



SLOVENSKI STANDARD
SIST EN 451-1:2017

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Nadomešča:
SIST EN 451-1:2004

Metoda preskušanja elektrofilskega pepela - 1. del: Ugotavljanje deleža prostega kalcijevega oksida

Method of testing fly ash - Part 1: Determination of free calcium oxide content

Prüfverfahren für Flugasche - Teil 1: Bestimmung des freien Calciumoxidgehalts

Méthode d'essai des cendres volantes - Partie 1: Détermination de la teneur en oxyde de calcium libre

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Ta slovenski standard je istoveten z: EN 451-1:2017

ICS:

91.100.30 Beton in betonski izdelki Concrete and concrete products

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en,fr,de

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EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 451-1

May 2017

ICS 91.100.30

Supersedes EN 451-1:2003

English Version

**Method of testing fly ash - Part 1: Determination of free
calcium oxide content**

Méthode d'essai des cendres volantes - Partie 1:
Détermination de la teneur en oxyde de calcium libre

Prüfverfahren für Flugasche - Teil 1: Bestimmung des
freien Calciumoxidgehalts

This European Standard was approved by CEN on 27 February 2017.

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 CEN-CENELEC 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 CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

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

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European foreword

This document (EN 451-1:2017) has been prepared by Technical Committee CEN/TC 104 “Concrete and related products”, the secretariat of which is held by DIN.

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 November 2017, and conflicting national standards shall be withdrawn at the latest by November 2017.

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 document supersedes EN 451-1:2003.

EN 451, *Method of testing fly ash*, is currently composed with the following parts:

- *Part 1: Determination of free calcium oxide content* [the present document];
- *Part 2: Determination of fineness by wet sieving.*

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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EN 451-1:2017 (E)

1 Scope

This European Standard specifies the procedure for the determination of free calcium oxide content in fly ash.

The European Standard specifies the reference procedure. If other methods are used it needs to be shown that they give results equivalent to those obtained by the reference method.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 450-1:2012, *Fly ash for concrete — Part 1: Definition, specifications and conformity criteria*

ISO 565, *Test sieves — Metal wire cloth, perforated metal plate and electroformed sheet — Nominal sizes of openings*

ISO 3534-1, *Statistics — Vocabulary and symbols — Part 1: General statistical terms and terms used in probability*

3 General

3.1 Number of determinations

Carry out twice the procedure for determining the free calcium oxide content of the sample.

If the difference between two determinations is more than twice the repeatability standard deviation, repeat the test and take the mean of the closest values.

3.2 Repeatability and reproducibility

The standard deviations of repeatability and reproducibility, as defined in ISO 3534-1, are expressed in absolute percentages by mass.

3.3 Expression of masses and volumes

Express masses in grams to the nearest 0,000 1 g, measure volumes using a burette and express them in millilitres to the nearest 0,05 ml.

4 Reagents

Use only reagents of analytical grade and distilled water, or water of equal purity.

4.1 Butanoic acid, 3-oxo-ethyl ester (= ethyl acetoacetate).

4.2 Butan-2-ol.

4.3 Propan-2-ol.

4.4 Indicator (0,1 g of bromophenol blue in 100 ml of ethanol).

4.5 Hydrochloric acid (0,100 M).

5 Apparatus

- 5.1 **Balance**, with a resolution of 0,000 1 g or better.
- 5.2 **Test sieve**, with 0,063 mm sieve cloth conforming to ISO 565.
- 5.3 **Mortar and pestle**, or similar equipment for grinding.
- 5.4 **Desiccator**, containing a drying agent, e.g. silica gel.
- 5.5 **Flask**, 250 ml.
- 5.6 **Spiral reflux condenser**.
- 5.7 **Absorption tube**, filled with sodium hydroxide on an inorganic carrier (to protect the contents of the flask and the condenser from reacting with atmospheric carbon dioxide).
- 5.8 **Filter crucible**, with pore sizes of 0,004 mm to 0,010 mm.

NOTE Alternatively also a filter funnel, in which a filter paper with fine pores of a diameter of approximately 0,002 mm and a filter paper with medium pores of a diameter of approximately 0,007 mm can be placed, can be used.

6 Procedure

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6.1 Preparation of sample (standards.iteh.ai)

Subdivide the laboratory sample, prepared in accordance with EN 450-1:2012, Clause 7 by a suitable method to obtain a subsample of about 20 g. Pass this subsample through the test sieve (5.2). Grind any residue in the mortar (5.3) until all the subsample passes through the sieve completely. Homogenize the total subsample and place it in the desiccator (5.4) until tested.

6.2 Determination

Place a weighed portion of 1,0 g to 1,5 g of the sub-sample prepared in accordance with 6.1 into the 250 ml flask (5.5) and add a mixture of 12 ml butanoic acid, 3-oxo-ethyl ester (4.1) and 80 ml butan-2-ol (4.2). Fit the flask with the spiral reflux condenser (5.6) and the absorption tube (5.7) and boil for 3 h. Filter the warm mixture through the filter crucible (5.8). Wash the residue with 50 ml propan-2-ol (4.3). If the filtrate is cloudy, reject it and repeat the extraction with a new weighed portion of the sub sample.

Add a few drops of bromophenol blue indicator (4.4) to the filtrate and titrate with hydrochloric acid (4.5) until the colour changes to yellow.

Record the volume V of hydrochloric acid used.

NOTE In addition to colour changes also other procedures for end point determination can be used (e.g. pH value, conductivity).

6.3 Calculation

The free calcium oxide content (W_{CaO}), expressed as a percentage by mass of the dry fly ash, shall be calculated from the following formula:

$$W_{CaO} = \frac{M \times c \times V}{m \times 1\,000} \times 100 \quad (1)$$

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where

- c is the concentration (in mol/l) of the hydrochloric acid solution;
- V is the volume (in ml) of hydrochloric acid solution used for titration;
- m is the mass of the test portion (in g) of the dried fly ash;
- M 28,04 g/mol (1/2 of molar mass of CaO).

7 Result

The mean value of two determinations, calculated to two decimal places and expressed to one decimal place, shall be taken as the free calcium oxide content of the sample.

8 Repeatability and reproducibility

The standard deviation for repeatability is 0,03 % by mass. (according to laboratory specific information)

The standard deviation for reproducibility is 0,09 % by mass. (according to Round Robin Test of 13 laboratories)

NOTE It is a measure of the dispersion of the distribution of test results under repeatability (reproducibility) conditions.

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