SLOVENSKI STANDARD
SIST EN 13581:2002

01-november-2002

Proizvodi in sistemi za zaģļ ito in popravilo betonskih konstrukcij - Preskusne metode - Doloļ evanje izgube mase hidrofobno impregniranega betona pri zmrzovanju/tajanju v prisotnosti soli

Products and systems for the protection and repair of concrete structures - Test method - Determination of loss of mass of hydrophobic impregnated concrete after freeze-thaw salt stress

Produkte und Systeme für den Schutz und die Instandsetzung von Betontragwerken - Prüfverfahren - Bestimmung des Masseverlustes von hydrophobiertem Beton nach der Beanspruchung durch Frost-Tausalz-Wechsel

Produits et systemes pour la protection et la réparation des structures en béton - Méthode d'essai - Détermination de la perte de masse apres la méthode d'essai de gel-dégel d'un béton hydrofuge

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91.080.40	Betonske konstrukcije	Concrete structures
91.100.30	Beton in betonski izdelki	Concrete and concrete products

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Produits et systèmes pour la protection et la réparation des structures en béton - Méthode d'essai - Détermination de la perte de masse après la méthode d'essai de gel-dégel d'un béton hydrofuge

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This European Standard was approved by CEN on 23 December 2001.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

Foreword

This document (EN 13581:2002) 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 annex A is normative and the annex B is 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 is one of a series dealing with products and systems for the protection and repair of concrete structures. It specifies a method for determining the loss of mass after freeze-thaw salt stress in sodium chloride solution. It can be used to test the resistance of hydrophobic impregnated concrete as well as the untreated concrete. There are two types of concrete deterioration when a freeze-thaw attack occurs: surface scaling and internal damage.

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 concrete for testing.*

3 Symbols

Symbol	Explanation	Unit
ΔC	Difference between the reached number of cycles of untreated and treated test cubes	-
C	Consumption of impregnant during treatment	g/m^2
C_{abs}	Quantity of fluid absorbed of one test cube during immersion in 3 % NaCl-solution	%
$C_{abs,\,m}$	Quantity of fluid absorbed of four test cubes during immersion in 3 % NaCl-solution; Mean value of treated an untreated test cubes	%
C_m	Mean consumption of impregnant during treatment	g/m^2
C_n	Consumption of impregnant for each face of the cube during treatment	g/m^2
C_u	Reached number of cycles of untreated test cubes	-
C_t	Reached number of cycles of treated test cubes	-
n	Indicating the number of cycles carried out	-
ΔW_n	Change of mass after the *n* cycle	%
W_n	Mass of a test cube after *n* cycles	g
W_0	Mass of a test cube before immersion for 24 h in 3 % NaCl solution	g
W_{t1}	Mass of test cube immediately prior to treatment	g
W_{t2}	Mass of test cube immediately after treatment	g
W_e	Mass of a test cube after immersion for 24 h in 3 % NaCl solution	g

4 Principle

The principle of the test method described in this standard is to compare the loss of mass and visible defects of treated and untreated test cubes from the same batch of concrete. The difference between the reached cycles of treated and untreated test cubes characterizes the effectiveness of a hydrophobic impregnant.

5 Apparatus

5.1 Eight moulds for concrete cubes (100 mm x 100 mm x 100 mm).

5.2 Laboratory or chamber maintained at constant temperature (21 ± 2) °C and relative humidity of (60 ± 10) %.

5.3 Four brass or stainless steel watertight containers with a width of (120 ± 10) mm, a length of (260 ± 10) mm and a height of (150 ± 10) mm. The sheet metal shall be approximately 1 mm thick. The containers are closed with lids which shall be designed so that they cannot be lifted off when the chamber is flooded. The lid of one container shall have an opening for placing a thermocouple to measure the temperature in the centre of one test cube.

5.4 Thermocouples, or an equivalent temperature measuring device with which the temperature shall be measured to an accuracy of 0,5 °C. A continuous recording device shall be used measuring and recording the temperature at least every 10 min over a period of 24 h.

5.5 An automatically-controlled freezing chamber with a flooding device. The performance of the freezing chamber shall be designed so that it is possible to maintain the temperature cycle referred to Figure 1 for each of the test cubes placed in it.

5.6 Brush, with short (about 20 mm), soft bristles for brushing off scaled material.

5.7 Spray bottle, containing tap water for washing off scaled material.

5.8 Drying cabinet, for a temperature of at least 110 °C.

5.9 Balance, with an accuracy within ± 0,1 g.

5.10 Desiccator cabinet containing silica gel

5.11 Fume cupboard

5.12 Sodium-chloride solution; 3 percent by weight.

5.13 One 5 l beaker with suitable spacers to support test cubes.

5.14 One 150 mm diameter petri dish with 2 spacers glued to bottom of dish to support the test cubes during treatment.

6 Preparation of test samples

Eight 100 mm concrete test cubes shall be cast from a single batch of type C (0,70) concrete and cured for 28 days according to EN 1766. No mould oil or release agent shall be used. After removal from the curing tank, the test cubes shall be cleaned with tap water using a soft brush (5.6) to remove any loose material. The surface of the test cubes shall not be grit blasted.

The test cubes shall then be conditioned for at least 60 days at a temperature of (21 ± 2) °C an a relative humidity of (60 ± 10) %.

7 Treatment

Four test cubes (No. 1 - 4) shall be treated in a fume cupboard (5.11) with the fan on after the conditioning of the specimens.

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 (5.14). 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 (5.14) 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 :

$$C_n = \frac{W_{t2} - W_{t1}}{0{,}01} \text{ in grams by square meters} \quad (1)$$

The above procedure shall be repeated on the remaining 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 in a climate (21 ± 2) °C and (60 ± 10) % R. H. for 14 days after the treatment suitably supported to allow air circulation around each of the 6 faces.

8 Test procedure

One day before the start of the freezing test, the mass of the 8 test cubes is determined with an accuracy of 0,1 g (W_0).

The 8 test cubes provided for the freezing test shall then be placed in four containers (5.3) so that the faces which were uppermost during manufacture are perpendicular to the base of the container and that there shall be about 10 mm distance between the test cubes and the steel containers.

The containers shall be filled with 3 % sodium-chloride-solution (5.12) until the solution covers the test cubes by more than 20 mm and less than 30 mm. 24 h after the start of this storage the mass of each test cube shall be determined again to an accuracy of 0,1 g (W_e) and the quantity of fluid absorbed in 24 h (C_{abs}) is calculated from the increase in mass following the equation 2 :

$$C_{abs} = \frac{W_e - W_o}{W_e} \cdot 100 \text{ in \%} \quad (2)$$

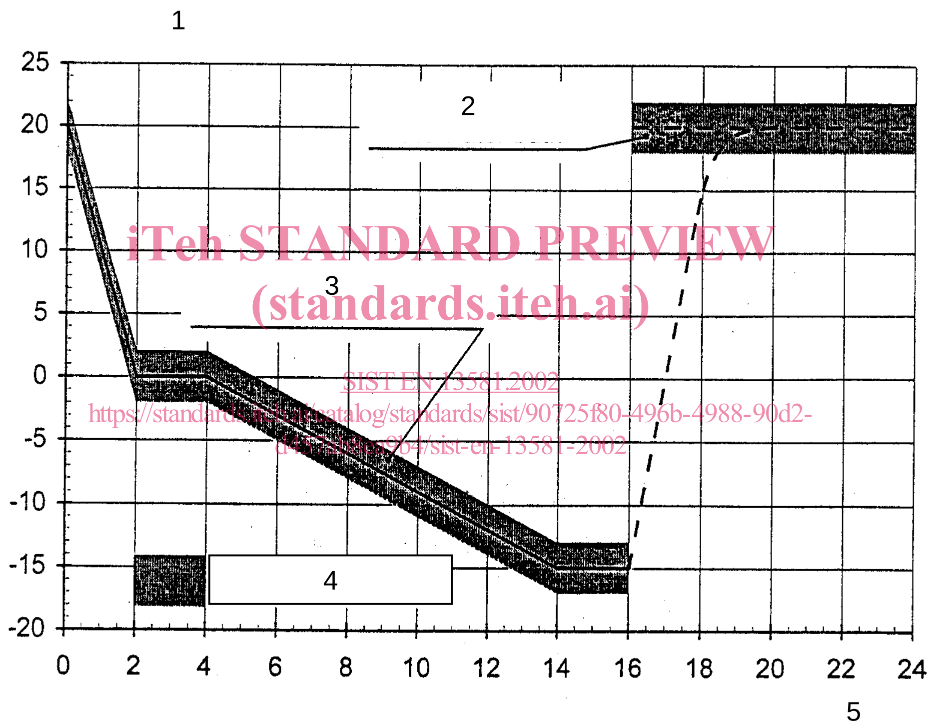
The means values $C_{abs,\,m}$ are to be calculated from the single values C_{abs} of treated and untreated test cubes.

The temperature of the freezing chamber (5.5) shall be controlled so that the temperature at the centre of the test cube corresponds to the solid line in Figure 1 and shall not leave the shaded area in the diagram. The air temperature shall not fall below - 25 °C.

Immediately after the determination of W_e the containers containing the test cubes immersed in 3 % sodium-chloride-solution shall be placed with closed lids in the freezing chamber ensuring that they are evenly distributed. The freeze-thaw cycle then begins. The containers shall be changed around once a week; they are turned through 180° and interchanged on a cyclic basis. The number of containers in the freezing chamber shall always be the same. If only a few test cubes are to be tested, containers with "blank test cubes" shall be put in for this purpose. The containers shall not be placed on top of each other.

Immediately after the 16 h cooling/freezing phase, the freezing chamber is flooded with water or the containers are put into a water bath of (21 ± 2) °C so that the water level shall be (20 ± 5) mm below the brims of the containers. The thawing phase shall last a total of 8 h. 15 min before the end of the 8 h thawing phase the water is pumped out of the freezing chamber for a maximum time of 15 min. The water shall always be in circulation and be kept at a constant temperature at (21 ± 2) °C during the entire thawing process. The test shall last 50 cycles. One cycle lasts 24 h (see Figure 1).

If, in exceptional cases, it is necessary to interrupt the test, the temperature of the containers with the test cubes shall be maintained at (- 15 ± 2) °C.



Key

1 Temperature in °C

2 Temperature of the water bath

3 Temperature in the center of a 100 mm cube

4 Temperature range

5 Time in h

Figure 1 — Temperature behaviour pattern in the centre of a test tube

The breakpoints specifying the shaded area in Figure 1 are given in Table 1 :