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Geosynthetics — Screening test method for determining the resistance of geotextiles and geotextile-related products to oxidation

Géosynthétiques — Méthode de détermination de la résistance des géotextiles et produits apparentés à l'oxydation

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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.

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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 221, *Geosynthetics*.

This second edition cancels and replaces the first edition (ISO 13438:2004), which has been technically revised. The main changes compared to the previous edition are as follows:

— procedural guidance regarding the use of exposure ovens has been added;

— procedural guidance regarding the use of autoclaves has been added.

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

In many civil engineering applications, geotextiles and geotextile-related products can come into contact with water or aqueous solutions present in the soil environment. At the same time, in specific parts of the construction, they can be exposed to oxygen, giving rise to oxidative degradation processes. These processes are usually very slow.

Polyolefin materials, such as polypropylene (PP) and polyethylene (PE), are inherently more sensitive to oxidation than those based on polyethylene terephthalate (PET). Other polymers, such as poly(vinyl alcohol) (PVAL according to ISO 1043-1), are also sensitive to oxidation in specific conditions (aqueous media with oxidizing agent). This behaviour can be improved very effectively by the use of appropriate stabilizing additives.

It is the purpose of this document to provide a method for screening the resistance to oxidation of geotextiles and geotextile-related products in service for 25, 50 and 100 years. In order to achieve the sufficiently short exposure times needed for screening tests, the oxidative degradation process is accelerated. This acceleration can be achieved either by raising the temperature or by increasing the concentration of the active reaction partner. Raising the temperature can lead to the oxidation rate being limited by oxygen diffusion, thus invalidating the acceleration. This applies particularly to materials with a low surface-to-volume ratio and less to nonwovens made from fine fibres. Two methods are therefore proposed.

Method A (which was Method B in the previous edition) uses temperature alone as the accelerating factor and is used for PE, PP, PA and AR.

Method B operates at moderately high temperatures and, at the same time, the oxygen concentration is increased by using pure oxygen at high pressure. Method B is used for PVAL.

Geosynthetics — Screening test method for determining the resistance of geotextiles and geotextile-related products to oxidation

1 Scope

This document specifies a screening test method for determining the resistance of geotextiles and geotextile-related products to oxidation. The test is applicable to products as follows:

— **Method A** for material consisting solely in polypropylene (PP), polyethylene (PE), polyamide (PA), aramide (AR);

— **Method B** for material consisting solely in polyvinyl alcohol (PVAL).

The data are suitable for screening purposes but not for deriving performance data such as lifetime, unless supported by further evidence.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 3696, *Water for analytical laboratory use — Specification and test methods*

EN 12226, *Geotextiles and geotextile-related products — General tests for evaluation following durability testing*

3 Terms and definitions

No terms and definitions are listed in this document.

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/

4 Method A

4.1 Principle

Test specimens are stored in water (Grade 3 or better according to ISO 3696) at 80 °C for 28 days before being exposed to an elevated temperature in air over a fixed time period, using a regulated laboratory oven as described in 4.3. Oven ageing shall be carried out at a temperature of (100 ± 1) °C.

NOTE In the previous edition, the only difference between Methods A and B was the temperature (100 °C and 110 °C). With this revision, this difference was deleted.

The test specimens shall hang freely in the oven space.

After the fixed time period of oven ageing, the exposed test specimens are submitted to a tensile test. The tensile strength and the strain at maximum load are measured for both the control specimens and

the exposed specimens. The tensile test shall be carried out in accordance with EN 12226. Both the machine and cross direction shall be tested, unless otherwise agreed (e.g. if the machine and cross machine direction use the same size, raw material, stabilizers). For nonwovens, only one direction has to be tested. There shall be at least five test specimens and five control specimens in each relevant direction, unless further specimens are required to assure statistical significance. More information on specimens is given in 4.2.

4.2 Specimens

Products shall be manufactured at least 24 h prior to testing.

Only specimens from the same raw material/recipe shall be stored in water for 28 days and later on in an oven at one time.

The specimens to be tested shall be in accordance with EN 12226.

It is recommended to expose additional specimens in case an extra mechanical test is required.

4.3 Apparatus for oven testing

For the tests, a thermostatically regulated oven with an internal volume of sufficient size, capable of exposing test specimens to a temperature of (100 ± 1) °C, shall be used.

The oven shall be provided with a ventilation opening which shall be adjusted such that the set temperature can be maintained in that part of the oven in which the specimens are to be suspended and the flow of air through the oven is not less than three and not more than ten air changes per hour.

A higher air flow than ten per hour is a positive deviation of the test method and is accepted. This shall be noted in the test report.

The specimens shall be suspended from glass or other chemically inert fixtures in the centre of the oven, spaced and not touching, the distance from each wall being at least 100 mm.

The temperature around the specimens shall be recorded, for instance, with the aid of suitable calibrated thermocouples and a data logger.

4.4 Test procedure

4.4.1 Leaching

4.4.1.1 General

The control specimens shall be exposed for 6 h in water (Grade 3 or better according to ISO 3696) at (80 ± 1) °C and then 6 h in an oven at (100 ± 1) °C. After exposure, they should be stored in a dark room at room temperature.

The test specimens shall be stored in water (Grade 3 or better according ISO 3696) at (80 ± 1) °C for 28 days.

4.4.1.2 Water temperature

Set the water temperature to (80 ± 1) °C.

4.4.1.3 Specimens subjected to leaching

Attach the specimens to the fixtures. Once the temperature has reached a steady value, place the specimens in the water. Suspend the specimens in the centre of the water bath, spaced, not touching each other and not touching the vessel wall.

4.4.1.4 Test conditions

Test specimens shall be exposed for 28 days at (80 ± 1) °C. The water has to be changed at least every 7 days and moved at least once per day.

4.4.2 Exposure in air

4.4.2.1 General

Test specimens shall be exposed in a temperature of (100 ± 1) °C in an oven.

4.4.2.2 Oven temperature

Set the oven temperature at (100 ± 1) °C.

4.4.2.3 Specimens subjected to heat ageing

Attach the specimens to the fixtures. Once the temperature has reached a steady value, place the specimens in the oven. Suspend the specimens in the centre of the oven, spaced, not touching each other, and so that the distance from each wall is at least 100 mm.

4.4.2.4 Duration of the oven test

Test specimens shall be exposed for the duration shown in Table 1.

This table shows the test duration for a service life in natural soil with 4 ≤ pH ≤ 9 and a soil temperature ≤25 °C.

Table 1 — Temperatures and durations

Method	Material	Application of material	Service life	First: Temperature and duration in water	Second: Temperature and duration in the oven
A	**Polypropylene (PP), Polyethylene (PE), Polyamide (PA) and aramid (AR)**	non-reinforcing and reinforcing	25 years	80 °C for 28 days	100 °C for 28 days
			50 years	80 °C for 28 days	100 °C for 56 days
			100 years	80 °C for 28 days	100 °C for 112 days

Practical experience has shown that the following considerations are important in order to achieve good reproducibility:

a) the specimens should be placed in the middle of the oven;

b) draught near the oven should be avoided if a reproducible fresh air change is to be maintained;

c) the oven and the fixtures should be cleaned of any remaining residues before each new test;

d) thermo-oxidative degradation of polymer material (e.g. polypropylene) can release substances which have a catalytic effect; therefore, polymers containing different stabilizers should not be tested at the same time in the same oven, with the exception of geotextile composites.