

Guide to

**Methods for assessing the
durability of geotextiles —
An interim document**

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Committees responsible for this Published Document

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Foreword

This Published Document has been prepared under the direction of the Textiles and Clothing Standards Policy Committee, by technical committee TCM/35, to meet an immediate need for guidance on the durability requirements of geotextiles. It is based on a draft prepared in 1990, which has since been updated to reflect ongoing discussion within the European Committee for Standardization (CEN), technical committee CEN/TC189, Geotextiles and geotextile-related products. Technical Committee TCM/35 wishes to acknowledge the personal contributions of D.I.Cook, J.H.Greenwood and J.E.Uprichard.

Once a draft European Standard (EN) is published, it should be used in preference to any method described in this document.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Introduction

Many civil engineers who specify geotextiles are concerned about the long-term durability of the products. While the evidence from samples extracted after years in service shows in general that geotextile products are extremely durable and that such concerns are unjustified, under certain conditions, e.g. tropical environments, angular limestones, polyesters in highly alkaline soils, the materials do degrade and the engineer requires guidance on both the testing and the interpretation of results. Much experimental work is in progress worldwide, the results of which will be submitted to national and international standards committees. This interim document is intended to provide some guidance to the design engineer both on test methods and on their interpretation, until a more definitive version can be written.

Polymers consist of long chains of, principally, carbon atoms, with various branches and side groups. Under certain conditions, this structure can be attacked: by oxidation promoted thermally, catalytically or by ultraviolet light; by other forms of chemical attack including hydrolysis; by the combined effect of chemicals and mechanical load; by micro-organisms.

Most polymers used in geotextiles contain additives and stabilizers, which greatly improve the resistance of the basic polymer; however, these additives themselves can be susceptible to leaching or to biological attack, ultimately leaving the polymer unprotected. In addition, the textile structure can be damaged by stones during compaction or by subsequent abrasion.

The principal result of this degradation is loss of mechanical strength and elongation. Other changes may include the formation of holes, which will negate the function of geotextiles used as filters and separators, dimensional changes and loss of visual quality. The design engineer has to know, therefore, firstly the function of his geotextile, and deduce what, for him, implies failure. Various methods are used to detect degradation, but the relative significance of the results depends upon the application and what the consequences of failure are.

Secondly, the design engineer has to know his environment, in order to identify the relative likelihood of different degradation mechanisms. Some guidance is given in this document concerning, for example, chemical environments known to be harmful, the problem of hydrolysis of polyesters and the difference between geotextiles that will see weathering for a few months on site and those exposed at the surface during the entire surface lifetime. It will be necessary to know the nature of the soil, in particular the particle size distribution and particle angularity, the pH, and the presence of calcium and transition metal ions.

Redox potential and the parameters used with regard to metals corrosion are of less significance. The design engineer will also need to know the temperature.

Temperature may affect the durability and performance of geotextiles in the following respects.

- a) An increase in temperature serves to accelerate chemical and ultraviolet degradation, while the effect of micro-organisms is on average a maximum at 28 °C. In the UK, the mean ground temperature is approximately 10 °C, with a range of about 0 °C to 20 °C at depth and about -10 °C to 40 °C near exposed surfaces in soil structures. In other climates, wider ranges may be expected. Where testing over a range of temperatures is required, -5, 10, 20, 40 and 50 °C are recommended for chemical tests. This aspect is taken into consideration in relevant sections of this document.
- b) Physical properties, in particular creep, are sensitive to temperature. The recommendations on testing over a range of temperatures given in a) apply. Temperatures within this range do not directly affect durability and this aspect is not considered further.
- c) Geotextiles may be subjected to higher temperatures, in particular if in contact with asphalt (170 °C) or waste materials liable to spontaneous combustion. These temperatures may approach the melting point or otherwise affect the stability of the polymers used in geotextiles. There is a need for a test to examine the effect of such temperatures in permanently changing geotextile properties. Such a test does not appear to be presently available.

Finally, the design engineer needs to know the service lifetime required of his structure. Most of the tests listed are accelerated, and the relation between the behaviour under accelerated and natural service conditions is frequently an estimate, if it is known at all. In addition, where results are extrapolated or accelerated tests are used, the engineer and the person carrying out the testing need to watch for any evidence of change in the mechanism of degradation, for, if the mechanisms change, the acceleration is invalid unless proved otherwise.

1 Scope

This document describes tests for the principal forms of degradation. The long-term effect of mechanical load on its own, i.e. creep and creep-rupture, is excluded and the reader is referred to BS 6906 : Part 5. In each case, an index and a performance test are defined. The index test is intended as a short, tightly defined, hopefully cheap test that can be applied to all types of

geotextiles for screening, ranking and classification. In order to achieve this end, the method may differ considerably from real service conditions. In many cases, however, it will be necessary to carry out further tests more closely related to service conditions using, for example, soil extracted directly from site. Such 'performance' tests are only described in outline and may be more complex and expensive.

NOTE. Many of the test methods described are currently under discussion in both European and International Standards Committees. It is anticipated that the tests, once agreed, will be used for interlaboratory trials and for comparison with service conditions. As a result of these trials, modifications to the tests are expected, together with improved guidelines for interpretation. As in other fields of engineering, confidence in the durability of geotextiles can only be expected to develop gradually as the technology matures and the results of long-term service experience accumulate.

2 References

2.1 Normative references

This document incorporates, by reference, provisions from specific editions of other publications. These normative references are cited at the appropriate points in the text and the publications are listed on page 15. Subsequent amendments to, or revisions of, any of these publications apply to this document only when incorporated in it by updating or revision.

2.2 Informative references

This document refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this document are listed on page 16, but reference should be made to the latest editions.

3 Evaluation tests

3.1 General

The test methods listed are recommended for the assessment of the effect of exposure on a geotextile, and are common to the various chemical, physical and biological agencies described. For the majority of durability tests, it is not practicable to use large specimens. The test methods recommended are therefore based upon those used in the textile industry, rather than the geotextile tests of the BS 6906 series.

The properties have been chosen as being most likely to show up the presence of degradation, but are not the only properties that may be affected. Compressive creep, transmissivity and permeability are examples of other properties that may change.

NOTE. A European Standard (EN) for evaluation tests is in preparation.

3.2 Sampling

Samples should be taken from the geotextile fabric as described in ISO 9862 : 1990.

If possible, the control samples and the samples to be treated should be juxtaposed on the fabric roll, e.g. if woven, the control and 'treated' samples should have common ends or picks.

The control samples should be stored in the dark at $20\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and 65 % r.h. $\pm 2\text{ }^{\circ}\text{C}$ and tested at the same time as the treated samples.

3.3 Visual examination

The exposed sample should be examined visually for holes or other signs of deterioration. The percentage area of holes should be evaluated.

3.4 Tensile strength and elongation at break

Determine the tensile strength and elongation using the method described in BS 2576 : 1986 (5 cm strip test; five specimens in both directions; similar to ISO 5081). Calculate the percentage changes after exposure to the agency.

While for nonwoven material this method will not give an accurate measure of tensile strength, it is felt that for durability testing the ratio of exposed to control material will be significant.

Geogrids should be tested in accordance with BS 6906 : Part 1 : 1987, if the width of the three ribs specified therein exceeds 50 mm, on one rib alone.

Certain variations to this procedure are indicated as follows.

- a) For biological testing where little degradation is anticipated, testing of 10 specimens instead of five is recommended to improve the statistical significance.
- b) In the case of UV light, continue testing until the reduction in strength exceeds 50 %.
- c) For oxidation, test embrittlement by hand.

3.5 Length/width

After treatment by the agency, or after specified intermediate intervals, determine the dimensions of the exposed and unexposed samples, in accordance with the methods given in BS 1930 : 1990 (width) and BS 1931 : 1968 (length).

Record the mean length and width in millimetres, and the percentage change after exposure to the agency.

3.6 Mass per unit area

Determine the mass of the samples in accordance with BS 2471 : 1978, except that the whole sample is weighed instead of cutting a standard size specimen. Depending on the agency concerned, rinsing with deionized water, cleaning and drying to constant mass may be necessary.