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Plastics — Marine biodegradation testing — Preparation of optimized intertidal seawater and sediment

Plastiques — Essais de biodégradation en milieu marin — Préparation d'eau de mer et de sédiments intertidaux optimisés

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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 61, *Plastics*, Subcommittee SC 14, *Environmental aspects*.

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

The assessment of the degree of biodegradation of plastics in marine habitats is one effective measure to understand and evaluate the impact of reuse, recycling and environmental pollution of plastics. The biodegradation of plastics is the process, in which plastics are decomposed by heterotrophic microorganisms, such as bacteria and fungi, through enzymatic hydrolysis and subsequent metabolization. Marine biodegradation proceeds mainly in microbial consortia that form at the interface between seawater and plastics. This is because marine microorganisms live aerobically within biofilms at the interface between the liquid phase of seawater and solid phases such as gravel and shells.

The diversity of microbial consortia in the marine environment is high, depending on their natural environmental conditions. The species and number of microorganisms vary depending on the climate, ocean currents, tides, and topography. Considering the diverse habitats of these microorganisms, three types of biodegradation assessment methods have been developed:

— one-phase systems consisting of seawater or sediment and

— two-phase systems consisting of seawater and seafloor sediments.

However, due to the diversity of microorganisms even a biodegradable material such as cellulose, which is used as a reference material, gave biodegradation results that ranged from 0 to 100 percent in ring tests of these test methods. From the perspective of biodegradable plastic specification, it is thus necessary to optimize the preparation of natural inoculum for the biodegradation tests to avoid those fluctuations in experimental outcomes.

In order to reduce the impact of seasonal and regional variation in the marine inoculum composition, this document describes a method for preparing seawater and seafloor sediments. The prepared seawater and sediment can be used for the test methods defined in ISO 19679, ISO 18830, ISO 22404, ISO 23977-1, ISO 23977-2 and ISO 23832.

Prepared seawater for biodegradation tests is obtained by rinsing seafloor sediments with seawater. Sand and gravel mixtures with particle sizes from 250 µm to 2 mm are used as sediments to provide pore water flow, oxygen supply, seawater filtration and biofilm growth. Through the preparation of defined compositions of seawater and sediments in marine tests, the number of microorganisms and aerobic conditions are stabilized, and reproducibility and comparability of biodegradation experiments (including curves, lag time, etc.) are improved.

This document specifies methods for preparing seawater and sediments in the intertidal zone for estimating the aerobic biodegradation of plastics in pelagic to coastal marine environments.

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Plastics — Marine biodegradation testing — Preparation of optimized intertidal seawater and sediment

1 Scope

This document specifies procedures for preparing seawater and sediments used in test methods to assess the biodegradation of plastic materials in the marine environment. The screened sediment and sediment-rinsed seawater are prepared to sustain aerobic testing at laboratory scale. The described method is designed to separate sediment-rinsed seawater and sand-gravel sediments from intertidal sediments by wet filtration and seawater flotation. This document does not include steps to enhance the biodegradation of plastic materials by concentrating the natural seawater, adding nutrients to the seawater, and pre-culturing the inoculum.

The methods described in this document are intended to be used in addition to issued ISO standard test methods for evaluating the biodegradation and disintegration of plastic materials. The applicable evaluation test methods are ISO 18830, ISO 19679, ISO 22404, ISO 23977-1, ISO 23977-2 and ISO 23832.

NOTE The conditions described in this document do not always correspond to the optimum conditions for maximum biodegradation. This is a method of preparing test sediments from coastal seafloor sediments, not a method of preparing sediments from deep-sea seafloors.

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 18830, *Plastics — Determination of aerobic biodegradation of non-floating plastic materials in a seawater/sandy sediment interface — Method by measuring the oxygen demand in closed respirometer*

ISO 19679, *Plastics — Determination of aerobic biodegradation of non-floating plastic materials in a seawater/sediment interface — Method by analysis of evolved carbon dioxide*

ISO 22404, *Plastics — Determination of the aerobic biodegradation of non-floating materials exposed to marine sediment — Method by analysis of evolved carbon dioxide*

ISO 23977-1, *Plastics — Determination of the aerobic biodegradation of plastic materials exposed to seawater — Part 1: Method by analysis of evolved carbon dioxide*

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

ISO 23832, *Plastics — Test methods for determination of degradation rate and disintegration degree of plastic materials exposed to marine environmental matrices under laboratory conditions*

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 https://www.electropedia.org/

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