BRITISH STANDARD

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Test method for glass-fibre reinforced cement

Part 8: Cyclic weathering type test

ICS 91.100.40

National foreword

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The UK participation in its preparation was entrusted to Technical Committee B/524, Precast concrete products.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Prüfverfahren für Glasfaserbeton - Teil 8: Prüfung der Dauerhaftigkeit im Klimazyklus- Test

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Foreword

This document (EN 1170-8:2008) has been prepared by Technical Committee CEN/TC 229 “Precast concrete products”, 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of an identical text or by endorsement, at the latest by April 2009, and conflicting national standards shall be withdrawn at the latest by April 2009.

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From the previous edition, modifications deal with the status of the standard and the scope.

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Introduction

This European Standard prescribes a cyclic wetting and drying test for glass-fibre reinforced concrete.

This test incorporates the main ageing parameters to which a glass-fibre reinforced concrete will be subjected under natural exposure conditions: humidity, drying, temperature.

However, it should be noted that at the end of 50 cycles (humidity/drying /temperature), there is some change of properties for normal GRC formulations. The results correspond to natural weathering during 10 to 20 years.

1 Scope

This European Standard specifies a test method for identifying, for a given GRC formulation (constituents and their proportions in the formulation), the effect of environmental factors such as water and temperature on the change of mechanical characteristics. For other conditions of exposure, e.g. where freezing, thawing and action of thawing salt occurs, the test will be adapted.

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.

EN 1170-5, *Precast concrete products — Test method for glass-fibre reinforced cement — Part 5: Measuring bending strength, "Complete bending test" method*

3 Symbols and abbreviations

3.1 Symbols

L estimate of the loss of resistance: $L = \frac{a_p}{c_p}$;

where

a_p = "after ageing" performance; and

c_p = “control” performance;

L_C lower limit of the one-sided 95 % confidence interval of the mean of the analysed parameter after ageing;

L_R lower limit of the one-sided 95 % confidence interval of the mean of the reference sample analysed parameter;

M_C mean of the individual values of σ_{LOP}, ε_{LOP}, σ_{MOR} and ε_{MOR} obtained from the sample evaluated after 50 ageing cycles;

M_R mean of the individual values of ε_{LOP}, σ_{MOR} and ε_{MOR} obtained from the reference sample;

S_C standard deviation of the individual values of ε_{LOP}, σ_{MOR} and ε_{MOR} obtained from the sample evaluated after 50 ageing cycles;

S_R standard deviation of the individual values of ε_{LOP}, σ_{MOR} and ε_{MOR} obtained from the reference sample;

ε_{LOP} deformation at the limit of proportionality;

ε_{MOR} deformation at the limit of rupture;

σ_{LOP} stress at the limit of proportionality, in MPa;

σ_{MOR} stress at the limit (Modulus) of rupture, in MPa.

3.2 Abbreviation

GRC Glass-fibre reinforced concrete.

4 Apparatus

All the equipment is located in a laboratory maintained at a temperature (20 ± 3) °C and a relative humidity of (60 ± 5) %.

4.1 Automatic or manually operated climatic chamber where:

a) ambient temperatures of (70 ± 5) °C and (20 ± 2) °C can be attained and maintained;

b) at least eight test pieces can be stored immersed in water, kept at (20 ± 2) °C;

c) a ventilation system capable of providing an air flow of (1 ± 0,1) m/s or of renewing air (30 ± 3) times per hour;

4.2 Equipment necessary to carry out the complete bending test as described in EN 1170-5.

5 Procedure

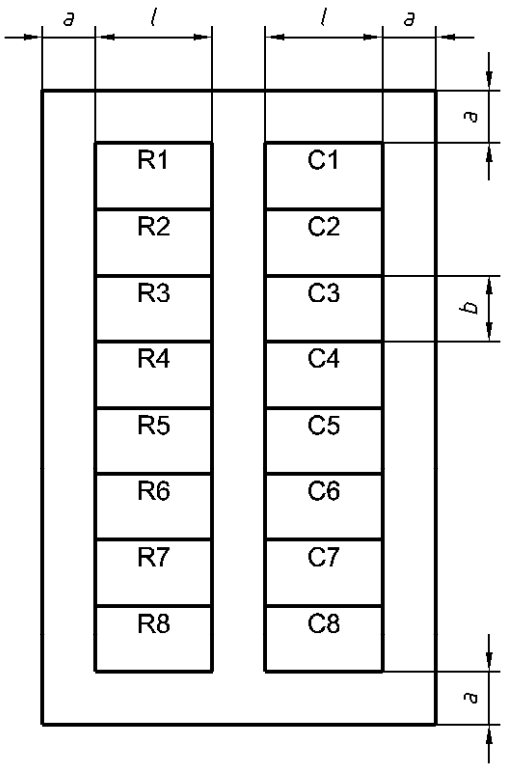
5.1 Samples

A total of (2 × 8) test pieces are taken as shown in Figure 1:

— eight test pieces comprising the reference sample "R";

— eight test pieces comprising the sample "C" subjected to the ageing cycles.

NOTE See EN 1170-5 for taking the test pieces and determining their length (l).



Key

a ≥ 50 mm

b = (50 ± 2) mm

l see EN 1170-5

Figure 1 — Position and identification of the test pieces

5.2 Test method

5.2.1 Description

This is the complete bending test as specified in EN 1170-5. The odd numbered test pieces (C1, R1, C3, R3, …) are placed with their mould face supported on the bottom rollers and the even numbered test pieces (C2, R2, C4, R4,…) with their mould face in contact with the top rollers.

5.2.2 Storage

5.2.2.1 "R" sample

The complete bending test of the test pieces of the "R" sample is carried out at (28 ± 0,5) days after storage as specified in EN 1170-5.

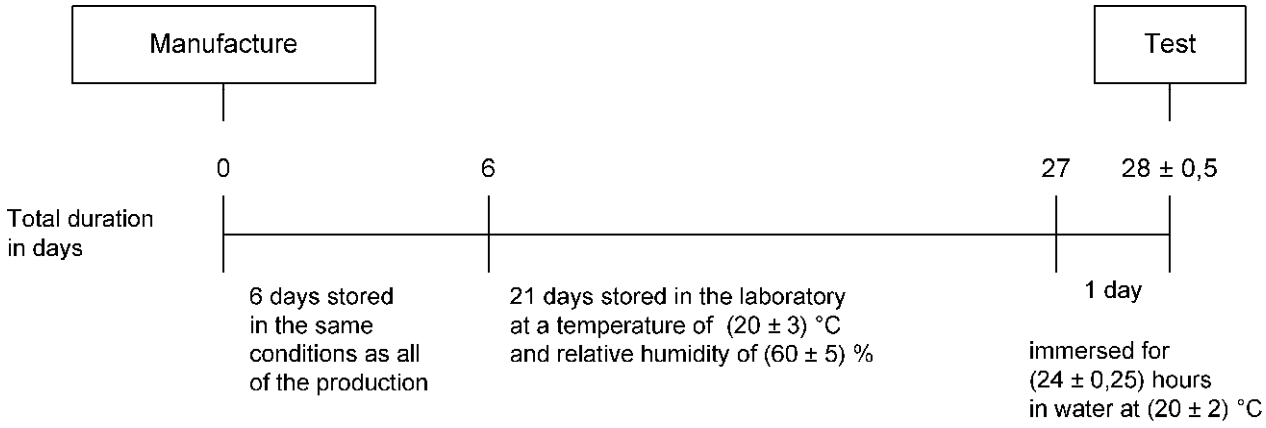


Figure 2 — Schematic diagram showing the storage phases of the "R" sample

5.2.2.2 "C" sample

The bending test on the test pieces of the "C" sample is carried out at (128 ± 1) days after storage for the first 27 days in accordance with EN 1170-5, then subjected to 50 ageing cycles of (48 ± 0,5) hours and finally immersed for (24 ± 0,25) h in water at (20 ± 2) °C (see Figure 3).

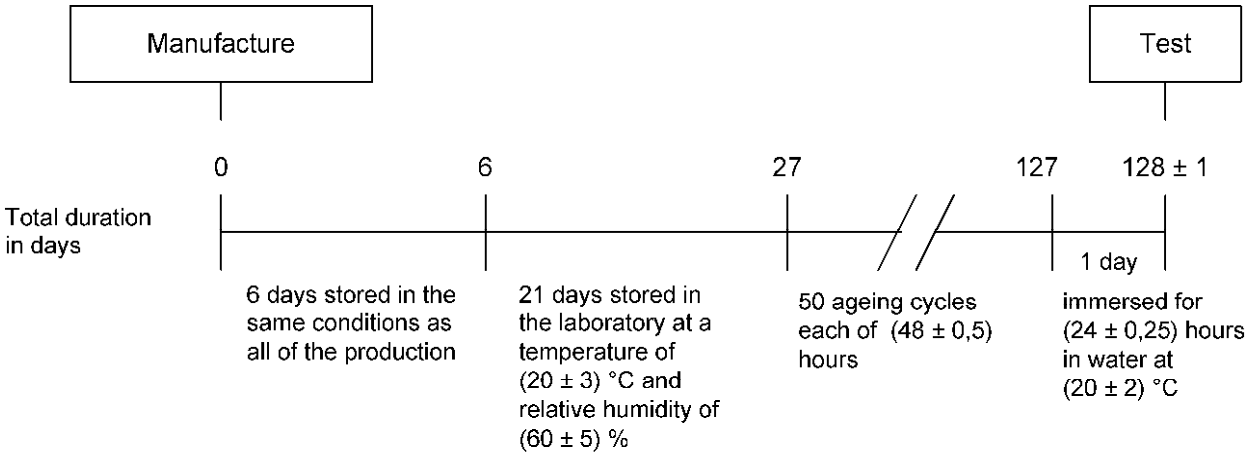


Figure 3 — Schematic diagram of the storage phases of the "C" sample

Each ageing cycle comprises the following four successive phases:

— first phase: immersion for (24 ± 0,25) h in water at (20 ± 2) °C;

— second phase: (30 ± 5) min of forced drying at a temperature of (70 ± 5) °C in an air flow of (1 ± 0,1) m/s or with the air being renewed (30 ± 3) times per hour;

— third phase: (23 ± 0,25) h in hot air at (70 ± 5) °C;

— fourth phase: (30 ± 5) min of forced cooling at a temperature of (20 ± 2) °C in an air flow of (1 ± 0,1) m/s or with the air being renewed (30 ± 3) times per hour.

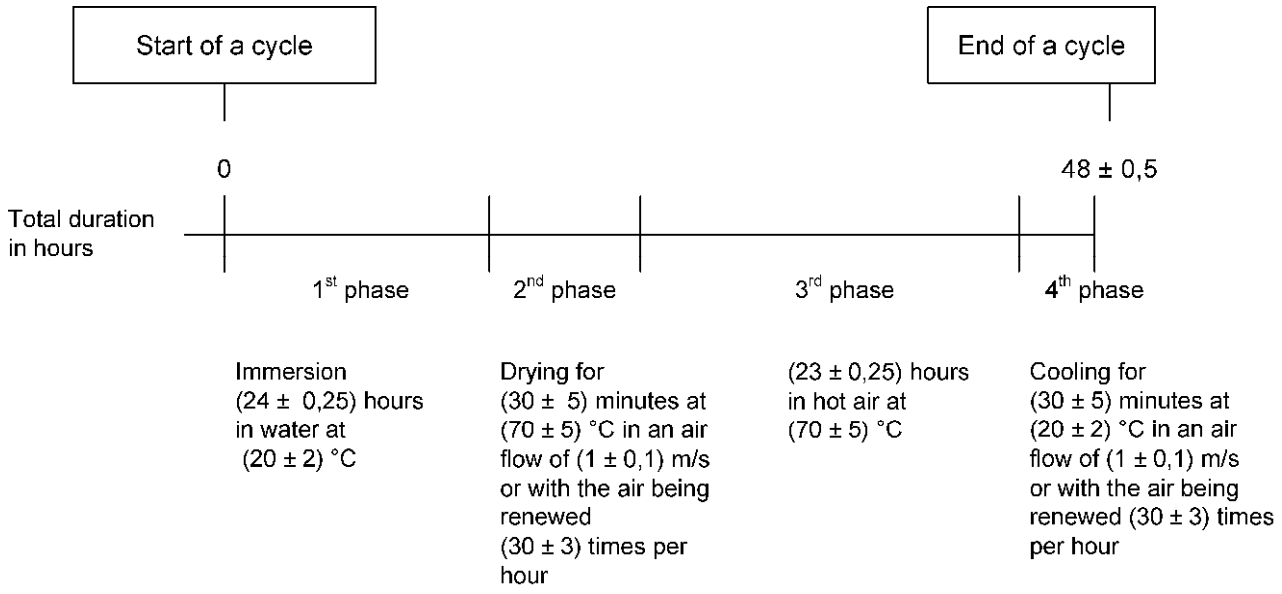


Figure 4 — Detailed diagram of an ageing cycle for the "C" sample

6 Expression of results

The results are expressed in accordance with EN 1170-5.

7 Interpretation of test

The results of the four significant parameters (σ_{LOP}, ε_{LOP}, σ_{MOR} and ε_{MOR}) are statistically analysed as follows:

For each of the two samples "R" and "C" and for the four significant parameters, calculate the means M_R and M_C and the standard deviations S_R and S_C of the individual values obtained.

Then calculate:

$$L_C = M_C - (0,67 \times S_C)$$

$$L_R = M_R - (0,67 \times S_R)$$

$$L = \frac{L_C}{L_R}$$

NOTE 1 The coefficient 0,67 corresponds to the ratio $\frac{t_{0,95}}{\sqrt{n}}$ where $t_{0,95}$ is the Student variable for the 95 % confidence level and n is the number of samples, i.e. in this case: $\frac{1,895}{\sqrt{8}}$ The values are given in ISO 2602.

NOTE 2 In order to have complete information on the change in the mechanical properties of the material, it may be useful to carry out additional tests after 10 and 25 ageing cycles. In this way, it is possible to draw a graph of the development of the loss of resistance L.

However, for this supplementary information to be representative, two test panels as defined in 5.1 shall be made:

— panel 1: "R" and "C"$_{50}$ samples for 50 ageing cycles;

— panel 2: "C"$_{10}$ an "C"$_{25}$ samples for 10 and 25 ageing cycles respectively.

It is essential that all the samples are taken from the same production run and that the number of test pieces for each of them is constant and equal to 8. If it is not possible to meet this last requirement (elimination of an aberrant result, for example) reference shall be made to ISO 2602 to calculate the limit of L_R or L_C in question.

Bibliography

[1] ISO 2602, *Statistical interpretation of test results — Estimation of the mean — Confidence interval*

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