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# Plastics — Determination of the degree of disintegration of plastic materials under defined composting conditions in a pilot-scale test

*Plastiques — Détermination du degré de désintégration des matériaux plastiques dans des conditions de compostage définies lors d'un essai à échelle pilote*



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



This third edition cancels and replaces the second edition (ISO 16929:2013), which has been technically revised.

The main changes compared to the previous edition are as follows:

— in 6.1.1, the minimum amount of biowaste has been changed to 30 kg from 60 kg due to the decreasing size of composting bins;

— in 6.2.2.3 and Clause 8, the temperature profile has been changed to new conditions adopted to small bins.

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

The biological treatment of biodegradable plastic materials includes aerobic composting in well-operated, municipal or industrial biological waste treatment facilities. Determining the degree of disintegration of plastic materials in a pilot-scale plant is an important step within a test scheme to evaluate the compostability of such materials.

# Plastics — Determination of the degree of disintegration of plastic materials under defined composting conditions in a pilot-scale test

**WARNING — Compost can contain potentially pathogenic organisms. Therefore, appropriate precautions should be taken when handling it.**

## 1 Scope

This document is used to determine the degree of disintegration of plastic materials in a pilot-scale aerobic composting test under defined conditions. It forms part of an overall scheme for the evaluation of the compostability of plastics as outlined in ISO 17088.

The test method laid down in this document is also used to determine the influence of the test material on the composting process and the quality of the compost obtained. It cannot be used to determine the aerobic biodegradability of a test material. Other methods are available for this (for example, see ISO 14851, ISO 14852 or ISO 14855-1 and ISO 14855-2).

## 2 Normative references



There are no normative references in this document.

## 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**
**degradation**
irreversible process leading to a significant change in the structure of a material, typically characterized by a loss of properties (e.g. integrity, molecular mass or structure, mechanical strength) and/or by fragmentation, affected by environmental conditions, proceeding over a period of time and comprising one or more steps

**3.2**
**biodegradation**
*degradation* (3.1) caused by biological activity especially by enzymatic action leading to a significant change in the chemical structure of a material

**3.3**
**disintegration**
physical breakdown of a material into very small fragments

**3.4**
**compost**
organic soil conditioner obtained by *biodegradation* (3.3) of a mixture principally consisting of various vegetable residues, occasionally with other organic material, and having a limited mineral content

**3.5**
**composting**
aerobic process designed to produce *compost* (3.4)

**3.6**
**compostability**
property of a material to be biodegraded in a *composting* (3.5) process

Note 1 to entry: To claim compostability, it shall have been demonstrated that a material can be biodegraded and disintegrated in a composting system (as can be shown by standard test methods) and completes its *biodegradation* (3.3) during the end-use of the compost. The compost shall meet the relevant quality criteria. Quality criteria include low content of regulated metals, no ecotoxicity, no obviously distinguishable residues.

**3.7**
**maturity of compost**
assignment of the maturity of a *compost* (3.4) based on the measurement of the maximum temperature in a self-heating test using Dewar vessels

Note 1 to entry: It is expressed in terms of the so-called "Rottegrad" (see 6.2.3.1).

**3.8**
**total dry solids**
amount of solids obtained by taking a known volume of test material or *compost* (3.4) and drying at about 105 °C to constant mass

**3.9**
**volatile solids**
amount of solids obtained by subtracting the residues of a known volume of test material or *compost* (3.4) after incineration at about 550 °C from the *total dry solids* (3.8) content of the same sample



Note 1 to entry: The volatile solids content is an indication of the amount of organic matter present.



## 4 Principle

The disintegration test is performed under defined and standardized composting conditions on a pilot-scale level.

The test material is mixed with fresh biowaste in a precise concentration and introduced into a defined composting environment. A natural ubiquitous microbial population starts the composting process spontaneously and the temperature increases. The composting mass is regularly turned over and mixed. Temperature, pH-value, moisture content and gas composition are regularly monitored. They should fulfil certain requirements to ensure sufficient and appropriate microbial activity. The composting process is continued until a fully stabilized compost is obtained. This is usually the case after 12 weeks.

The compost is visually observed at regular time intervals to detect any adverse effect of the test material on the composting process. At the end of the test, the maturity of compost is determined, and the mixture of compost and test material is sieved through 2 mm and 10 mm mesh sieves. The disintegration of the test material is evaluated based on the total dry solids by comparing the fraction of test material retained by the 2 mm sieve and the amount tested. The compost obtained at the end of the composting process may be used for further measurements, such as chemical analyses and ecotoxicity tests.

# 5 Apparatus

## 5.1 Composting environment.

### 5.1.1 General

The composting environment may be either a pilot-scale composting bin or nets buried in a pilot-scale composting bin. The volume of each bin shall be high enough for natural self-heating to occur. Sufficient and even aeration shall be provided by an appropriate air supply system.

NOTE To standardize conditions for the test, the composting trials can be run in bins which are placed in a climatic chamber with a constant chamber temperature or in insulated bins.

If during the spontaneous thermophilic phase the compost reaches temperatures higher than 65 °C, the diversity of microbial species can be reduced. To restore a full array of thermophilic bacteria, the compost can be re-inoculated with mature compost (about 1 % of the total initial biowaste mass) of recent origin (maximum 3 months old).

### 5.1.2 Composting bins

#### 5.1.2.1 Volume and material

The bins shall:

— have a minimum volume of 35 l;

— consist of a sturdy, heat-resistant and non-biodegradable material;

— not affect the composting process or the quality of the compost.



#### 5.1.2.2 Drainage

The drainage shall consist of a layer of drains with a thickness of at least 5 cm at the bottom of the bins.

**5.1.3 Sample nets**, if used, shall consist of mesh-like material with a mesh size of 1 mm made of non-degradable plastic which is resistant to temperatures up to 120 °C. The minimum volume shall be 20 l.

## 5.2 Apparatus for temperature measurement.

## 5.3 pH-meter.

## 5.4 Apparatus for oxygen measurement.

**5.5 Sieves,** of suitable shape with screens of 2 mm and 10 mm mesh (as specified, for instance, in ISO 3310-2).