegradation of plastic materials is determined by measuring the oxygen demand in a closed respirometer when exposed to seawater sampled from coastal areas under laboratory conditions.

The conditions described in this document might not always correspond to the optimum conditions for the maximum degree of biodegradation, however this test method is designed to give an indication of the potential biodegradability of plastic materials.

NOTE This document addresses plastic materials but can also be used for other materials.

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 5667-3, *Water quality — Sampling — Part 3: Preservation and handling of water samples*

ISO 8245, *Water quality — Guidelines for the determination of total organic carbon (TOC) and dissolved organic carbon (DOC)*

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

ISO 10523, *Water quality — Determination of pH*

ISO 11261, *Soil quality — Determination of total nitrogen — Modified Kjeldahl method*

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

pelagic zone

water body above the seafloor

Note 1 to entry: It is also referred to as the open water or the water column.