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Betong – Avgivning av reglerade farliga ämnen till mark, grundvatten och ytvatten – Provningsmetoder för nya eller ej beprövade delmaterial till betong samt för betong

Concrete – Release of regulated dangerous substances into soil, groundwater and surface water – Test method for new or unapproved constituents of concrete and for production concretes



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TECHNICAL REPORT
RAPPORT TECHNIQUE
TECHNISCHER BERICHT

CEN/TR 15678

April 2008

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English Version

**Concrete - Release of regulated dangerous substances into soil,
groundwater and surface water - Test method for new or
unapproved constituents of concrete and for production
concretes**

Béton - Relargage de substances dangereuses
réglementées dans les sols, les eaux souterraines et les
eaux de surface - Méthode d'essai des constituants du
béton, nouveaux ou non-approuvés, et des formules de
béton

Beton - Freisetzung regulierter gefährlicher Stoffe in den
Boden, das Grundwasser und das Oberflächenwasser -
Testmethode für neue oder noch nicht zugelassene
Bestandteile von Beton und für Betone

This Technical Report was approved by CEN on 1 October 2007. It has been drawn up by the Technical Committee CEN/TC 51.

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Foreword

This document (CEN/TR 15678:2008) has been prepared by Technical Committee CEN/TC 51 “Cement and building limes”, the secretariat of which is held by NBN.

It describes test methods, that when completed, will produce eluates for the assessment of inorganic and organic substances potentially released from either the constituents of concretes (tested within hardened reference concretes) or from production concretes (or test pieces representative of production concretes) whether presented in the pre-hardened/precast state, fresh wet state or pre-packaged.

This document is currently incomplete. This document does not include the extraction procedure necessary to produce the eluates because extraction procedures will be developed within a programme of horizontal test method standardisation under a mandate given to CEN by the European Commission and the European Free Trade Association in order to support essential requirements of EU Directives. The necessary programme of work is being undertaken in CEN/TC 351 Construction products – Assessment of release of dangerous substances.

Annex A, which is normative, describes the testing for release of (regulated) dangerous substances from pre-hardened concrete products formed in the factory.

Annex B, which is informative, describes the testing for release of (regulated) dangerous substances from hardened test pieces representative of fresh wet concretes or pre-packaged concretes.

Annex C, which is informative, describes the principles of laboratory concrete mix design to be applied for the assessment of new/unapproved constituents of concrete.

Introduction

Regulatory background

In March 2005 the Commission Services of the European Union published mandate M/366 "Development of horizontal standardised assessment methods for harmonised approaches relating to (regulated) dangerous substances under the Construction Products Directive (CPD)". M/366 deals with the subject of emissions or release of (regulated) dangerous substances from construction products, as defined in the CPD, which may have harmful impacts on human health and the environment in relation to essential requirement No. 3 (ER 3), Health, hygiene and the environment, of the CPD. The mandate is intended to provide harmonised European measurement/test method standards that are needed in order to remove technical barriers to trade and bring about the "approximation" of laws, regulations and administrative provisions of the Member States. The measurement/test standards should provide results that can be expressed in performance terms and be suitable for addressing the emission or release of (regulated) dangerous substances within provisions in harmonised European Technical Specifications (ETS).

For ease of assigning the appropriate environments or exposure scenarios to individual products, the environment is notionally divided into two distinct environmental compartments: indoor air and soil, groundwater and surface water. In this context, it is important to recognize that essential requirement No. 3 only covers the potential effects of construction on the health of occupants and neighbours of construction works and the environment immediately surrounding the works. In life-cycle terms, it covers only the service life of a product and, therefore, does not cover the construction phase or end-of-use/disposal.

These distinct environmental compartments are necessarily associated with exposure-specific test methodologies, the emission of volatile, semi-volatile or other substances into indoor air being physico-chemically, kinetically and thermodynamically distinct from release into aqueous environments. The test methods described herein address only the potential release of substances into soil, groundwater and surface water, forms of aqueous exposure which, given the focus on service-life, could be described as the natural environment. Assessment of emission of substances into indoor air may or may not be relevant for the cementitious products identified in this CEN TR. However, if it emerges that the regulatory regime requires that this aspect of performance be addressed, then the European cement and concrete sector, via its standardization committees, will involve itself in appropriate work items.

At the time of drafting this CEN TR, spring 2007, there are a number of uncertainties about the regulatory regime that will eventually govern the assessment of emission/release of dangerous substances from construction products within Europe. In particular, it is unclear which products and/or materials will be subject to any part of the emerging regulatory regime. In the case of cement-containing products or materials such as concrete there is additional uncertainty because, with the exception of mixing water, all the constituents of concrete are construction products mandated in their own right under the Construction Products Directive (CPD). However, the constituents of concrete do not come into direct contact with either soil, groundwater or surface water and this could be taken to infer that they should not be subject to any regulatory provisions except that some (i.e. those not already standardised under national standards or European Technical Specifications) are subject to assessment within some Member States' existing environmental regulations. Furthermore, some types of concrete, for example fresh wet concretes, have not been mandated as construction products under the CPD and therefore might be considered to be outside any European regulatory regime based upon it. The complicating factor for these materials, though, is that they are subject to some EU Member States' existing regulations and may, in consequence, need to be assessed under a European regulatory regime.

It is also unclear whether the assessment and classification framework under development for use in the European regulatory regime will eventually be adopted. Currently, however, there are indications that the framework will include three distinct elements:

a 'deemed to satisfy' classification scheme for assessing some products on the basis of existing, generally accepted knowledge, currently known as 'without testing (WT)';

a classification scheme known as 'without further testing (WFT)' but based on initial testing using agreed European test methods may also form part of the regime;

and for use in those cases where the above classifications are either inapplicable or where products cannot achieve either classification because they can emit or release substances in amounts in excess of the classification criteria, there would be a need to carry out 'further testing (FT)' in the form of routine or conformity testing, again using agreed European test methods called up from appropriate provisions placed in harmonised European Technical Specifications (e.g. harmonised European product standards and European Technical Approvals). However, it is clear that the eventual European regulatory regime will neither establish nor include any pan-European assessment criteria for assessing emission or release under conditions of 'further testing (FT)'. Assessment under FT conditions will be a matter of comparing results obtained using European test methods with the appropriate, and possibly appropriately modified, limiting criteria in EU Member States' existing national regulations.

Given the regulatory uncertainties outlined above, this CEN TR has taken the position that its scope must initially include:

all types of concrete [pre-hardened/precast, fresh wet (ready-mixed and site-mixed) and pre-packaged];

and all the constituents of concrete, with the exception of mixing water;

so as to cover the eventuality that any of these, whether mandated construction products or not, may need to be assessed for the purposes of conformity with Essential Requirement 3 of the Construction Products Directive because any can come into either direct or indirect (constituents of concrete) contact with soil, groundwater or surface water. However, those products that have been mandated as construction products in their own right under the CPD are dealt with in normative provisions in this CEN TR whereas those that have not been mandated are dealt with in informative provisions.

Overall scope of products and test methods

This CEN TR describes three distinct test methods but all use the same extraction procedure. The first will permit the constituents (e.g. cement, additions, aggregates, admixtures, fibres etc) of concrete that have not been officially classified as WT products (i.e. without testing to a European standard test method being required) to be assessed against any European or national requirements for release of (regulated) dangerous substances from hardened test pieces of concrete into soil, groundwater or surface water.

The second method, in normative Annex A, is designed to permit factory made pre-hardened concretes, or test pieces representative of factory made concretes, which have not been officially classified as WT products, to be assessed against any European or national requirements for release of (regulated) dangerous substances into soil, groundwater or surface water.

The third method, in informative Annex B, is designed to permit concretes sampled in the fresh wet state or pre-packaged (and also not officially classified as WT products) to be assessed in the hardened state, against any European or national requirements for release of (regulated) dangerous substances into soil, groundwater or surface water.

Construction products, whether constituents of concrete or concrete itself, that have been officially classified as WT products by way of authorised procedures will not require to be tested by the methods described herein. In consequence, the overall scope is directed to the testing of new or previously unapproved constituents of concretes, or to production concretes where a requirement to test the end-use product has arisen.

SIS-CEN/TR 15678:2008 (E)**Constituents - general description of the method of test**

The first method describes how to determine the release of (regulated) dangerous substances from a new/unapproved constituent of concrete. The method is comparative in that results obtained from a laboratory prepared reference concrete which does not include the constituent under test (control mix) are subtracted from the results obtained from a reference concrete that incorporates the test constituent by either substitution or addition (test mix).

A new/unapproved constituent for use in concrete can be incorporated into a reference concrete in three different ways, either by:

- *substitution* (partial or full) for a reference constituent of the same type and which reference constituent has either been classified as WT or has otherwise demonstrated its fitness for intended use, as in the case of: factory-made cements, aggregates, type I additions;
- *substitution* (partial) for a reference constituent of a different type and which reference constituent has either been classified as WT or has otherwise demonstrated its fitness for intended use, as in the case of: type I or type II additions;
- or by *addition* to the reference concrete, as in the case of: admixtures, polymer modifiers and fibres.

As a principle, the method seeks to isolate, as far as is practicable, the contribution to the release of substances from the unapproved constituent i.e. the constituent under test, from the contributions from the other constituents that make up the reference concrete. However, complete isolation of contributions to release, one constituent from another, is not possible for all types of constituents. For example, if *substitution* by a type II addition or *addition* by a chemical admixture leads via a synergistic effect (e.g. by a micro-structural modification) to a reduction in permeability of a test mix in comparison with its companion control mix, then complete isolation will not have been achieved. Such synergies, however, occur in concretes as used in the field, therefore, the overall effects on release from the relevant hardened test mixes will also tend to reflect reality.

In general, in the case where an unapproved constituent replaces a reference constituent by *substitution*, the assessment is made by subtracting, in whole or in part (depending on the type of constituent and the level of substitution), the results for release of substances obtained for the reference concrete (i.e. the control mix) from those obtained for the test mix in which the unapproved constituent is present. The exception to this rule occurs in the specific case where the unapproved constituent is a factory made cement. In this particular case the design of the method is such that there will be no contributions from other constituents to be subtracted.

Similarly, in the case where an unapproved constituent is *added* to a reference concrete, the assessment is made after subtracting any contributions to release of substances from the reference concrete in which the constituent under test is absent (i.e. the control mix) from any contributions from the test mix to which the constituent has been added.

Production concretes - general description of the method of test

The second and third methods, in normative Annex A and informative Annex B, respectively, utilise the same test conditions for assessing release of (regulated) dangerous substances but start from the sampling of production concretes. In cases where products are supplied to the market as formed in the factory, they may be sampled as either finished items (monoliths) or as proxy samples of the fresh wet material used in their production. Where materials are supplied in a formless state, samples are taken from the fresh wet materials. Where products are supplied pre-packaged, each sample is a representative whole bag of product.

In the case of products sampled in the fully formed (monolithic) state, test pieces are prepared by either sawing or coring regular shaped test pieces of appropriate dimensions from the factory-made item. Whereas, in the case of samples of fresh wet material and pre-packaged products, test pieces are prepared as standard-sized moulded test pieces.

Moulded test pieces are cured under different conditions depending on the product type from which they are taken. In the case of proxy samples taken from fresh wet material used in the production of factory made

items, these are cured under conditions that are representative of those used in the manufacture of the item. In the case of test pieces prepared from pre-packaged products and fresh wet materials as supplied to the market, these are cured for periods specified in specifications or regulations appropriate to the material type. Subsequent to curing, test pieces, representing production of concrete, are subject to the same extraction conditions as those used for testing individual constituents in reference mixes of concrete.

However, in the case of production materials, there is no place for a reference concrete in the test method because it is the overall release of substances from the sample taken from production that is to be assessed against either generic limit (e.g. threshold) values or classes of performance appropriate to concrete, rather than, as in the first method, limit values or performance classes appropriate to individual constituents.

Extraction conditions

The extraction procedure to be adopted by the methods described herein will be the horizontal monolithic bulk diffusion method developed by CEN/TC 351 *Construction products – Assessment of release of dangerous substances*, established in 2005.

However, a preliminary comparison has been carried out by CEN/TC 51 of the main features of the bulk diffusion tests that are, or could be, relevant to concrete and its constituents that are either already published or are currently under development. The extraction conditions employed by the different methods, and that may have relevance to the bulk diffusion extraction procedure likely to be developed by CEN/TC 351, are summarised in Table 1 below.

Table 1 — Test methods

Main feature of method	Test method			
	CEN CR 351XX [3] (unpublished)	Draft procedure in support of German DIBt regulations[4]	Dutch NEN 7345 [5]	CEN/TC 292 draft compliance test for leaching from monolithic waste (2003) [6]
Scope	Natural environment	Natural environment (groundwater & soil)	Natural environment	Natural environment
Test pieces	100 mm concrete cubes made in accordance with EN 12390-2	100 mm concrete cubes	Minimum dimension 40 mm	Minimum dimension 40 mm
Moulding requirements	Thorough washing, no release oil.	Shale oil must not be used	Method is generic and does not deal with concrete specifically	May be prepared by moulding, cutting or coring
Reference concrete composition	Test samples are production concretes	Cement content 280 kg/m ³ w/c 0.60 (or highest anticipated for use) Aggregate to DIN 4226	Method is generic and does not deal with concrete specifically	Method is generic and does not deal with concrete specifically
Curing conditions	Demoulded at 24 h 6 days in sealed polythene bag at	Demoulded at 24 h Up to 56 days in sealed plastics at (20 ± 2) °C.	Method is generic and does not deal with concrete specifically	Not specified but age must be recorded Test pieces to be stored in sealed containers at