SLOVENSKI STANDARD
SIST EN 14617-13:2005

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Aglomeriran kamen - Preskusne metode - 13. del: Ugotavljanje elektriļne 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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Agglomerated stone - Test methods - Part 13: Determination of electrical resistivity

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

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This European Standard was approved by CEN on 3 February 2005.

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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

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

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Foreword

This document (EN 14617-13:2005) 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of an identical text or by endorsement, at the latest by September 2005, and conflicting national standards shall be withdrawn at the latest by September 2005.

Test methods for agglomerated stones consist of the following:

EN 14617-1, *Agglomerated stone - Test methods – Part 1: Determination of apparent density and water absorption*

EN 14617-2, *Agglomerated stone – Test methods – Part 2: Determination of flexural strength (bending)*

prEN 14617-3, Agglomerated stone - Test methods – Part 3: Determination of slipperiness

EN 14617-4, *Agglomerated stone - Test methods – Part 4: Determination of the abrasion resistance*

EN 14617-5, *Agglomerated stone - Test methods – Part 5: Determination of freeze and thaw resistance*

EN 14617-6, *Agglomerated stone - Test methods – Part 6: Determination of thermal shock resistance*

prEN 14617-7, *Agglomerated stone – Test methods – Part 7: Determination of ageing*

prEN 14617-8, *Agglomerated stone – Test methods – Part 8: Determination of resistance to fixing (dowel hole)*

EN 14617-9, *Agglomerated stone - Test methods – Part 9: Determination of impact resistance*

EN 14617-10, *Agglomerated stone – Test methods – Part 10: Determination of chemical resistance*

EN 14617-11, *Agglomerated stone – Test methods – Part 11: Determination of linear thermal expansion coefficient*

EN 14617-12, *Agglomerated stone – Test methods – Part 12: Determination of dimensional stability*

EN 14617-13, *Agglomerated stone – Test methods – Part 13: Determination of electrical resistivity*

EN 14617-15, *Agglomerated stone – Test methods – Part 15: Determination of compressive strength*

EN 14617-16, *Agglomerated stone – Test methods – Part 16: Determination of dimensions, geometric characteristics and surface quality of modular tiles*

prEN 14617-17, *Agglomerated stone – Test methods – Part 17: Determination of biological resistance*

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

1 Scope

This test method covers the determination of dc insulation resistance, volume resistance and resistivity, as well as 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 be also used as an indirect measure of some properties of agglomerated stones products (see Annex A).

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.

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. Surface and volume resistance/conductance may be measured separately by the same electrode system. The resistivity/conductivity shall be calculated from specimen and electrode dimensions and shapes.

4 Definitions and symbols

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

4.1
insulation resistance (Ω → Ω = 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; it is dependent upon the shape and size as well as the volume and surface resistance of the specimen.

4.2
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.

4.3
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. Surface conductivity cannot be known accurately, but only conventionally, because more or less volume contribution is usually involved in the measurement, depending on the nature of the specimen and environment.

4.4
volume resistivity ρ_v (Ω·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 (i.e., the charge carriers flow through the specimen, charge flowing in the unit time across the unit surface area normal to the current direction).

4.5
surface resistivity ρ_s ($\Omega_{\square}$)
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.

4.6
volume conductivity γ_v (Ω^{-1}·m^{-1} = S/m → S = siemens)
reciprocal of the volume resistivity

4.7
surface conductivity γ_s ($\Omega^{-1}_{\square}$)
reciprocal of the surface 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 be however representative of the agglomerated stone sample and can be directly obtained from both laboratory moulding and curing according 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 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 20 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 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 (70±5) °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 till 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 volume and surface characteristics of agglomerated stones flat specimens. The guard electrode allows any contribution of the surface conductivity to be excluded in the measurement of volume conductivity. It 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, stabilized 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 stones specimen under testing.

8 Procedure

At least five test specimens shall be measured.

Referring to Figure 1, measure the diameter D_o, D_2 of the electrodes, the width g of the guard gap and the thickness t 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 500 V (or higher, depending on both specimen thickness and sample resisitivity) shall be used.

9 Expression of results

Volume resistivity ρ_v, volume conductivity γ_v, surface resistivity ρ_s and surface conductivity γ_s are then 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 flat circular agglomerated stone specimen the following equations shall be used:

$$\rho_v = 1/\gamma_v = R_v \cdot A/t \quad [\Omega \cdot m]$$

$$\rho_s = 1/\gamma_s = R_s \cdot P/g \quad [\Omega_{\square}]$$

where:

R_V = measured volume resistance in Ω

R_S = measured surface resistance in Ω

$A = \pi (D_1+g)^2/4$ in m^2

$P = \pi D_1$ in m

D_O, D_1, D_2, g, t 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) number, title and date of issue of this document;

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

d) name and address of the client;

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

- name of the supplier;

- name of the person or organization which carried out the sampling;

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

- nature of the binders

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

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

h) number of specimens in the sample;

i) 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 and type, shape and dimensions of electrical contacts;

m) measuring conditions (temperature, relative humidity and applied electrical voltage or field);

n) type of measuring equipment;

o) applied voltage;

p) time of voltage application;

q) number of test specimens measured

r) volume resistivity value and statistical evaluation of the test results, if any;

[surface resistivity value (when it applies)]

s) all deviations from the standard and their justification;

t) remarks.

The test report shall contain the signatures and roles of the responsible (s) for the testing and the date of issue of the report. It shall also state that the report should not be partially reproduced without written consent of the test laboratory (ies) and the responsible (s) for the execution of the test.