BRITISH STANDARD

BS EN 14806:2005

Packaging — Preliminary evaluation of the disintegration of packaging materials under simulated composting conditions in a laboratory scale test

The European Standard EN 14806:2005 has the status of a British Standard

ICS 55.040; 13.030.99

British Standards

National foreword

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EUROPÄISCHE NORM

EN 14806

July 2005

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English Version

Packaging - Preliminary evaluation of the disintegration of packaging materials under simulated composting conditions in a laboratory scale test

Emballage - Evaluation préliminaire de la désintégration des matériaux d'emballage dans des conditions simulées de compostage dans le cadre d'un essai à l'échelle du laboratoire

Verpackung - Vorbeurteilung des Auflösens von Verpackungsmaterial unter simulierten Kompostierungsbedingungen im Labormaßstab

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Contents

Foreword

This European Standard (EN 14806:2005) has been prepared by Technical Committee CEN/TC 261 "Packaging", the secretariat of which is held by AFNOR.

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of an identical text or by endorsement, at the latest by January 2006, and conflicting national standards shall be withdrawn at the latest by January 2006.

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Introduction

The method does not require special bioreactors and it is well suited to be run at laboratory scale in any general purpose laboratory. It requires the use of a standard, homogeneous synthetic waste. The synthetic waste components are dry, clean, safe products which can be stored in the laboratory without any problem neither of smell nor of health. The synthetic waste is of constant composition and devoid of any undesired packaging material, which could be erroneously identified as test material at the end of testing, altering the final evaluation. The bioreactors are small, the amount of synthetic waste to be composted is also very small (about 3 L) and, likewise, the amount of test material's specimens is very limited, with an overall simplification of the test procedures. The test method is not aimed at determining the biodegradability of packaging materials under composting conditions and does not cover environmental safety and ecotoxicity issues. Further testing is necessary for claiming compostability.

1 Scope

This laboratory scale test method using synthetic waste aims at simulating the environmental conditions found in industrial composting plants. Packaging materials exposed to this environment can be preliminary assessed for disintegrability. A negative result does not necessarily mean that the test material is not disintegrating under industrial composting conditions. This test does not replace the acceptance disintegration test as specified in EN 14045, in accordance with EN 13432.

2 Normative references

The following referenced documents are indispensable for the application of this European Standard. 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, *Test sieves — Technical requirements and testing — Part 1: Test sieves of metal wire cloth*.

EN 13193:2000, *Packaging — Packaging and the environment — Terminology*.

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 13193:2000 and the following 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
potential of a material to be biodegraded in a composting process

3.3
composting
aerobic process designed to produce compost

3.4
disintegration
physical falling apart of a material into very small fragments

3.5
dry mass
mass of a sample measured after drying. It is expressed as a percentage of the mass of the wet sample

3.6
total dry solids
amount of solids obtained by taking a known amount of test material or compost and drying at about 105 °C to constant weight.

3.7
volatile solids
amount of solids obtained by subtracting the residue of a known amount of test material or compost after incineration at about (550 ± 10) °C from the total dry solids content of the same sample

NOTE The volatile-solids content is representative for the amount of organic matter present.

4 Principle

The test method evaluates the degree of disintegration of test materials at laboratory scale under conditions similar to an intensive aerobic composting process. The solid matrix used consists of a synthetic solid waste inoculated with compost derived from a composting plant. Specimens of the test material are co-composted with the synthetic solid waste. 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 not disintegrated residues of test material. The missing mass of the test material is considered as disintegrated and used to calculate the degree of disintegration.

5 Synthetic solid waste

A synthetic waste, whose composition is described in Table 1, is needed in order to perform the test.

Table 1 — Composition of synthetic solid waste

Material	dry mass %
Sawdust	40
rabbit-feed	30
compost	10
starch	10
saccharose	4
cornseed oil	4
urea	2
Total	100

Sawdust of untreated wood shall be used. The sawdust shall be sieved with a 5 mm sieve before application.

NOTE Wood from deciduous trees should preferably be used.

The rabbit-feed shall be a commercial product based on alfalfa (Medicago sativa) and vegetable-meals. If a product with a different composition is used, it shall be mentioned in the test report. The protein content of the rabbit-feed shall be of about 15 % and the cellulose content of about 20 %.

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

Synthetic waste is manually prepared by mixing the different components listed in Table 1. The allowed tolerance on the mass measurements of the synthetic waste components, water included, is of 5 %. Water is then added to the mixture to adjust its final water content to about 55 % by weight in total. This operation should be performed before start-up. The synthetic waste shall have a carbon:nitrogen (C/N) ratio preferably comprised between 20-30. The urea concentration can be changed to adjust the C/N value to the prefixed range. In this case the concentration of the other components shall be proportionally adjusted in order to bring the total sum to 100.

6 Composting reactor

The composting reactor is a box made with a suitable inert material which does not affect the composting process, having preferably the following dimensions: 30 cm × 20 cm × 10 cm (l, w, h). In the series the container chosen shall not vary more than 5 % in dimensions. The box shall be provided with a lid assuring a tight closing to avoid an excessive evaporation. Additionally the closing between box and lid may be sealed with an adhesive tape. In the middle of the two 20 cm wide sides, a hole of 5 mm in diameter shall be applied at a height of about 6,5 cm from the bottom. The two holes provide gas exchange between the inner atmosphere and the outside environment.

NOTE Attention should be paid not to cover the holes with the adhesive tape, or in any other way.

Other containers with a volume between 5 L and 20 L may also be used, provided that it is preliminary verified that unfavourable anaerobic conditions are not produced. The container should be closed in a way to avoid excessive drying out of the content. At the same time openings shall be provided in order to enable gas exchange and ensure aerobic conditions throughout the composting phase.

7 Procedure

7.1 Sample preparation

The test material shall be cut in order to get specimens with the fixed dimensions defined in Table 2, based on the test material's thickness.

The mass of the specimens is determined in material dried to constant mass. The drying technique used at this stage shall also be used at the end of the test for assessing the final mass of specimens (see 10.2).

Table 2 — Dimension of the specimens to be used in the disintegration test

Thickness of the test material mm	Dimension of specimens mm
≤ 5	25 × 25 × original thickness
> 5	15 × 15 × thickness ≤ 15

7.2 Start-up of the test

At least two reactors are prepared for each test material. The specimen of the test materials are mixed with 1 Kg of wet synthetic waste. The mass of the specimens shall comprise between 5 g and 20 g per reactor, according to the volume occupied by the specimens. The ratio between the specimen mass and the wet synthetic waste mass shall be, therefore, in the range 0,5 % – 2 %. The mass of the specimens effectively added to each reactor is recorded. The mixture is spread on the bottom of the reactor forming a homogeneous layer. The mixture should not be pressed, to support the gas exchange also with the inner parts of the bed.

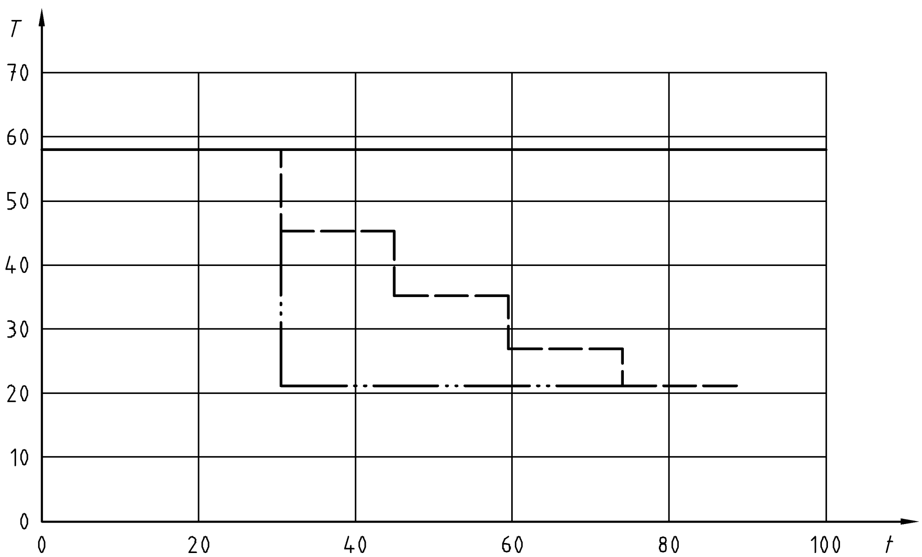
NOTE It could be useful to run in parallel a blank reactor, with no test material, as a means of controlling the evolution of the composting reaction.

7.3 Temperature profile

Each reactor is closed, weighed, and placed into an oven with air circulation maintained at a constant temperature of (58 ± 2) °C. Optionally, after 30 days the temperature can be lowered. The range of temperature allowed is between room temperature (21 °C) and 58 °C. The maximum test duration is 90 days. The diagram in Figure 1 shows possible temperature profiles, as an example. After 28 days 25 g of fertile soil or compost may be added to each reactor as a re-inoculation. After soil addition, the content is gently mixed. The nature of soil or compost shall be indicated in the final report.

NOTE It is known that a higher microbial activity towards ligno-cellulose is reached at temperatures between (35 - 40) °C. Therefore, when testing ligno-cellulosic materials it is suggested to shift the test temperature to these values after the first month until the end of the test.

The temperature of the air-circulation oven shall be recorded for the whole test period. Alternatively, a thermometer with the indication of the maximum and minimum temperature can be used. Temperature shall be controlled periodically. The test may be interrupted after 45 days.



Key

T Temperature °C

t Time (days)

Profile A

Profile B

Profile C

Figure 1

The test temperature is 58°C (profile A). Optionally, after 1 month, temperature may be decreased to lower values, in the range between 21 °C -58 °C. Profile B shows the sharpest temperature decrease allowed and profile C is an example of a temperature profile varying stepwise within the allowed range.

7.4 Moisture control

In order to perform a proper composting process, the moisture shall be controlled periodically. The optimal amount of water is obtained when the matter under composting is wet but it is not present as free water, i.e. it has not reached the saturation of the water absorbing capability.

NOTE The operator can control this condition by squeezing the composting matter, which should exude a small amount of water.

7.5 Mixing

The composting matter shall be mixed periodically. Aeration and mixing is not only important to distribute water after addition (see 7.4) but also to aerate the composting matter.

A procedure to aerate the composting matter and maintain sufficient water content is suggested in Table 3. The gross mass of the reactor filled with the mixture is determined in the beginning of the composting process. Periodically the reactor is weighed and, if needed, the initial mass restored, totally or in part, adding water according to the directions of Table 3.

8 Monitoring the composting process

8.1 Odour

During the composting process it is possible to detect a precise succession of specific odours. Within the first two-three days the synthetic waste has an acidic smell, which gradually declines to shift into an ammonia smell, starting from day 5 – day 10 and lasting about 10 days. Then, no particular odours or an earth-like one is detected. Record in the test report any possible variation from this scheme.

8.2 pH

A sequence can be also easily followed by checking the pH of the composting matter by using pH universal indicator papers. Strips of pH indicator are moistened with some compost. The pH shall shift from initial acidic values (about 6) to basic ones (about 8 to 9) during the first 10 days - 15 days to become neutral-basic (about 7 to 8) at the end of the test. Record in the test report any possible variation from this scheme.

8.3 Visual inspection

The visual appearance of the composting matter changes during the first two weeks. Mycelia growing on the composting matter can be visible during the first week. The colour of the synthetic waste which is initially light -yellow- because of the high sawdust concentration, turns into brown within 10 days. Record in the test report any possible variation from this scheme.

Table 3 — Example of composting procedure

Day of treatment	Treatment	
0	start of the test	
1,2,3,4,7,9, 11,14	Control of mass and addition of water to restore 100 % of the initial mass	turning of the composting mass
8,10,16,18, 21,23,25,28	Control of mass and addition of water to restore 100 % of the initial mass	
30	Control of mass and addition of water to restore 80 % of the initial mass	turning of the composting mass
from 30 until 45, twice a week	Control of mass and addition of water to restore 80 % of the initial mass	
45	Control of mass and addition of water to restore 80 % of the initial mass	turning of the composting mass
from 45 until 60, twice a week	Control of mass and addition of water to restore 80 % of the initial mass	
from 60 onwards, twice a week	Control of mass and addition of water to restore 70 % of the initial mass	

9 Chemical analysis

9.1 Determination of dry mass and volatile substances

Determine dry mass and volatile substances on samples of the synthetic waste used in the beginning and on samples of compost obtained at the end of the process of composting, after sieving (see Clause 10). The dry mass (DM) of the sample is determined by drying in an oven at 105 °C until constant mass. The dry mass is expressed as a percentage of the total mass of the sample. In order to determine the volatile substances, the sample, previously desiccated in the oven at 105 °C for the determination of the dry mass, is calcinated at 550 °C for 6 h - 8 h. The mass is determined and the procedures of calcination and weighing are repeated until constant mass. The mass loss for calcination corresponds to the volatile substances of the sample. The volatile substances (VS) are expressed as percentage of the DM of the sample.

9.2 Determination of C/N ratio and pH

If the composting process does not occur properly (the odour remains acidic; the colour fails to become brown; the pH fails to increase to basic values; see Clause 8) it is suggested to determine the C/N ratio and pH of samples of synthetic waste and samples of the compost obtained in the end of the composting process, after sieving, using standard test methods. If the pH is still acid and the C/N ratio has not decreased the composting process has probably not started. For validity of the test see Clause 12.

NOTE For the purpose of this test, the total carbon value applied to determine the C/N ratio can be estimated by the volatile solids value divided by a factor 2.

10 Termination of the test

10.1 Sieving

The compost of each reactor is sieved through a 2 mm sieve and the packaging residues present in the > 2 mm fraction collected. Standard sieves (see ISO 3310-1) shall be used. The particles or pieces present in the > 2mm fraction which do not differ from the sieved compost (e.g. colour, structure, dimensions, moisture feeling, brightness/gloss) are considered to be compost.

NOTE In order to facilitate the sieving, the following procedure is suggested. First of all a 5 mm sieve is used. The fraction not passing through the sieve is collected and examined. Clumps of compost are gently broken up paying attention not to damage possible residues trapped inside; the particles are allowed to pass through the screen into the fraction with dimensions lower than 5 mm. Possible test material residues present in the fraction higher than 5 mm are collected and stored. The compost is then screened subsequently with a 2 mm standard sieve, repeating the procedures done with the 5 mm sieve. The different fractions (> 5 mm, > 2 mm) are finally pooled.

10.2 Cleaning, drying, weighing

The residues of the packaging material collected in the total > 2 mm fraction are cleaned from the compost and, if appropriate, washed by dipping in water and finally dried in an oven to constant mass, using the same drying conditions applied to the original material at the beginning of the test (see 7.1). The final mass is recorded.

NOTE The cleaning and washing procedures of the residues are to be performed with great care in order to avoid any accidental loss of test materials.

11 Calculation of degree of disintegration

The packaging material recovered in the total fraction above 2 mm (see Clause 10) is considered the not disintegrated fraction. The material passed through the sieves is considered disintegrated. The degree of disintegration (D) is therefore:

$$D(\%) = \frac{Mi - Mr}{Mi} \times 100$$

where

Mi is the initial dry mass of the test material;

Mr is the mass of the dry residues recovered by sieving.

The degree of disintegration is calculated for each reactor.

12 Validity of the test

The test is considered valid if in each reactor, the percentage of reduction (R) of the total volatile substances between the initial synthetic waste and the compost obtained at the end of the test is equal or higher than 30 %.

NOTE At least 30 % weight reduction is a good indicator that a normal composting process has taken place.

For the calculation of R the following formula is used:

$$R = \frac{(M_{SW} \times DM_{SW} \times VS_{SW}) - (M_C \times DM_C \times VS_C)}{(M_{SW} \times DM_{SW} \times VS_{SW})} \times 100 \geq 30\ \%$$

where

M_{SW} is the initial mass of the wet synthetic waste introduced in the reactor;

DM_{SW} is the initial percentage of dry mass of the wet synthetic waste;

VS_{SW} is the initial percentage of volatile solids of the synthetic waste;

M_c is the final mass of the wet compost;

DM_C is the final percentage of dry mass of compost,

VS_C is the final percentage of volatile solids of compost.

13 Test report

The test report shall include:

— reference to the present European Standard;

— testing institute, address, name of the person responsible for the test and signature;

— temperature profile chosen according to 7.3;

— any information to identify properly and characterise sufficiently the test materials with a description of their physical form, thickness or mass per surface unit, and dimensions;

— description of the synthetic waste i.e.: the components used to prepare the synthetic waste and their amount; the ratio C/N of the synthetic waste; dry mass (expressed as percentage of wet mass of the waste sample) and volatile substances (expressed as a percentage of dry mass of the sample); pH;

— any information on the compost inoculum such as source, age, date of collection, storage, handling, stabilization, total dry solids, volatile solids, pH value of a suspension;

— description of the equipment: bioreactor and its dimensions; the standard sieves;

— table showing, for each reactor, the following information: the number of the reactor; the sample number; the amount of synthetic waste introduced; total amount of mixture (synthetic waste plus test material); initial mass of the reactor (gross mass);

— table showing, for each reactor: the number of the reactor; the percentage of reduction of the total volatile substances (R, according to what is indicated in Clause 12);

— table showing the operations of water addition and turning performed for each reactor (day, operation performed and observations, mass of the reactor, water added);

— table showing, for each reactor, the initial amount of test material, the amount of residues recovered at test termination and the degree of disintegration (D, according to what is indicated in Clause 11);

— degree of disintegration. The degree of disintegration considered for the purposes of the present European Standard is the average of the degrees of disintegration obtained in the two replicates.

Annex A
(informative)

Synthetic Waste Composition

Component	Trade name or type	Amount (g)
Sawdust		
Rabbit-feed		
Compost[a]		
Starch		
Saccharose		
Cornseed oil		
Urea		
Water added		
[a] Indicate origin, date of sampling, and age at the moment of sampling		

Dry weight (%)	
C/N	
Volatile solids (%)	
pH	

The amount of each component actually used to prepare the synthetic waste and other information as requested shall be indicated.

Annex B
(informative)

Test Set-up

THE REACTOR IS MADE OF:____________________________

ITS LID IS MADE OF:________________________________

REACTOR'S DIMENSIONS:_______________________________

Reactor No.	Synthetic Waste (g)	TEST MATERIAL		Initial gross mass (synthetic waste + test material + reactor) (g)
		Name	Amount (g)	

The actual amount of synthetic waste introduced in each reactor along with the actual amount of test material shall be indicated here. The weight of reactor plus the mixture at the start shall also be reported. This value is needed for water control.

Annex C
(informative)

Final Compost Characterisation after Sieving

REACTOR No	Reduction of total volatile substances (R)

Annex D
(informative)

Water Addition and Turning of Composting Mass

Reac. No.	Date	Elapsed time (d)	Reactor mass (g)		water added (g)	Turning (yes/no)	Notes
			Initial	Measured			

Annex E
(informative)

Degree of Disintegration

SIEVE____________________________

	Mi	Mr	D
REACTOR No.	Initial Amount (g)	Residues (g)	100(Mi-Mr)/Mi

Report initial amount of test material and amount of residues recovered by sieving. Make calculation of disintegration as indicated. Report also information on the sieve.

Bibliography

[1] Maurizio Tosin, Francesco Degli Innocenti, Catia Bastioli (1996) Effect of the Composting Substrate on Biodegradation of Solid Materials under Controlled Composting Conditions. J. of Environ. Polymer Degr. 4:55-63.

[2] EN 13432, *Packaging — Requirements for packaging recoverable through composting and biodegradation — Test scheme and evaluation criteria for the final acceptance of packaging*.

[3] EN 14045, *Packaging — Evaluation of the disintegration of packaging materials in practical oriented tests under defined composting conditions*.

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