SLOVENSKI STANDARD
oSIST prEN 197-1:2018

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Cement - 1. del: Sestava, zahteve in merila skladnosti za običajne cemente

Cement - Part 1: Composition, specifications and conformity criteria for common cements

Zement - Teil 1: Zusammensetzung, Anforderungen und Konformitätskriterien von Normalzement

Ciment - Partie 1 : Composition, spécifications et critères de conformité des ciments courants

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English Version

Cement - Part 1: Composition, specifications and conformity criteria for common cements

Ciment - Partie 1 : Composition, spécifications et critères de conformité des ciments courants

Zement - Teil 1: Zusammensetzung, Anforderungen und Konformitätskriterien von Normalzement

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 51.

If this draft becomes a European Standard, 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.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (prEN 197-1:2018) has been prepared by Technical Committee CEN/TC 51 “Cement and building lime”, the secretariat of which is held by NBN.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 197-1:2011.

This document has been prepared under a standardization request given to CEN by the European Commission and the European Free Trade Association, and supports basic requirements of Regulation (EU) No 305/2011 amended by the Commission Delegated Regulations (EU) No 157/2014 of 30 October 2013, No 568/2014 of 18 February 2014 and No 574/2014 of 21 February 2014.

For relationship with Regulation (EU) No 305/2011, see informative Annex ZA, which is an integral part of this document.

Annexes A and ZA are informative.

Compared to the version EN 197-1:2011 the following major changes have been included in this document:

— CEM II/C and CEM VI have been defined as new cement types;

— CEM V has been renamed as Slag-pozzolanic cement;

— the total alkali content was included as part of the essentials characteristics and corresponding rules were laid down;

— Annex ZA has been revised.

EN 197, *Cement*, is currently composed with the following parts:

— *Part 1: Composition, specifications and conformity criteria for common cements*

— *Part 2: Conformity evaluation*

The preparation of a standard for cement was initiated by the European Economic Community (EEC) in 1969 and, at the request of a member state later in 1973, the work was given to the European Committee for Standardization (CEN). The Technical Committee CEN/TC 51 was entrusted with the task of preparing a cement standard for the countries of Western Europe, comprising the EEC and EFTA members.

In the early eighties, CEN/TC 51 decided to include in the standard for cement only those cements which are intended for use in any plain and reinforced concrete and which are familiar in most countries in Western Europe because they have been produced and used in these countries for many years. The EU Construction Products Directive (89/106/EEC) required the incorporation of all traditional and well-tried cements in order to remove technical barriers to trade in the construction field. There are currently no criteria for the descriptions “traditional” and “well tried” and it was maintained the need to separate the “common cements” from “special cements”, i.e. those with additional or special properties.

The requirements in this standard are based on the results of tests on cement in accordance with EN 196-1, EN 196-2, EN 196-3, EN 196-5, EN 196-6, EN 196-7, EN 196-8, and EN 196-9. The scheme for the assessment and verification of constancy of performance (AVCP) of common cements including common cements with low heat of hydration and common cements generally accepted as being sulfate resisting and of special cements are specified in EN 197-2.

In 2006, CEN/TC 51 began to investigate the possible standardization of some new cements produced using traditional constituents and manufacturing methods but where compositions were outside the limits of EN 197-1. Based on the results of a pre-normative study presented in 2011, new cements containing Portland cement clinker and, as other main constituents, limestone, granulated blast furnace slag or siliceous fly ash or natural pozzolana, have been standardized in this document as CEM II/C and CEM VI.

The strength attained at twenty-8 days is the important criterion in classifying cement for most uses. In order to achieve a specific strength class at twenty-8 days the early strength, at two days or at seven days, can vary and some types of cement may not attain the minimum early strengths specified in EN 197-1 for common cements.

The heat of hydration is linked to the early reactivity and lower early strengths indicate lower heat evolution and lower temperatures in concrete. For these cements additional precautions in use can be necessary to ensure adequate curing and safety in construction.

The purpose of this standard is to specify the composition requirements and conformity requirements for common cements, including common cements with low heat of hydration and common cements with adequate sulfate resistance as well as low early strength blast furnace cements and low early strength blast furnace cements with low heat of hydration.

Cement types and strength classes defined in this document allow the specifier and/or the user to fulfil objectives of sustainability for cement based constructions. Cement types produced by using constituents listed and defined in Clause 5 allow the manufacturer to minimize the use of natural resources in accordance with local conditions of production.

Introduction

It is recognized that different cements have different properties and performance. Those performance tests now available (i.e. setting time, strength, soundness and heat of hydration), have been included in this standard. In addition, work is being carried out by CEN/TC 51 to identify any additional tests which are needed to specify further performance characteristics of cement. Until further performance tests are available it is necessary that the choice of cement, especially the type and/or strength class in relation to the requirements for durability depending on exposure class and type of construction in which it is incorporated, follows the appropriate standards and/or regulations for concrete, mortar, grout etc. valid in the place of use.

1 Scope

This document defines and gives the specifications of 39 distinct common cements, 7 sulfate resisting common cements as well as 3 distinct low early strength blast furnace cements and 2 sulfate resisting low early strength blast furnace cements and their constituents. The definition of each cement includes the proportions in which the constituents are to be combined to produce these distinct products in a range of nine strength classes. The definition also includes requirements which the constituents have to meet. It also includes mechanical, physical, and chemical requirements. Furthermore, this standard states the conformity criteria and the related rules. Necessary durability requirements are also given.

In addition to those sulfate resisting cements defined in the present document, other cements conforming either to this standard or to other standards, European or national, have been nationally demonstrated to have sulfate resisting properties. These cements which are listed in Annex A, are considered by different CEN Member countries as sulfate resisting within the limits of their territory.

NOTE 1 In addition to the specified requirements, an exchange of additional information between the cement manufacturer and user can be helpful. The procedures for such an exchange are not within the scope of this standard but should be dealt with in accordance with national standards or regulations or can be agreed between the parties concerned.

NOTE 2 The word “cement” in EN 197-1 is used to refer only to common cements unless otherwise specified.

This document does not cover:

— very low heat special cement covered by EN 14216;

— supersulfated cement covered by EN 15743;

— calcium aluminate cement covered by EN 14647;

— masonry cement covered by EN 413-1.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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, *Methods of testing cement — Part 1: Determination of strength*

EN 196-2, *Methods of testing cement — Part 2: Chemical analysis of cement*

EN 196-3, *Methods of testing cement — Part 3: Determination of setting times and soundness*

EN 196-5, *Methods of testing cement — Part 5: Pozzolanicity test for pozzolanic cement*

EN 196-6, *Methods of testing cement — Part 6: Determination of fineness*

EN 196-7, *Methods of testing cement — Part 7: Methods of taking and preparing samples of cement*

EN 196-8, *Methods of testing cement — Part 8: Heat of hydration — Solution method*

EN 196-9, *Methods of testing cement — Part 9: Heat of hydration — Semi-adiabatic method*

EN 197-2, *Cement — Part 2: Conformity evaluation*

EN 451-1, *Method of testing fly ash — Part 1: Determination of free calcium oxide content*

EN 933-9, *Tests for geometrical properties of aggregates — Part 9: Assessment of fines — Methylene blue test*

EN 13639, *Determination of total organic carbon in limestone*

ISO 9277, *Determination of the specific surface area of solids by gas adsorption — BET method*

ISO 9286, *Abrasive grains and crude — Chemical analysis of silicon carbide*

ISO 10694, *Soil quality — Determination of organic and total carbon after dry combustion (elementary analysis)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1

reactive calcium oxide (CaO)

fraction of the calcium oxide which, under normal hardening conditions, can form calcium silicate hydrates or calcium aluminate hydrates

Note 1 to entry: To evaluate this fraction, the total calcium oxide content (see EN 196-2) is reduced by the fraction corresponding to calcium carbonate ($CaCO_3$), based on the measured carbon dioxide (CO_2) content (see EN 196-2), and the fraction corresponding to calcium sulfate ($CaSO_4$), based on the measured sulfate (SO_3) content (see EN 196-2) after subtraction of the SO_3 taken up by alkalis.

3.2

reactive silicon dioxide (SiO_2)

fraction of the silicon dioxide which is soluble after treatment with hydrochloric acid (HCl) and with boiling potassium hydroxide (KOH) solution

Note 1 to entry: The quantity of reactive silicon dioxide is determined by subtracting from the total silicon dioxide content (see EN 196-2) the fraction contained in the residue insoluble in hydrochloric acid and potassium hydroxide (see EN 196-2), both on a dry basis.

3.3

main constituent

specially selected inorganic material in a proportion exceeding 5 % by mass related to the sum of all main and minor additional constituents

3.4

minor additional constituent

specially selected inorganic material used in a proportion not exceeding a total of 5 % by mass related to the sum of all main and minor additional constituents

3.5
type of common cement
one of the 39 products in the family of common cements

Note 1 to entry: Table 1 lists the 39 products in the family of common cements.

3.6
strength class of cement
class of compressive strength

3.7
autocontrol testing
continual testing by the manufacturer of cement spot samples taken at the point(s) of release from the factory/depot

3.8
control period
period of production and dispatch identified for the evaluation of the autocontrol test results

3.9
characteristic value
value of a required property outside of which lies a specified percentage, the percentile P_k, of all the values of the population

3.10
specified characteristic value
characteristic value of a mechanical, physical or chemical property which in the case of an upper limit is not to be exceeded or in the case of a lower limit is, as a minimum, to be reached

3.11
single result limit value
value of a mechanical, physical or chemical property which – for any single test result – in the case of an upper limit is not to be exceeded or in the case of a lower limit is, as a minimum, to be reached

3.12
allowable probability of acceptance CR
for a given sampling plan, allowed probability of acceptance of cement with a characteristic value outside the specified characteristic value

3.13
sampling plan
specific plan which states the (statistical) sample size(s) to be used, the percentile P_k and the allowable probability of acceptance CR

3.14
spot sample
sample which is taken at the same time and from one and the same place, relating to the intended tests, and which can be obtained by combining one or more immediately consecutive increments

Note 1 to entry: See EN 196-7.

3.15
heat of hydration
quantity of heat developed by the hydration of a cement within a given period of time

3.16
low heat common cement
common cement with a limited heat of hydration

3.17
sulfate resisting common cement
common cement which fulfils the requirements for sulfate resisting properties

3.18
low heat low early strength blast furnace cement
low early strength blast furnace cement with a limited heat of hydration

3.19
sulfate resisting low early strength blast furnace cement
low early strength blast furnace cement which fulfils the requirements for sulfate resisting properties

3.20
total alkali content
alkali content of a cement determined according to EN 196-2 and expressed as the sodium oxide equivalent

Note 1 to entry: The "available" or "effective" alkali content or any calculated alkali content of cement (e.g. weighted value) is not dealt with in this document.

4 Cement

Cement is a hydraulic binder, i.e. a finely ground inorganic material which, when mixed with water, forms a paste which sets and hardens by means of hydration reactions and processes and which, after hardening, retains its strength and stability even under water.

Cement conforming to this standard, termed CEM cement, shall, when appropriately batched and mixed with aggregate and water, be capable of producing concrete or mortar which retains its workability for a sufficient time and shall after defined periods attain specified strength levels and also possess long-term volume stability.

Hydraulic hardening of CEM cement is primarily due to the hydration of calcium silicates but other chemical compounds can also participate in the hardening process, e.g. aluminates. The sum of the proportions of reactive calcium oxide (CaO) and reactive silicon dioxide (SiO_2) in CEM cement shall be at least 50 % by mass when the proportions are determined in accordance with EN 196-2.

CEM cements consist of different materials and are statistically homogeneous in composition resulting from quality ensured production and material handling processes. The link between these production and material handling processes and the conformity of cement to this standard is elaborated in EN 197-2.

NOTE There are also cements whose hardening is mainly due to other compounds, e.g. calcium aluminate in calcium aluminate cement.

5 Constituents

5.1 General

The requirements for the constituents specified in 5.2 to 5.5 shall be determined in principle in accordance with the test methods described in EN 196 unless otherwise specified.

5.2 Main constituents

5.2.1 Portland cement clinker (K)

Portland cement clinker is made by sintering a precisely specified mixture of raw materials (raw meal, paste or slurry) containing elements, usually expressed as oxides, CaO, SiO_2, Al_2O_3, Fe_2O_3 and small quantities of other materials. The raw meal, paste or slurry is finely divided, intimately mixed and therefore homogeneous.

Portland cement clinker is a hydraulic material which shall consist of at least two-thirds by mass of calcium silicates ($3CaO \cdot SiO_2$ and $2CaO \cdot SiO_2$), the remainder consisting of aluminium and iron containing clinker phases and other compounds. The ratio by mass $(CaO)/(SiO_2)$ shall be not less than 2,0. The content of magnesium oxide (MgO) shall not exceed 5,0 % by mass.

Portland cement clinker incorporated in sulfate resisting Portland cement (CEM I, see 6.2) and sulfate resisting pozzolanic cements (CEM IV, see 6.2) shall fulfil additional requirements for tricalcium aluminate content (C_3A). The tricalcium aluminate content of the clinker shall be calculated by Formula (1) as follows:

$$C_3A = 2{,}65\ A - 1{,}69\ F \quad (1)$$

where

A is the percentage of aluminium oxide (Al_2O_3) by mass of the clinker as determined in accordance with EN 196-2;

F is the percentage of iron (III) oxide (Fe_2O_3) by mass of the clinker as determined in accordance with EN 196-2.

It can happen that a negative C_3A value is obtained from the calculation. In this case, the value 0 % by mass should be recorded. A test method to determine the C_3A content of clinker from the analysis of a spot sample of cement is currently under development by CEN/TC 51. Until this method is available, the C_3A content should be directly measured on the clinker. In the specific case of CEM I, it is permissible to calculate the C_3A content of clinker from the chemical analysis of the cement. The minimum frequency of testing and the use of alternative methods for the direct or indirect evaluation of C_3A should be included in the factory production control (see EN 197-2). A typical frequency of testing is two per month in routine situations.

Sulfate resisting Portland cements and sulfate resisting pozzolanic cements are made with Portland cement clinker in which the C_3A content does not exceed:

— for CEM I: 0 % by mass, 3 % by mass or 5 % by mass as appropriate (see 6.2);

— for CEM IV/A and CEM IV/B: 9 % by mass.