BS EN ISO 14855-1:2012

BSI Standards Publication

Determination of the ultimate aerobic biodegradability of plastic materials under controlled composting conditions — Method by analysis of evolved carbon dioxide

Part 1: General method (ISO 14855-1:2012)

bsi.

...making excellence a habit.™

Document Sharing Hub

Full document details: BS EN ISO 14855-1:2012

National foreword

This British Standard is the UK implementation of EN ISO 14855-1:2012. It supersedes BS EN ISO 14855-1:2007 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PRI/21, Testing of plastics.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2012. Published by BSI Standards Limited 2012

ISBN 978 0 580 74001 5

ICS 13.030.99; 83.080.01

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 December 2012.

Amendments issued since publication

Date	Text affected

Documents
Document Sharing Hub

Full document details: BS EN ISO 14855-1:2012

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 14855-1

December 2012

ICS 83.080.01

Supersedes EN ISO 14855-1:2007

English Version

Determination of the ultimate aerobic biodegradability of plastic materials under controlled composting conditions - Method by analysis of evolved carbon dioxide - Part 1: General method (ISO 14855-1:2012)

Évaluation de la biodégradabilité aérobie ultime des matériaux plastiques dans des conditions contrôlées de compostage - Méthode par analyse du dioxyde de carbone libéré - Partie 1: Méthode générale (ISO 14855-1:2012)

Bestimmung der vollständigen aeroben Bioabbaubarkeit von Kunststoff-Materialien unter den Bedingungen kontrollierter Kompostierung - Verfahren mittels Analyse des freigesetzten Kohlenstoffdioxides - Teil 1: Allgemeines Verfahren (ISO 14855-1:2012)

This European Standard was approved by CEN on 13 November 2012.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: Avenue Marnix 17, B-1000 Brussels

© 2012 CEN All rights of exploitation in any form and by any means reserved worldwide for CEN national Members.

Ref. No. EN ISO 14855-1:2012: E

Documents
Document Sharing Hub

Full document details: BS EN ISO 14855-1:2012

Foreword

This document (EN ISO 14855-1:2012) has been prepared by Technical Committee ISO/TC 61 "Plastics" in collaboration with Technical Committee CEN/TC 249 “Plastics” the secretariat of which is held by NBN.

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 June 2013, and conflicting national standards shall be withdrawn at the latest by June 2013.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN ISO 14855-1:2007.

According to the CEN/CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Endorsement notice

The text of ISO 14855-1:2012 has been approved by CEN as a EN ISO 14855-1:2012 without any modification.

Documents
Document Sharing Hub

Full document details: BS EN ISO 14855-1:2012

Contents

Page

Foreword ... iv

Introduction ... v

1 Scope ... 1

2 Normative references ... 1

3 Terms and definitions ... 1

4 Principle ... 2

5 Test environment ... 3

6 Reagents ... 3
6.1 TLC (thin-layer chromatography) grade cellulose ... 3
6.2 Vermiculite ... 3

7 Apparatus ... 4

8 Procedure ... 5
8.1 Preparation of the inoculum ... 5
8.2 Preparation of test material and reference material ... 5
8.3 Start-up of the test ... 6
8.4 Incubation period ... 6
8.5 Termination of the test ... 7
8.6 Use of vermiculite ... 7
8.7 Recovery procedure and carbon balance when using vermiculite ... 8

9 Calculation and expression of results ... 9
9.1 Calculation of the theoretical amount of carbon dioxide ... 9
9.2 Calculation of the percentage biodegradation ... 9
9.3 Calculation of loss in mass ... 9
9.4 Expression of results ... 9

10 Validity of results ... 10

11 Test report ... 10

Annex A (informative) **Principle of test system** ... 11

Annex B (informative) **Examples of graphical representation of carbon dioxide evolution and biodegradation curves** ... 12

Annex C (informative) **Example of mass loss determination** ... 14

Annex D (informative) **Round-robin testing** ... 16

Annex E (informative) **Examples of forms** ... 17

Bibliography ... 20

© ISO 2012 – All rights reserved

Documents
Document Sharing Hub

Full document details: BS EN ISO 14855-1:2012

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 14855-1 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 5, *Physical-chemical properties*.

This second edition of ISO 14855-1 cancels and replaces the first edition (ISO 14855-1:2005), of which it constitutes a minor revision intended principally to clarify the wording of the fourth paragraph in Subclause 8.1. In addition, the footnote to 6.2 concerning a possible supplier of “concrete” type vermiculite has been deleted as it appeared to be no longer valid.

This second edition also cancels and replaces the Technical Corrigendum ISO 14855-1:2005/Cor.1:2009.

ISO 14855 consists of the following parts, under the general title *Determination of the ultimate aerobic biodegradability of plastic materials under controlled composting conditions — Method by analysis of evolved carbon dioxide*:

— *Part 1: General method*

— *Part 2: Gravimetric measurement of carbon dioxide evolved in a laboratory-scale test*

© ISO 2012 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS EN ISO 14855-1:2012

Introduction

The main method specified in this part of ISO 14855 uses a solid-phase respirometric test system based on mature compost used as a solid bed, a source of nutrients, and an inoculum rich in thermophilic microorganisms. Mature compost is a very heterogeneous and complex material. Therefore, it can be difficult to quantify the residual polymeric material left in the bed at the end of the test, to detect possible low-molecular-mass molecules released into the solid bed by the polymeric material during degradation, and to assess the biomass. As a result, it can be difficult to perform a complete carbon balance. Another difficulty which is sometimes encountered with mature compost is a “priming effect”: the organic matter present in large amounts in the mature compost can undergo polymer-induced degradation, known as the “priming effect”, which affects the measurement of the biodegradability.

To overcome these difficulties and to improve the reliability of the method, the mature compost can be replaced by a solid mineral medium which is used as the composting bed, thus facilitating analyses. This variant can be used to measure the biodegradation in terms of CO_2 evolution, to quantify and analyse the biomass and the residues of polymeric material left in the solid bed at the end of the test, and to perform a complete carbon balance. Furthermore, the method is not significantly affected by the priming effect and can, therefore, be used to assess materials known to cause this problem with mature compost. The mineral bed can also be subjected to an ecotoxicological analysis to verify the absence of any ecotoxic activity in the bed after biodegradation.

© ISO 2012 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS EN ISO 14855-1:2012

Documents
Document Sharing Hub

INTERNATIONAL STANDARD ISO 14855-1:2012(E)

Determination of the ultimate aerobic biodegradability of plastic materials under controlled composting conditions — Method by analysis of evolved carbon dioxide —

Part 1: General method

WARNING — Sewage, activated sludge, soil and compost may contain potentially pathogenic organisms. Therefore appropriate precautions should be taken when handling them. Toxic test compounds and those whose properties are unknown should be handled with care.

1 Scope

This part of ISO 14855 specifies a method for the determination of the ultimate aerobic biodegradability of plastics, based on organic compounds, under controlled composting conditions by measurement of the amount of carbon dioxide evolved and the degree of disintegration of the plastic at the end of the test. This method is designed to simulate typical aerobic composting conditions for the organic fraction of solid mixed municipal waste. The test material is exposed to an inoculum which is derived from compost. The composting takes place in an environment wherein temperature, aeration and humidity are closely monitored and controlled. The test method is designed to yield the percentage conversion of the carbon in the test material to evolved carbon dioxide as well as the rate of conversion.

Subclauses 8.6 and 8.7 specify a variant of the method, using a mineral bed (vermiculite) inoculated with thermophilic microorganisms obtained from compost with a specific activation phase, instead of mature compost. This variant is designed to yield the percentage of carbon in the test substance converted to carbon dioxide and the rate of conversion.

The conditions described in this part of ISO 14855 may not always correspond to the optimum conditions for the maximum degree of biodegradation to occur.

2 Normative references

The following referenced documents are indispensable for the application 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 5663, *Water quality — Determination of Kjeldahl nitrogen — Method after mineralization with selenium*

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
ultimate aerobic biodegradation
breakdown of an organic compound by microorganisms in the presence of oxygen into carbon dioxide, water and mineral salts of any other elements present (mineralization) plus new biomass

© ISO 2012 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS EN ISO 14855-1:2012

3.2
composting
aerobic process designed to produce compost

NOTE Compost is an organic soil conditioner obtained by biodegradation of a mixture consisting principally of vegetable residues, occasionally with other organic material, and having a limited mineral content.

3.3
disintegration
physical breakdown of a material into very small fragments

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

3.5
volatile solids
amount of solids obtained by subtracting the residue of a known volume of test material or compost after incineration at about 550 °C from the total dry solids of the same sample

NOTE The volatile-solids content is an indication of the amount of organic matter present.

3.6
theoretical amount of evolved carbon dioxide
$ThCO_2$
maximum theoretical amount of carbon dioxide evolved after completely oxidizing a chemical compound, calculated from the molecular formula and expressed as milligrams of carbon dioxide evolved per milligram or gram of test compound

3.7
lag phase
time, measured in days, from the start of a test until adaptation and/or selection of the degrading microorganisms is achieved and the degree of biodegradation of a chemical compound or organic matter has increased to about 10 % of the maximum level of biodegradation

3.8
maximum level of biodegradation
degree of biodegradation, measured in per cent, of a chemical compound or organic matter in a test, above which no further biodegradation takes place during the test

3.9
biodegradation phase
time, measured in days, from the end of the lag phase of a test until about 90 % of the maximum level of biodegradation has been reached

3.10
plateau phase
time, measured in days, from the end of the biodegradation phase until the end of a test

3.11
activated vermiculite
vermiculite colonized by an active microbial population during a preliminary growth phase

4 Principle

The test method determines the ultimate biodegradability and degree of disintegration of test material under conditions simulating an intensive aerobic composting process. The inoculum used consists of stabilized, mature compost derived, if possible, from composting the organic fraction of solid municipal waste.

© ISO 2012 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS EN ISO 14855-1:2012