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Plastics — Determination of the degree of disintegration of plastic materials under simulated composting conditions in a laboratory-scale test

Plastiques — Évaluation du degré de désintégration de matériaux plastiques dans des conditions de compostage simulées lors d'un essai de laboratoire

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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 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 20200 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 5, *Physical-chemical properties*.

Introduction

The test method described in this International Standard determines the degree of disintegration of plastic materials when exposed to a composting environment. The method is simple and inexpensive, does not require special bioreactors and is scaled for use in any general-purpose laboratory. It requires the use of a standard and homogeneous synthetic solid waste. The synthetic waste components are dry, clean, safe products which can be stored in the laboratory without any odour or health problems. The synthetic waste is of constant composition and devoid of any undesired plastic material which could be erroneously identified as test material at the end of testing, altering the final evaluation. The bioreactors are small, as is the amount of synthetic waste to be composted (approximately 3 l). With the limited amount of test material, this method provides a simplified test procedure. This test method is not aimed at determining the biodegradability of plastic materials under composting conditions. Further testing will be necessary before being able to claim compostability.

Plastics — Determination of the degree of disintegration of plastic materials under simulated composting conditions in a laboratory-scale test

1 Scope

This International Standard specifies a method of determining the degree of disintegration of plastic materials when exposed to a laboratory-scale composting environment. The method is not applicable to the determination of the biodegradability of plastic materials under composting conditions. Further testing is necessary to be able to claim compostability.

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 3310-1:2000, *Test sieves — Technical requirements and testing — Part 1: Test sieves of metal wire cloth*

3 Terms and definitions

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

3.1
compost
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

3.2
compostability
ability 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.

3.3
composting
aerobic process designed to produce compost

3.4
disintegration
physical breakdown of a material into very small fragments

3.5
dry mass
mass of a sample measured after drying

NOTE Dry mass is expressed as a percentage of the mass of the wet sample.

3.6
mesophilic incubation period
incubation at 25 °C to allow the development of microorganisms growing at room temperature

3.7
thermophilic incubation period
incubation at 58 °C to allow the development of microorganisms growing at high temperature

3.8
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

3.9
volatile solids
amount of solids obtained by subtracting the residue obtained from 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 method determines the degree of disintegration of test materials on a laboratory scale under conditions simulating an intensive aerobic composting process. The solid matrix used consists of a synthetic solid waste inoculated with mature compost taken from a commercial composting plant. Pieces of the plastic test material are composted with this prepared solid matrix. The degree of disintegration is determined after a composting cycle, by sieving the final matrix through a 2 mm sieve in order to recover the non-disintegrated residues. The reduction in mass of the test sample is considered as disintegrated material and used to calculate the degree of disintegration.

5 Synthetic solid waste

The composition of the synthetic waste used in this method is described in Table 1.

Well aerated compost from a commercial aerobic composting plant shall be used as the inoculum. The compost inoculum shall be homogeneous and free from large inert objects such as glass, stones or pieces of metal. Remove any such objects manually and then sieve the compost on a screen of mesh aperture between 0,5 cm and 1 cm. It is recommended that compost from a plant composting the organic fraction of solid municipal waste be used in order to ensure sufficient diversity of microorganisms. If such a compost is not available, then compost from plants treating farmyard waste or mixtures of garden waste and solid municipal waste may be used. The compost shall not be older than 4 months.

Prepare the synthetic waste manually by mixing the different components listed in Table 1. The allowed tolerance on the mass measurements of the synthetic waste components, water included, is 5 %. Add chlorine-free tap water, or de-ionized or distilled water, to the mixture to adjust its final water content to 55 % in total. Perform this operation just before start-up. The synthetic waste shall have a carbon:nitrogen (C/N) ratio of between 20:1 and 40:1. The urea concentration can be changed to adjust the C/N ratio to the required range. In this case, the concentration of the other components shall be adjusted proportionately in order to bring the total dry mass of the solid waste to 100 %.

Table 1 — Composition of synthetic solid waste

Material	Dry mass %
Sawdust	40
Rabbit-feed	30
Ripe compost	10
Corn starch	10
Saccharose	5
Cornseed oil	4
Urea	1
Total	100

NOTE 1 Sawdust from untreated wood shall be used. It is preferable to use wood from deciduous trees. Sawdust shall be sieved through a 5 mm sieve before use.

NOTE 2 The rabbit-feed shall be a commercial product based on alfalfa (lucerne) (*Medicago sativa*) and vegetable meal. If a product with a different composition is used, the composition shall be given in the test report. The protein content of the rabbit-feed shall be approximately 15 % and the cellulose content approximately 20 %.

6 Composting reactor

The preferred composting reactor is a box made of polypropylene or other suitable material, having the following dimensions: 30 cm × 20 cm × 10 cm (l, w, h). The box shall be covered with a lid assuring a tight seal to avoid excessive evaporation. Additionally, any gap between box and lid may be sealed with adhesive tape. In the middle of the two 20 cm wide sides, a hole of 5 mm diameter shall be made approximately 6,5 cm from the bottom of the box. These two holes provide gas exchange between the inner atmosphere and the outside environment and shall not be blocked.

Other containers with a volume between 5 l and 20 l may also be used, provided that it can be verified that no unfavourable anaerobic conditions are generated. The container shall be closed in a way which avoids excessive drying-out of the contents. Again, openings shall be provided in order to allow gas exchange and ensure aerobic conditions throughout the composting phase.

7 Procedure

7.1 Test material preparation

Cut up test material to give pieces with the dimensions defined in Table 2, based on the thickness of the material.

Dry the pieces of test material in an oven at (40 ± 2) °C under vacuum for the length of time needed to reach constant mass. Prior to mixing the pieces of test material with the synthetic waste, immerse them in distilled water for no more than 30 s.