SLOVENSKI STANDARD
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Aglomeriran kamen - Preskusne metode - 13. del: Ugotavljanje električne upornosti

Agglomerated stone - Test methods - Part 13: Determination of electrical resistivity

Künstlich hergestellter Stein - Prüfverfahren - Teil 13: Bestimmung des spezifischen elektrischen Widerstands

Pierre agglomérée - Méthodes d'essai - Partie 13 : Détermination de la résistivité électrique

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91.100.15	Mineralni materiali in izdelki	Mineral materials and products

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EUROPEAN STANDARD

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Agglomerated stone - Test methods - Part 13: Determination of electrical resistivity

Pierre agglomérée - Méthodes d'essai - Partie 13 : Détermination de la résistivité électrique

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This European Standard was approved by CEN on 1 March 2013.

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

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Foreword

This document (EN 14617-13:2013) has been prepared by Technical Committee CEN/TC 246 “Natural stones”, the secretariat of which is held by UNI.

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of an identical text or by endorsement, at the latest by October 2013, and conflicting national standards shall be withdrawn at the latest by October 2013.

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 14617-13:2005.

Clauses 6, 7, 8, 9 and 10 have been modified and a new Annex C has been added since the last edition of this European Standard.

This European Standard is one of a series of standards for test methods for agglomerated stones which includes the following:

— *Part 1: Determination of apparent density and water absorption*

— *Part 2: Determination of flexural strength (bending)*

— *Part 4: Determination of the abrasion resistance*

— *Part 5: Determination of freeze and thaw resistance*

— *Part 6: Determination of thermal shock resistance*

— *Part 8: Determination of resistance to fixing (dowel hole)*

— *Part 9: Determination of impact resistance*

— *Part 10: Determination of chemical resistance*

— *Part 11: Determination of linear thermal expansion coefficient*

— *Part 12: Determination of dimensional stability*

— *Part 13: Determination of electrical resistivity*

— *Part 15: Determination of compressive strength*

— *Part 16: Determination of dimensions, geometric characteristics and surface quality of modular tiles*

According to the CEN-CENELEC Internal Regulations, the national standards organisations 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, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard covers the determination of DC insulation resistance, surface resistance and resistivity, and the corresponding electrical conductance and conductivity of specimens of agglomerated stone products conforming to the definition reported in EN 14618. These products are usually made by stone aggregates bound via either resin and filler or cement and water (paste components), or a mixture of polymer/cement and related addition (such as reinforcing fibres, electrically insulating/conducting fillers, etc.).

Resistivity/conductivity may also be used as an indirect measure of some properties of agglomerated stone products (see Annex A - informative).

Volume resistance and resistivity test method and the corresponding electrical conductance and conductivity of specimens of agglomerated stone products are also included (see Annex C - informative).

2 Normative references

Not applicable.

3 Principle

The resistance/conductance of an agglomerated stone specimen is evaluated by the measurement of direct current (DC) flow in the specimen under specified conditions by appropriate electrode systems. The resistivity/conductivity shall be calculated from specimen and electrode dimensions and shapes.

4 Terms and definitions and symbols

4.1
insulation resistance
$\Omega \rightarrow \Omega$ = ohm
insulation resistance between two electrodes that are in electrical contact with an agglomerated stone specimen, calculated as the ratio of the direct voltage applied to the electrodes to the total current flowing between them

Note 1 to entry: It is dependent upon the shape and size as well as the volume and surface resistance of the specimen.

4.2
surface resistance
R_S (Ω)
surface resistance between two electrodes that are in electrical contact with the surface of an agglomerated stone specimen, calculated as the ratio of the direct voltage applied to the electrodes to that portion of the current between them which is primarily distributed on the specimen surface and a thin material layer beneath the specimen surface

Note 1 to entry: Surface conductivity cannot be accurately known, only conventionally, because more or less volume contribution is usually involved in the measurement, depending on the nature of the specimen and environment.

4.3
surface resistivity
ρ_s (Ω)
surface resistivity of the agglomerated stone material, which is calculated as the ratio of the potential gradient parallel to the current direction along its surface to the current per unit width of the surface

4.4
surface conductivity
γ_S (Ω-1)
reciprocal of the surface resistivity

4.5
volume resistance
R_V (Ω)
volume resistance between two electrodes that are in electrical contact with a specimen, calculated as the ratio of the direct voltage applied to the electrodes to that portion of the current between them that flows only through the volume of the specimen

4.6
volume resistivity
ρ_V ($\Omega \cdot m$)
volume resistivity of the agglomerated stone material, which is calculated as the ratio of the potential gradient, parallel to the current direction in the material, to the current density

EXAMPLE The charge carriers flow through the specimen, charge flowing in the unit time across the unit surface area normal to the current direction.

4.7
volume conductivity
γ_V ($\Omega^{-1} \cdot m^{-1}$ = S/m → S = siemens)
reciprocal of the volume resistivity

5 Sampling and test specimen preparation

Sampling is not the responsibility of the test laboratory, unless otherwise agreed. It shall be appropriate to agglomerated stone consignment. Whenever possible, the random sampling method shall be used. Test specimens shall, however, be representative of the agglomerated stone sample and can be directly obtained from laboratory moulding and curing according to a detailed procedure (properly described in the test report) and/or core samples taken "in situ" and cut to proper size for the measuring apparatus. The surfaces shall be honed or polished.

The test specimen may have any practical shape allowing the use of a proper three terminal electrodes system, according to the electrode assembly schematically shown in Figure 1 for flat test specimens. Sheet specimens like those illustrated in Figure 1 should exhibit a thickness exceeding by 20 % the largest stone fragments size used in the agglomerated stone, and a diameter of 20 mm to 160 mm according to the resistivity of the tested material. At least five test specimens shall be selected by sampling.

6 Specimen conditioning

Measurements shall be made on either room-conditioned (23 ± 2) °C and (50 ± 10) % R.U. or dried specimens. In the first case, specimens shall be measured after proper conditioning (24 h at least) in the measuring environment according to other existing standard conditioning procedures. In the latter case, specimen should be dried to constant weight in a circulating-air oven at (50 ± 2) °C (i.e. difference < 0,1 % mass by consecutive weighing/ 24 h). After removing from the oven, specimens shall be cooled to room temperature in a dessicator under anhydrous atmosphere (anhydrous calcium chloride can be used) or in a vacuum enclosure until testing.

7 Electrode system and measuring equipment

Flat circular electrodes with the three-terminal configuration of Figure 1 shall be used for the measurement of surface characteristics of agglomerated stone flat specimens. The guard electrode may be omitted only for materials that have really ascertained negligible charge surface leakage. A two-terminal configuration (i.e. without the guard electrode) shall be used only for insulation resistance measurement.

To ensure an effective electrical contact of the measuring electrodes with the specimen surface, the three-terminal configuration on the specimen should be obtained by applying either a conducting layer (e.g. colloidal graphite, metal spray or paint; conducting metal layer - gold, aluminium – by vacuum deposition, etc.) or placing a semiconducting sheet (e.g. a soft polymeric or rubber semiconducting sheet) of the required geometry and size on the specimen surfaces and pressing it between the electrode system.

The voltmeter-ammeter method of Figure A.1 should be used whenever possible. A constant voltage shall be supplied by a constant, stabilised voltage generator. The current flowing through the specimen at a fixed, constant voltage may be measured by any equipment having the required sensitivity and accuracy (± 10 % is usually adequate) and data acquisition and treatment by personal computer. Electrometers or direct-reading multimeters of suitable sensitivity may be used with the voltmeter-ammeter method of Figure 2, depending on the current range exhibited by the agglomerated stone specimen under testing.

8 Procedure

At least five test specimens shall be measured.

Referring to Figure 1, measure the diameter *d* of the electrodes, the width *g* of the guard gap and the thickness *th* of the specimen with the appropriate measuring gauges (caliper and micrometer of proper sensitivity and accuracy are usually adequate).

Make the electrical measurement with suitable devices having the required sensitivity and accuracy in a controlled atmosphere; the following standard conditions are suggested: for room-conditioned specimens, a temperature of (23 ± 2) °C and a relative humidity of (50 ± 10) %; for dried specimens, either a vacuum or dry environment. Unless otherwise specified, a time of electrification of 60 s and an applied direct voltage of 100 V (or higher, depending on both specimen thickness and sample resistivity) shall be used.

Electrode position (Figure 1):

— Electrode n° 1: measuring or guarded electrode;

— Electrode n° 2: high voltage electrode;

— Electrode n° 3: guard electrode.

9 Expression of results

Surface resistivity ρ_s and surface conductivity γ_s are calculated as a function of specimen shape at the measuring time t. When measured in a vacuum enclosure, “intrinsic” (i.e. without any environment influence) electrical resistivity/conductivity of agglomerated stones should be referred to.

For a flat circular agglomerated stone specimen, the following formula shall be used:

$$\rho_s = 1/\gamma_s = R_s \cdot P/g \ [\Omega] \quad (1)$$

where:

R_s is measured surface resistance in Ω;

P is πD_1 in m.

d_0, D_1, D_2, g, th are the dimensions reported in Figure 1.

Calculate the mean value. In addition, statistical treatment of the measurement data should be made to obtain standard deviation and coefficient of variation for the proper quantile factor according to existing procedures, when a normal distribution of data are assumed (see Annex B).

10 Report

The report shall include the following:

a) unique identification number of the report;

b) the number and year of issue of this European Standard, i.e. EN 14617-13:2013;

c) the name and address of the test laboratory and the address where the test was carried out if different from the test laboratory;

d) the name and address of the client;

e) it is the responsibility of the client to supply the following information:

   1) the name of the supplier;

   2) the name of the person or organisation which carried out the sampling;

   3) the surface finish of the specimens (if relevant to the test);

   4) the nature of the binders;

f) the date of delivery of the sample or of the specimens;

g) the date when the test specimens were prepared (if relevant) and the date of testing;

h) the number of specimens in the sample;

i) the dimensions of the specimens;

j) curing conditions and age of test specimens;

k) dimensions of specimens according to either Figure 1 or proper sample shape;

l) type of surface finishing;

m) type, shape and dimensions of electrical contacts;

n) measuring conditions (temperature, relative humidity and applied electrical field);

o) type of measuring equipment;

p) applied voltage;

q) time of voltage application;

r) the number of test specimens measured;