



SLOVENSKI STANDARD

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Vpliv cementnih proizvodov na pitno vodo - Preskusne metode - 3. del: Prehod snovi iz cementnih, tovarniško izdelanih proizvodov

Influence of cementitious products on water intended for human consumption - Test methods - Part 3: Migration of substances from factory-made cementitious products

Einfluss zementgebundener Produkte auf Wasser für den menschlichen Gebrauch - Prüfverfahren - Teil 3: Migration von Substanzen aus fabrikmäßig hergestellten zementgebundenen Produkten

Influence des produits a base de ciment sur l'eau destinée a la consommation humaine - Méthodes d'essais - Partie 3 : Migration de substances a partir des produits fabriqués en usine

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67.250	Materiali in predmeti v stiku z živili	Materials and articles in contact with foodstuffs

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Influence of cementitious products on water intended for human consumption - Test methods - Part 3: Migration of substances from factory-made cementitious products

Influence des produits à base de ciment sur l'eau destinées à la consommation humaine - Méthodes d'essais - Partie 3 : Migration de substances à partir des produits fabriqués en usine

Einfluss zementgebundener Produkte auf Wasser für den menschlichen Gebrauch - Prüfverfahren - Teil 3: Migration von Substanzen aus fabrikmäßig hergestellten zementgebundenen Produkten

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Foreword

This document (EN 14944-3:2007) has been prepared by Technical Committee CEN/TC 164 "Water supply", 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of an identical text or by endorsement, at the latest by June 2008, and conflicting national standards shall be withdrawn at the latest by June 2008.

This European Standard is Part 3 of a series dealing with the influence of cementitious and associated non-cementitious products/materials on water intended for human consumption, including:

- Part 1 Influence of factory made cementitious products on organoleptic parameters;
- Part 2¹⁾ Influence of site-applied cementitious materials and associated non-cementitious products/materials on organoleptic parameters;
- Part 3 Migration of substances from factory made cementitious products;
- Part 4²⁾ Migration of substances from site-applied cementitious materials and associated non-cementitious products/materials.

This European Standard will result in one of a series of standards that support appropriate standards.

It describes a test method to produce migration waters for the assessment of inorganic and organic substances.

Annex A, which is normative, describes additional procedures for testing factory made pipes (cement mortar lined and concrete).

Annex B, which is normative, describes additional procedures for testing factory made fittings (cement mortar lined and concrete).

Annex C, which is normative, describes additional procedures for testing factory made storage systems (cement mortar, cement mortar lined and concrete).

Annex D, which is informative, provides examples of typical test pieces and test conditions as a function of S/V ratio.

Annex E, which is informative, describes test arrangements for testing factory made cementitious products.

Annex F, which is normative, describes additional procedures for testing factory made cementitious products at elevated temperature.

Annex G, which is informative, provides a means of discriminating between porous and non-porous coatings on factory made products.

Annex H, which is informative, provides a schematic description of the test (preconditioning and migration) procedure.

Annex I, which is informative, gives recommendations for procedural tests using standard additions (positive controls).

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.

1) The work on Part 2 of EN 14944 has not yet begun.

2) The work on Part 4 of EN 14944 has not yet begun.

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Introduction

With respect to any potential adverse effects of products and materials on the quality of water intended for human consumption, it should be understood that relevant national regulations remain in force until verifiable European acceptance criteria are adopted.

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1 Scope

This European Standard specifies a method to determine the migration of substances from factory made cementitious products into test waters after contact with the products.

This European Standard is applicable to factory made cementitious products, e.g. cement mortar linings to metallic pipes, tanks, concrete pipes etc., intended to be used for the transport and storage of water intended for human consumption, including raw water used for the production of drinking water.

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 196-1, *Method of testing cement — Part 1: Determination of strength*

EN 1015-2, *Method of test for mortar for masonry — Part 2: Bulk sampling of mortars and preparation of test mortars*

EN 1015-11, *Methods of test for mortar for masonry - Part 11: Determination of flexural and compressive strength of hardened mortar*

EN 10088-1, *Stainless steels — List of stainless steels*

EN 12350-1, *Testing fresh concrete — Part 1: Sampling*

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 ISO 3696, *Water for analytical laboratory use — Specification and test methods (ISO 3696:1987)*

EN ISO 7393-1, *Water quality - Determination of free chlorine and total chlorine - Part 1: Titrimetric method using N, N-diethyl-1,4-phenylenediamine (ISO 7393-1:1985)*

EN ISO 7393-2, *Water quality - Determination of free chlorine and total chlorine - Part 2: Colorimetric method using N, N-diethyl-1, 4-phenylenediamine, for routine control purposes (ISO 7393-2:1985)*

ISO 10523, *Water quality — Determination of pH*

3 Terms and Definitions

For the purpose of this European Standard, the following terms and definitions apply.

3.1

appropriate body

certification body, inspection body or test laboratory, as relevant to a particular requirement

3.2

cementitious product

factory made product containing a cementitious material supplied in the hardened state with a formed surface prior to its incorporation into the construction works

3.3

cementitious material

material that contains a hydraulic cement in sufficient proportion to act as the main binder by forming a hydrate structure that governs the performance of the material

3.4**associated non-cementitious product**

product that is applied to the surface of a cementitious product, directly or indirectly, during manufacture (or construction) and that either provides a porous seal to the product or remains as a residue in contact with water

EXAMPLE Porous seal coats, formwork release agents and curing compounds.

3.5**porous seal coat**

polymeric (usually organic) materials applied in a thin (25 µm to 200 µm thickness) surface layer to a cement mortar lining to restrict (but not prevent) interactions between the mortar and conveyed water (ISO 16132 [1])

3.6**proxy sample**

sample of fresh mortar or fresh concrete taken from material to be used for the production of a factory made product; either spray-applied to a laboratory test plate (mortar only) or cast into a mould (mortar or concrete) of appropriate dimensions (e.g. standard cube, cylinder or prism etc.) and compacted (where appropriate), cured and hardened under conditions representative of those intended for the product

3.7**fresh concrete**

concrete that is fully mixed and still in a condition capable of being compacted by the chosen method

EXAMPLE Examples of associated non-cementitious products are porous seal coats, release agents and curing compounds.

3.8**fresh mortar**

cement mortar that is fully mixed and still in a condition to be applied to a substrate by the chosen method

EXAMPLE Examples of associated non-cementitious products are porous seal coats, release agents and curing compounds.

3.9**test**

technical operation that consists of the determination of one or more characteristics of a given product

3.10**test procedure**

specified technical method for performing a test

3.11**sample**

one or more units, or a specified quantity, drawn from a batch or lot, selected at random for testing, e.g. at the factory or in a laboratory

3.12**test piece**

sample or portion of a sample which is to be conditioned, treated or otherwise prepared to be tested to obtain a single test result

3.13**nominal diameter (DN/ID) or (DN/OD)**

numerical designation of the size of a component, which is a whole number approximately equal to the actual dimensions in millimetres. This applies to either the internal diameter (DN/ID) or the external diameter (DN/OD)

3.14**preconditioning**

succession of contact periods of a test piece with the preconditioning water (3.15) before contact with the test water

3.15**preconditioning water**

water used for preconditioning prepared as described in 5.3.1

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3.16**test water**

water used for testing purposes prepared as described in 5.3.2 and used in accordance with 5.3.3 and 5.3.4

3.17**migration water**

test water that has been in contact with a test piece under specified conditions

3.18**blank water**

test water which has been kept at the same specified conditions as migration water but without contact with the test piece

3.19**disinfection treatment water**

preconditioning water containing chlorine as described in 5.2.2

3.20**tap water**

drinking water distributed by a public supplier

NOTE Tap water is used as a lubricant/coolant for the sawing and coring operations used to obtain test pieces generally from products of large dimensions. See normative Annex A, Annex B and Annex C.

3.21**demineralized water**

water conforming to the requirements in EN ISO 3696 for Grade 3

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4 Principle

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Each test piece is subjected to a specified preconditioning procedure where the surface that is exposed in practice to water intended for human consumption, is brought into contact with preconditioning water during five sequential periods: three periods of 24 h, 1 period of 72 h and a final period of 24 h {with 50 mg/l Cl₂ (5.2.2) if requested to simulate chlorine disinfection treatment}.

The preconditioned test piece is then put in contact with test water, chlorinated and/or chlorine-free during three sequential migration periods. A migration period is either:

- a) 72 h at (23 ± 2) °C for products intended to come into contact with chlorinated or chlorine-free cold water;
- b) 24 h at a specified elevated temperature for products intended to come into contact with warm or hot chlorine-free water.

Migration rates are calculated after each contact period by determination of the content of specified substances in the corresponding migration water.

NOTE 1 The test is carried out under conditions that ensure that reliable migration rates are calculated. These conditions are not meant to simulate service conditions. Relating the results obtained from this European Standard to the service condition is carried out using a conversion procedure. This procedure will be specified in regulations.

NOTE 2 The selection of:

- a) appropriate test water, chlorinated and/or chlorine-free, from those made available in this European Standard;
- b) temperature of the test water;
- c) need for chlorination during preconditioning;

is specified in product or system standards or in national or European regulations, as appropriate.

5 Reagents

5.1 General requirements

Use only reagents of analytical quality unless otherwise stated.

5.2 Disinfection reagents

5.2.1 Sodium hypochlorite solution, prepared from a technical or general purpose reagent grade of sodium hypochlorite (NaOCl), using test water (5.3.2) and having a known concentration of about 0,1 % by mass of free chlorine determined in accordance with either EN ISO 7393-1 or EN ISO 7393-2.

NOTE Unless tests have proved otherwise, the sodium hypochlorite solution should be considered unstable and be prepared on the day of use.

5.2.2 Disinfection treatment water, shall consist of a batch of preconditioning water (5.3.1) with a free chlorine content of (50 ± 5) mg/l as Cl_2 , determined in accordance with either EN ISO 7393-1 or EN ISO 7393-2, after the addition of sodium hypochlorite solution (5.2.1).

5.3 Waters to be used for testing

5.3.1 Preconditioning water prepared by dissolving (222 ± 2) mg anhydrous calcium chloride (CaCl_2) and (336 ± 2) mg sodium hydrogen-carbonate (NaHCO_3) in one litre of demineralized water (3.21). The pH is determined in accordance with ISO 10523 and adjusted to $7,4 \pm 0,1$ by bubbling air and/or CO_2 into the solution.

NOTE The target total hardness is 200 mg/l as CaCO_3 and the target alkalinity is 244 mg/l as HCO_3^- .

5.3.2 Test water, prepared by dissolving (110 ± 1) mg anhydrous calcium chloride (CaCl_2), (140 ± 1) mg sodium hydrogen carbonate (NaHCO_3) and (48 ± 1) mg sodium silicate ($\text{Na}_2\text{SiO}_3 \cdot 9\text{H}_2\text{O}$) in one litre of demineralized water.

The pH is determined in accordance with ISO 10523 and adjusted to $7,0 \pm 0,1$ by bubbling air and/or CO_2 into the solution.

NOTE The target total hardness is 100 mg/l as CaCO_3 , the target alkalinity is 122 mg/l as HCO_3^- and the silica concentration is 10 mg/l as SiO_2 .

5.3.3 Test water without chlorine content (chlorine-free), shall consist of a batch of test water (5.3.2) used for contact with test pieces and preparation of the blank water (3.18).

5.3.4 Test water with chlorine content (chlorinated), shall consist of test water (5.3.2) with a free chlorine content of $(1,0 \pm 0,2)$ mg/l as Cl_2 , determined in accordance with either EN ISO 7393-1 or EN ISO 7393-2, after addition of sodium hypochlorite solution (5.2.1).

5.4 Cleaning liquids for apparatus

Use one of the following cleaning liquids:

- non-perfumed biodegradable detergent;
- hydrochloric acid, 2 mol/l;
- nitric acid, 10 % or 1,5 mol/l.

6 Apparatus

6.1 General

For cleaning the glassware, and appropriate apparatus, before use, the following general requirements apply:

- a) Clean the glassware to be used, using detergent (5.4). Rinse the glassware in demineralized water.

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- b) Clean the inner surface of the glassware with hydrochloric acid (5.4) and rinse it with demineralized water. For stainless steel, clean with nitric acid (5.4) and then rinse with demineralized water.
- c) Before use, rinse the glassware, and appropriate apparatus, at least three times using preconditioning water before preconditioning (8.3) or test water before the test procedure (clause 9).

6.2 Apparatus and materials for test piece preparation (see normative Annex A, B and C)

6.2.1 Stainless steel plates and cylinders

6.2.1.1 Stainless steel

Stainless steel shall be austenitic, super austenitic or duplex grades in accordance with the corresponding numerical designations, 1.4301, 1.4436, 1.4429, 1.4259 or 1.4462 in EN 10088-1 for stainless steels.

NOTE The grades above are specified for the use of stainless steel as reinforcement in concrete. Therefore they are considered to be inert when used in contact with cementitious proxy samples (see normative Annex A, Annex B and Annex C of this European Standard).

6.2.1.2 Plates

To provide a sufficient volume of migration water for assessment, the surface area of one face of a plate should be between 10 000 mm² and 90 000 mm². The length/width of the plates should be selected to be consistent with the dimensions of the test container and the volume of test water in which they will be immersed.

6.2.1.3 Cylinders

The diameter and length of a cylinder should be consistent with the dimensions of the test piece (see normative Annex A, Annex B or Annex C and informative Annex D and Annex E) and the volume of test water appropriate to the specified S/V ratio given in 7.3.

6.2.2 Glass cylinders

The diameter and length of a glass cylinder should be consistent with the dimensions of the test piece (see normative Annex A, Annex B or Annex C and informative Annex D and Annex E) and the volume of test water appropriate to the specified S/V ratio given in 7.3. Glass cylinders should be provided with suitable external (opaque) shielding for use during migration procedures (test pieces and blanks), in order to minimize exposure of migration waters to ambient light.

6.2.3 Moulds for forming test pieces

Moulds for forming prisms of mortar shall conform to the requirements of EN 196-1, as specified for use in EN 1015-11, or to EN 12390-1 for forming cubes/cylinders of concrete, with modifications to materials and dimensional tolerances as specified by the appropriate normative Annex A, Annex B or Annex C of this European Standard.

Clean moulds and any filling frame used with a mould, by thoroughly washing with non-perfumed detergent (5.4) and tap water (3.20), rinsing with copious amounts of tap water, followed by a final rinse with demineralized water (3.21) and dry before use.

Where a factory made cementitious product has been formed in a process where its entire contact surface has been in contact with a release agent then where proxy samples (3.6) are used, the same release agent shall be applied to the internal surfaces of the mould, otherwise use of release agents is not permitted by this European Standard.

6.3 Apparatus and materials for preconditioning and migration procedure

6.3.1 Vessels, containers, stoppers and connectors shall consist of a material, such as glass, PTFE or stainless steel that is inert under the specified test conditions (clause 9).

NOTE The material PTFE should only be used when there is a small contact area with the test water. Thus PTFE is unsuitable for containers.

6.3.2 Equipment, capable of maintaining the test temperature within ± 2 °C for the duration of the test.

6.3.3 Where required, use only sealants that do not affect the determinations under the specified test conditions (see clause 9).

7 Samples and test pieces

7.1 Sampling, transport and storage of samples

Carry out sampling of factory made products in accordance with the relevant product standard, system standard or the national or European regulations, or the relevant normative annex to this European Standard, as appropriate.

Take care that the transport conditions do not influence the test results.

If it is necessary to store samples or test pieces before testing, ensure that they are protected from contamination taking into account any written instructions that are provided.

When appropriate, clean storage containers using the same procedures as are used for the test containers.

Ensure that the surfaces of the test pieces intended to come in contact with the test water are free from any contamination e.g. adhesive tape, labels, ink or pencil marks.

7.2 Preparation of test pieces

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7.2.1 General

Prepare the test pieces in such a way that only the surface intended to come into contact with drinking water is exposed to the test water except as given in normative Annex C (see C.1.2.3.2.1) where stainless steel plates are coated with cement mortar on one face only prior to complete immersion during testing.

In the preparation of a test piece the following general principles apply:

- a) ensure that test pieces are representative of the finished product;
- b) during the preparation of test pieces, include any procedures that are performed in practice for curing and cleaning;
- c) ensure that the minimum age of the test piece, at test, conforms to that recommended by the manufacturer for the product to be ready for use;
- d) ensure that the surface area of the test piece is sufficient to fulfil the appropriate surface area to volume (S/V) ratio in accordance with the requirements of 7.3.

7.2.2 Factory made pipes, fittings and storage systems

Where possible, use the sample or test piece as the test vessel, with dimensions that provide sufficient migration water for assessment. In cases where this is not practicable (e.g. large pipes, storage systems etc.), and where alternatives are specified, use as appropriate, an alternative test piece described in the relevant normative Annex A, Annex B or Annex C of this European Standard and an appropriate test arrangement given in informative Annex E.

NOTE Where it is required to discriminate between porous and non-porous coatings already applied to factory made products, use the test procedure given in informative Annex G of this European Standard.