INTERNATIONAL STANDARD

ISO 13438

First edition
2004-11-01

Geotextiles and geotextile-related products — Screening test method for determining the resistance to oxidation

Géotextiles et produits apparentés — Méthode de détermination de la résistance à l'oxydation

Reference number
ISO 13438:2004(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

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 13438 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 189, *Geosynthetics* in collaboration with Technical Committee ISO/TC 221, *Geosynthetics*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Introduction

In many civil engineering applications geotextiles and geotextile-related products may come into contact with water or aqueous solutions present in the soil environment. At the same time, in specific parts of the construction, they may 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). This behaviour can be improved very effectively by the use of appropriate stabilizing additives.

It is the purpose of this international standard to provide a method for screening the resistance to oxidation of geotextiles and geotextile-related products in service up to 25 years. In order to achieve the sufficiently short exposure times needed for screening tests, it is necessary to accelerate the oxidative degradation process. This acceleration can be achieved either by raising the temperature or by increasing the concentration of the active reaction partner. Raising the temperature may 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.

Methods A1, A2, B1 and B2 use temperature alone as the accelerating factor.

Methods C1 and C2 operate at moderately high temperatures and at the same time the oxygen concentration is increased by using pure oxygen at high pressure.

Each test may be performed at a shorter duration for non-reinforcing materials (A1, B1, C1) or for a longer duration for reinforcing materials (A2, B2, C2).

NOTE This International Standard should be used with reference to ISO/TR 13434. For further information see Annex A.

Geotextiles and geotextile-related products — Screening test method for determining the resistance to oxidation

1 Scope

This International Standard specifies a screening test method for determining the resistance of geotextiles and geotextile-related products to oxidation. The test is applicable to polypropylene- and polyethylene-based products.

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 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 188:1998, *Rubber, vulcanized or thermoplastic — Accelerated ageing and heat resistance tests*

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 Methods A1, A2, B1 and B2

3.1 Principle

Test specimens are exposed to an elevated temperature in air over a fixed time period, using a regulated laboratory oven without forced air circulation.

Oven ageing on polypropylene shall be carried out at a temperature of (110 ± 1) °C (Methods A1 and A2).

Oven ageing of polyethylene shall be carried out at a temperature of (100 ± 1) °C (Methods B1 and B2).

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. For woven fabrics both the machine and cross direction shall be tested, unless otherwise agreed.

3.2 Specimens

Products shall have been manufactured at least 24 h prior to testing. The number of specimens shall be five test specimens and five control specimens, unless further specimens are required to assure statistical significance.

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

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

3.3 Apparatus

For the tests, a thermostatically regulated oven without forced air circulation, in accordance with 3.2.2 of ISO 188:1998, is required, with an internal volume of sufficient size, capable of exposing test specimens to a temperature of (110 ± 1) °C or (100 ± 1) °C.

The oven without forced air circulation 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.

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.

3.4 Conditioning

Conditioning of the specimens before exposure in the laboratory oven is not required. Because of the possible occurrence of shrinkage during the oven test, the control specimens shall be exposed for 6 h, to the same conditions as in the oven test.

3.5 Test procedure

3.5.1 Oven temperature

Set the oven temperature at (110 ± 1) °C or (100 ± 1) °C in accordance with the chosen method (A1, A2, B1 or B2).

3.5.2 Specimens

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.

3.5.3 Duration of the oven test

Geotextile specimens for reinforcing applications, or for other applications where long-term strength is a significant parameter, shall be exposed to the durations shown in Table 1.

Table 1 — Temperatures and durations

Method	Material	Application of material	Temperature	Duration
A1	polypropylene	non-reinforcing	110 ºC	14 days
A2	polypropylene	reinforcing	110 ºC	28 days
B1	polyethylene	non-reinforcing	100 ºC	28 days
B2	polyethylene	reinforcing	100 ºC	56 days

The control specimens shall be exposed to the same oven temperature for (6 ± 1) h and then removed and stored.

NOTE Practical experience has shown that, to achieve good reproducibility, the following should be taken into account:

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

b) draughts near the oven should be avoided if a reproducible natural air circulation 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) may 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.

4 Methods C1 and C2

4.1 Principle

Test specimens are exposed for a specified time to an aqueous test liquid enriched with oxygen at a pressure of 5 000 kPa and at a temperature of 80 °C. Method C1 specifies a duration of 14 days and Method C2 (intended for reinforcing applications or those where tensile strength is a relevant parameter) specifies 28 days.

The properties of the specimens are tested after this exposure in accordance with EN 12226. The tensile strength and the strain at maximum load are measured for both the control and the exposed specimens.

4.2 Apparatus and reagents

4.2.1 Apparatus

4.2.1.1 A pressured vessel (autoclave), large enough for the test liquid (see 4.3.1) that shall cover the specimens completely during the test. The free space above the liquid should be at least 20 % of the liquid volume. The material of the vessel and equipment shall be resistant to the test liquid under the conditions used, e.g., high-grade stainless steels.

4.2.1.2 A pressure transducer, to measure the oxygen pressure above the test liquid, with a precision of ± 50 kPa.

4.2.1.3 A temperature sensor, to measure the temperature, with a precision of ± 0,5 °C.

4.2.1.4 Specimen holders, to ensure correct placing of specimens (see 4.3.2).

4.2.1.5 Stirring device, to maintain the homogeneity of solvent, solutes and temperature, and to allow exchange of matter between specimens and solvent.