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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

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 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 16929 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 5, *Physical-chemical properties*.

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 may contain potentially pathogenic organisms. Therefore appropriate precautions should be taken when handling it.

1 Scope

This International Standard 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, *Plastics — Evaluation of compostability — Test scheme for final acceptance* (currently under preparation). The test method laid down in this International Standard can also be 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 (see e.g. ISO 14851, ISO 14852 or ISO 14855).

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 3310-2, *Test sieves — Technical requirements and testing — Part 2: Test sieves of perforated metal plate*

ISO 5663, *Water quality — Determination of Kjeldahl nitrogen — Method after mineralization with selenium*

ISO 7150-1, *Water quality — Determination of ammonium — Part 1: Manual spectrometric method*

ISO 10304-2, *Water quality — Determination of dissolved anions by liquid chromatography of ions — Part 2: Determination of bromide, chloride, nitrate, nitrite, orthophosphate and sulfate in waste water*

ISO 10390, *Soil quality — Determination of pH*

ISO 11465, *Soil quality — Determination of dry matter and water content on a mass basis — Gravimetric method*

ISO 14851, *Determination of the ultimate aerobic biodegradability of plastic materials in an aqueous medium — Method by measuring the oxygen demand in a closed respirometer*

ISO 14852, *Determination of the ultimate aerobic biodegradability of plastic materials in an aqueous medium — Method by analysis of evolved carbon dioxide*

ISO 14855, *Determination of the ultimate aerobic biodegradability and disintegration of plastic materials under controlled composting conditions — Method by analysis of evolved carbon dioxide*

3 Terms and definitions

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

3.1
biological treatability
the potential of a material to be aerobically composted or anaerobically biogasified

3.2
degradation
an 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

3.3
biodegradation
degradation caused by biological activity especially by enzymatic action leading to a significant change in the chemical structure of a material

3.4
disintegration
the physical breakdown of a material into very small fragments

3.5
compost
organic soil conditioner obtained by biodegradation of a mixture principally consisting of various vegetable residues, occasionally with other organic material, and having a limited mineral content

3.6
composting
an aerobic process designed to produce compost

3.7
compostability
property of a material to be biodegraded in a composting process

NOTE To claim compostability, it must 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 during the end-use of the compost. The compost must meet the relevant quality criteria. Quality criteria are e.g. low heavy-metal content, no ecotoxicity, no obviously distinguishable residues.

3.8
maturity of compost
assignment of the maturity of a compost based on the measurement of the maximum temperature in a self-heating test using Dewar vessels

NOTE It is expressed in terms of the so-called “Rottegrad” (see 6.2.3.1).

3.9
total dry solids
the amount of solids obtained by taking a known volume of test material or compost and drying at about 105 °C to constant mass

3.10
volatile solids
the amount of solids obtained by subtracting the residues of a known volume of test material or compost after incineration at about 550 °C from the total dry solids content of the same sample

NOTE 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 will start the composting process spontaneously and the temperature will increase. The composting mass is regularly turned over and mixed. Temperature, pH-value, moisture content and gas composition are regularly monitored. They have to 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 the 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 on the basis of 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 can 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 1 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.

NOTE 2 If during the spontaneous thermophilic phase the compost reaches temperatures higher than 65 °C, the diversity of microbial species may be reduced. To restore a full array of thermophilic bacteria, it is recommended that the compost 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 140 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

The 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