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Testing hardened concrete - Part 10: Determination of the relative carbonation resistance of concrete

Essai pour béton durci - Partie 10: Détermination de la résistance relative à la carbonatation du béton

Prüfung von Festbeton - Teil 10: Bestimmung des relativen Karbonatisierungswiderstandes von Beton

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

Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

This document (CEN/TS 12390-10:2007) has been prepared by Technical Committee CEN/TC 104 “Concrete and related products”, the secretariat of which is held by DIN.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This test method has been prepared by CEN TC 51/WG12/TG5

This method is one of a series on testing hardened concrete comprising:

EN 12390 Testing hardened concrete

Part 1: Shape, dimensions and other requirements for specimens and moulds

Part 2: Making and curing specimens for strength tests

Part 3: Compressive strength of test specimens

Part 4: Compressive strength – Specification for testing machines

Part 5: Flexural strength of test specimens

Part 6: Tensile splitting strength of test specimens

Part 7: Density of hardened concrete

Part 8: Depth of penetration of water under pressure

Part 9: Freeze-thaw resistance – Scaling[1]

Part 10: Determination of the relative carbonation resistance of concrete [1]

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[1] These documents are published as CEN/TC for the time being.

1 Scope

This is a method for evaluating the carbonation resistance of concrete mixes by comparison with a concrete mix with known carbonation resistance. It is not a method for the determination of carbonation depths in existing concrete structures. The test is carried out under controlled exposure conditions using natural levels of carbon dioxide or under natural conditions protected from direct rainfall.

If the carbonation depth of the unknown mix is equal or less than the known mix, it is be assumed that the risk of reinforcement corrosion for the new mix is equivalent to the known mix (with the same cover required for the known mix). The “reference” concrete may be any concrete with known performance in the intended place of use (environment).

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 932-1, *Tests for general properties of aggregates – Part 1: Methods for sampling*

EN 1097-5, *Tests for mechanical and physical properties of aggregates – Part 5: Determination of the water content by drying in a ventilated oven*

EN 1097-6, *Tests for mechanical and physical properties of aggregates – Part 6: Determination of particle density and water absorption*

EN 12350-2, *Testing fresh concrete – Part 2: Slump test*

EN 12350-3, *Testing fresh concrete – Part 3: Vebe test*

EN 12350-4, *Testing fresh concrete – Part 4: Degree of compactability*

EN 12350-5, *Testing fresh concrete – Part 5: Flow table test*

EN 12390-1, *Testing hardened concrete – Part 1: Shape, dimensions and other requirements for specimens and moulds*

EN 12390-2, *Testing hardened concrete – Part 2: Making and curing specimens for strength tests*

EN 12390-3, *Testing hardened concrete – Part 3: Compressive strength of test specimens*

3 Principle

A concrete mix with known performance under classified exposure conditions in the place of use is chosen as the reference concrete.

From previous information or by trial mixes on the concrete under investigation, determine the mix proportions to give an equal compressive strength as the reference concrete. Two prisms and at least six compression test specimens of both reference concrete and concrete under investigation are manufactured with these mix proportions. In addition two concretes are manufactured using an 8% higher and 8% lower cement content, giving a total of 12 prisms and (at least) 36 compression test specimens. All prisms are sealed-cured until the concrete has reached 50% of the reference strength. The prisms are then exposed to one of the two storage conditions. At defined periods up to at least two years, slices are split from the prisms and the freshly split

surface is sprayed with a phenolphthalein solution. The mean depth of the reacted surface layer is calculated and called the depth of carbonation. The mean depths of carbonation for the pairs of prisms are used to interpolate the depth of carbonation at the reference strength.

The three mixes of the reference concrete and the three mixes of the concrete under investigation are made, ideally, on the same day. The days on which they are placed in the storage chamber may vary as this depends on their relative rates of strength development. Testing for carbonation depth should be on the same days.

The relative performance of the two concretes should be compared with the objective of determining if the unknown concrete gives a carbonation depth equal to or lower than that of the known concrete. Such an approach is not dependent on the repeatability or reproducibility of the test and any failure of the storage chamber is unlikley be significant, as both concretes will have been subjected to the same exposure.

4 Reagents and apparatus

4.1 A solution of 1 % phenolphthalein in 70 % ethanol.

4.2 A magnifier and a gauge to measure the depth of carbonation perpendicular to the exposed concrete surface with a precision of 0,2 mm.

4.3 A storage chamber controlling the carbon dioxide concentration at (0,035 ± 0,005) %, temperature at (20 ± 2) °C and a relative humidity at (65 ± 5) % , see Annex A for details of a suitable chamber.

4.4 A natural exposure site where specimens are protected from direct rainfall, see Annex B for details of a suitable arrangement.

4.5 Apparatus for recording the relative humidity with a precision of ± 2,0 % and the temperature with a precision of ± 0,5 ° C.

4.6 Apparatus for recording CO_2 concentration with a precision of ± 0,001 % by volume fitted with an audible/visual alarm to signify breaching of limits.

4.7 Fans to facilitate circulation of air within the storage chamber.

5 Production of specimens

5.1 General

Prior to production and testing, the following shall be specified or agreed:

— reference strength at a given age under the conditions of the test method;

— consistence class.

Prior to testing, the following may be specified or agreed:

— some or all of the constituent materials;

— maximum nominal upper aggregate size;

— other performance requirements for the concrete to be tested;

— environment for the test