

Products and systems for the protection and repair of concrete structures — Test methods — Drying test for hydrophobic impregnation

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British Standard

ICS 91.080.40; 91.100.99

National foreword

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The UK participation in its preparation was entrusted by Technical Committee B/517, Concrete, to Subcommittee B/517/8, Protection and repair of concrete structures, which has the responsibility to:

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- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
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Products and systems for the protection and repair of concrete structures - Test methods - Drying test for hydrophobic impregnation

Produits et systèmes pour la protection et la réparation des structures en béton - Méthodes d'essai - Essai de séchage pour l'imprégnation hydrofuge

Produkte und Systeme für den Schutz und die Instandsetzung von Betontragwerken - Prüfverfahren - Trocknungsprüfung für hydrophobierende Imprägnierungen

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Foreword

This document (EN 13579:2002) has been prepared by Technical Committee CEN/TC 104 "Concrete and related products", the secretariat of which is held by DIN.

It has been elaborated by Subcommittee SC 8 "Products and systems for the protection and repair of concrete structures", 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of an identical text or by endorsement, at the latest by February 2003, and conflicting national standards shall be withdrawn at the latest by February 2003.

The Annexes A and B are informative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies a test method to evaluate the effect of hydrophobic impregnation on the drying rate coefficient of impregnated specimens. The method primarily relates to the protection of concrete structures.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 1766, *Products and systems for the protection and repair of concrete structures - Test methods - Reference concretes for testing.*

EN 13580, *Products and systems for the protection and repair of concrete structures - Test methods - Water absorption and resistance to alkali for hydrophobic impregnations.*

3 Symbols

Symbol	Explanation	Unit
C_n	Consumption of impregnant for each face of test cube during treatment	g/m^2
C_m	Mean consumption of impregnant during treatment	g/m^2
d_0	Weight of a test cube prior to placing in environmental cabinet	g
d_1	Weight of a test cube after initial conditioning in environmental cabinet	g
d_2	Weight of a test cube at end of drying test	g
DRC	Drying Rate Coefficient	%
D_t	Drying rate of a treated test cube	$\text{g/m}^2 \cdot \text{h}$
D_{tm}	Mean drying rate of three treated test cubes	$\text{g/m}^2 \cdot \text{h}$
D_u	Drying rate of an untreated test cube	$\text{g/m}^2 \cdot \text{h}$
D_{um}	Mean drying rate of three untreated test cubes	$\text{g/m}^2 \cdot \text{h}$
M'_t	Estimated moisture content of each test cube after conditioning	%
M_m	Mean saturated surface dry moisture content of 3 oven dry test cubes	%
M_{ssd}	Saturated, surface dry moisture content of a test cube, calculated	%
W'_{od}	Estimated weight of a test cube in oven dry condition	g
W_{od}	Weight of a test cube in oven dry condition	g
W_{ssd}	Weight of a test cube in saturated surface dry condition	g
W_t	Actual weight of test cube after conditioning	g
W_{t1}	Weight of test cube immediately prior to treatment	g
W_{t2}	Weight of test cube immediately after treatment	g

4 Principle

The principle of the test method described in this European Standard is to compare the rate of drying of treated and untreated test cubes from the same batch of concrete. The ratio of the rates is defined as the drying rate coefficient.

5 Apparatus

- 5.1 Nine moulds for concrete cubes (100 mm x 100 mm x 100 mm).
- 5.2 Soft brush.
- 5.3 Absorbent paper towel
- 5.4 Balance with an accuracy of 0,01 g.
- 5.5 Support for test cubes on bench in laboratory or in fume cupboard to allow air to circulate around all 6 faces.
- 5.6 Laboratory or chamber maintained at constant temperature (21 ± 2) °C and relative humidity of (60 ± 10) %.
- 5.7 Forced air circulation oven to run at (105 ± 5) °C.
- 5.8 Desiccator cabinet containing silica gel.
- 5.9 Fume cupboard.
- 5.10 One 150 mm diameter petri dish with 2 spacers glued to bottom of dish to support the test cubes during treatment.
- 5.11 Suitable environmental cabinet which maintains temperature at (30 ± 2) °C and relative humidity of (40 ± 5) %.
- 5.12 Two suitable air tight boxes containing saturated potassium sulphate solution for storing specimens. Note that treated and untreated test cubes shall be stored in separate boxes.

6 Preparation of test specimens

Nine 100 mm concrete test cubes shall be cast from a single batch of Type C (0,45) concrete and cured for 28 days according to EN 1766. No oil or release agent will be permitted on the surface of the moulds (5.1). After removal from the curing tank, the test cubes shall be cleaned with tap water using a soft brush (5.2) to remove any loose material. The surface of the test cubes shall not be grit blasted. The test cubes shall be surface dried with an absorbent paper towel (5.3) and then weighed (W_{ssd}) using the balance (5.4).

Six test cubes (No. 1 - 6), suitably supported to allow air to circulate around each of the 6 faces (5.5), shall be conditioned on a bench in the laboratory (temperature (21 ± 2) °C and relative humidity (60 ± 10 %) (5.6) for 7 days and reweighed (W_l). The remaining three test cubes (No. 7 - 9) shall be dried in an oven at (105 ± 5) °C (5.7) for 7 days, cooled in a desiccator cabinet containing silica gel (5.8) and reweighed (W_{od}).

The saturated surface dry moisture content (M_{ssd}) of the 3 oven dry test cubes (No. 7 - 9), shall be calculated using the following formula :

$$M_{ssd} = \frac{W_{ssd} - W_{od}}{W_{od}} \cdot 100 \text{ in \% by weight} \quad (1)$$

The estimated oven dry weight (W'_{od}) of each of the remaining 6 test cubes (No. 1 - 6) shall be calculated using the formula :

$$W'_{od} = \frac{W_{ssd}}{1 + \left(\frac{M_m}{100}\right)} \text{ in g} \quad (2)$$

where M_m in % by weight is the mean saturated surface dry moisture content of the 3 oven dry test cubes (No. 7 - 9).

The estimated moisture content (M'_t) of each of the test cubes after conditioning shall be calculated from the weight, W'_t :

$$M'_t = \frac{W'_t - W'_{od}}{W'_{od}} \cdot 100 \text{ in \% by weight} \quad (3)$$

The test cubes (No. 1 - 6) shall be weighed daily during conditioning from the fourth day until the weight W'_t obtained is equivalent to a moisture content of $(5,0 \pm 0,5) \%$.

7 Treatment

Three test cubes from the batch shall be treated in a fume cupboard (5.9) with the fan on immediately after conditioning.

Each cube shall be treated by dipping each face in the impregnant. Immediately prior to treatment of each face, the cube shall be weighed (W_{t1}). 60 ml of the material shall be measured into a petri dish 150 mm in diameter (5.10).

One side of the cube, supported on the 2 mm plastic spacers, shall be dipped in the material for (120 ± 5) s and then removed. Excess liquid on the cube shall be allowed to drain back into the dish and the cube immediately reweighed (W_{t2}). The excess material in the dish is then to be discarded. This procedure shall be repeated for first side of the other two cubes.

The consumption (C_n) of the material for each face of the cube shall be calculated as follows :

$$C_n = \frac{W_{t2} - W_{t1}}{0,01} \text{ in grams by square meters} \quad (4)$$

The above procedure shall be repeated on the remaining six faces of each of the cubes and the average consumption for each cube shall be calculated.

The mean consumption (C_m) for the three test cubes shall be calculated.

If the consumption is below the manufacturer's recommended value the time of dipping can be extended.

If it is not practical to treat test cubes by this method, the treatment should be carried out in accordance with the manufacturer's instructions.

The cubes shall be stored, suitably supported to allow air to circulate around all 6 faces, in the fume cupboard for (48 ± 1) h after the start of treatment with the fan off.

8 Test procedure

8.1 General

The drying test shall be carried out on 3 treated and 3 untreated test cubes prepared as in sections 6 and 7 above.

The rate of drying of three treated and three untreated test cubes shall be determined by measuring their weight loss in an environmental cabinet. The treated and untreated test cubes must be tested at different times to avoid cross contamination.

The drying tests on the untreated test cubes shall be started immediately after the conditioning. The drying test on the treated test cubes shall be started 48 h after treatment.

8.2 Untreated test cubes

The 3 untreated test cubes shall be weighed (d_0) and placed in a cabinet with a controlled environment of $(30 \pm 2)^\circ\text{C}$ and $(40 \pm 5)\%$ R. H. (5.11) immediately after conditioning and reweighed (d_1) after $(6,0 \pm 0,1)$ h. The drying test shall be continued for further $(18,0 \pm 0,1)$ h. The test cubes shall again be weighed (d_2) and the drying rate (D_u) of each test cube shall be calculated as :

$$D_u = \frac{d_1 - d_2}{18 \cdot 0,06} \text{ in } \frac{\text{g}}{\text{m}^2 \cdot \text{h}} \quad (5)$$

NOTE In practice, $d_0 = W_t$.

8.3 Treated test cubes

The 3 treated test cubes shall be weighed (48 ± 1) h after the start of treatment (d_0) and then placed in the cabinet with a controlled environment of $(30 \pm 2)^\circ\text{C}$ and $(40 \pm 5)\%$ R. H. The test cubes shall be reweighed after $(24,0 \pm 0,1)$ h (d_1). This weight (d_1) shall be less than the weight (W_t) of the test cube after conditioning and immediately prior to treatment; if $d_1 > W_t$ then the test cubes shall be weighed after further periods in the cabinet until $d_1 < W_t$. The drying test shall then continue for further $(24,0 \pm 0,1)$ h. The test cubes shall then be reweighed (d_2) and the drying rate (D_t) of each test cube shall be calculated :

$$D_t = \frac{d_1 - d_2}{24 \cdot 0,06} \text{ in } \frac{\text{g}}{\text{m}^2 \cdot \text{h}} \quad (6)$$

The drying rate coefficient (DRC) shall be calculated as :

$$DRC = \frac{D_{tm}}{D_{um}} \cdot 100 \text{ in } \% \quad (7)$$

where D_{tm} is the mean drying rate of the three treated test cubes and D_{um} is the mean drying rate of the untreated test cubes.

If there is a requirement to determine the water absorption and alkali resistance of the impregnant as specified in prEN 13580, it is permitted to use the test cubes from the drying test. In this case, the treated and untreated test cubes shall be stored in separate air tight boxes over a saturated solution of potassium (5.12) sulphate immediately after the end of the drying test until required for further testing.

9 Test report

The test report shall contain at least the following information :

- a) a reference to this European standard ;
- b) name and address of the test laboratory ;
- c) identification number and date of the test report ;
- d) name and address of the manufacturer or supplier of the product(s) ;
- e) name and identification marks or batch number of the product(s);
- f) date of supply of the product ;
- g) date of preparation of the test specimens and any deviation from the prescribed method of preparation ;
- h) numbering of cubes ;
- i) details of the concrete mix design ;
- j) conditions of storage of prepared specimens prior to test ;
- k) the mean saturated surface dry moisture content of the test cubes ;
- l) the mean moisture content of the test cubes after conditioning ;
- m) the mean consumption of the impregnant ;
- n) the drying rate coefficient ;
- o) date of test and details of the test equipment used ;
- p) any deviation from the test method specified ;
- q) date of the report and signature ;
- r) any other observations.

Annex A (informative)

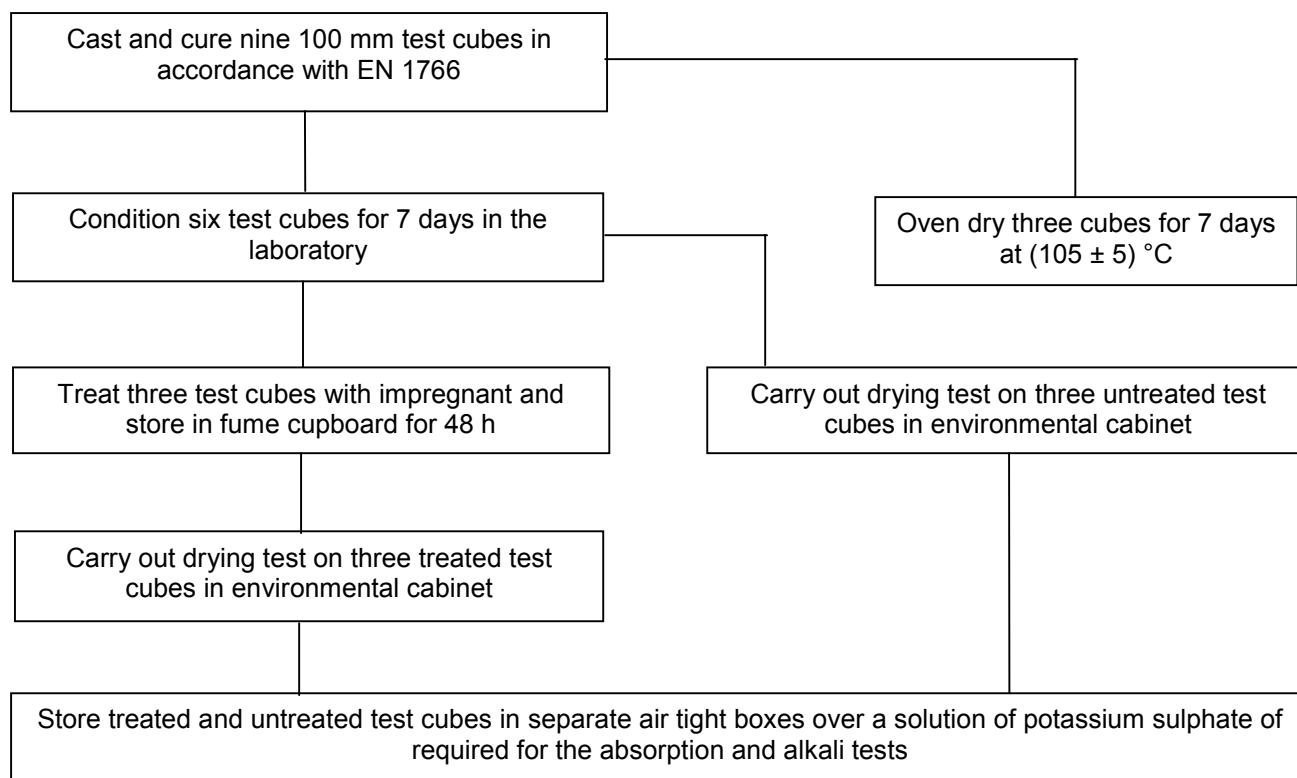


Figure A.1 — Flow chart of test procedure for drying test

Annex B (informative)

If all parties agree, the tests can be carried out on Type C (0,70) concrete as specified in EN 1766.

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