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Preskusi mehanskih in fizikalnih lastnosti agregatov - 6. del: Določevanje prostorninske mase zrn in vpijanja vode

Tests for mechanical and physical properties of aggregates - Part 6: Determination of particle density and water absorption

Prüfverfahren für mechanische und physikalische Eigenschaften von Gesteinskörnungen - Teil 6: Bestimmung der Rohdichte und der Wasseraufnahme

Essais pour déterminer les caractéristiques mécaniques et physiques des granulats - Partie 6 : Détermination de la masse volumique et du coefficient d'absorption d'eau

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English Version

Tests for mechanical and physical properties of aggregates - Part 6: Determination of particle density and water absorption

Essais pour déterminer les caractéristiques mécaniques et physiques des granulats - Partie 6 : Détermination de la densité des particules et de l'absorption d'eau

Prüfverfahren für mechanische und physikalische Eigenschaften von Gesteinskörnungen - Teil 6: Bestimmung der Rohdichte und der Wasseraufnahme

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 154.

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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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 1097-6:2020) has been prepared by Technical Committee CEN/TC 154 “Aggregates”, the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 1097-6:2013. In comparison with the previous edition, the following technical modifications have been made:

a) a new Annex D (normative) has been designed to determine the particle density and water absorption of fine lightweight aggregates;

b) a new Annex F (informative) has been designed to determine the particle density and water absorption of aggregate particles passing the 4 mm test sieve (including the 0/0,063 mm size fraction).

This document forms a part of a series of tests for mechanical and physical properties of aggregates. Test methods for other properties of aggregates are covered by the following European standards:

— EN 932 (all parts), *Tests for general properties of aggregates*

— EN 933 (all parts), *Tests for geometrical properties of aggregates*

— EN 1367 (all parts), *Tests for thermal and weathering properties of aggregates*

— EN 1744 (all parts), *Tests for chemical properties of aggregates*

— EN 13179 (all parts), *Tests for filler aggregate used in bituminous mixtures*

The other parts of EN 1097 include:

— *Part 1: Determination of the resistance to wear (micro-Deval)*

— *Part 2: Methods for the determination of resistance to fragmentation*

— *Part 3: Determination of loose bulk density and voids*

— *Part 4: Determination of the voids of dry compacted filler*

— *Part 5: Determination of the water content by drying in a ventilated oven*

— *Part 7: Determination of the particle density of filler — Pyknometer method*

— *Part 8: Determination of the polished stone value*

— *Part 9: Determination of the resistance to wear by abrasion from studded tyres — Nordic test*

— *Part 10: Determination of water suction height*

1 Scope

This document specifies the reference methods used for type testing and in case of dispute, for the determination of particle density and water absorption of normal weight and lightweight aggregates. Other methods can be used for other purposes, such as factory production control, provided that an appropriate working relationship with the reference method has been established. For convenience, some of these other methods are also described in this document.

The reference methods for normal weight aggregates are:

— a wire basket method for aggregate particles retained on the 31,5 mm sieve (Clause 7, except for railway ballast which uses Annex B);

— a pyknometer method for aggregate particles passing the 31,5 mm test sieve and retained on the 4 mm test sieve (Clause 8);

— a pyknometer method for aggregate particles passing the 4 mm test sieve and retained on the 0,063 mm test sieve (Clause 9).

In Clauses 7, 8 and 9, three different particle density parameters (oven-dried particle density, saturated and surface-dried particle density and apparent particle density) and water absorption are determined after a soaking period of 24 h. In Annex B, the oven-dried particle density parameter is determined after soaking in water to constant mass.

For aggregate particles passing the 31,5 mm test sieve and retained on the 4 mm test sieve, the wire basket method in Clause 7 can be used as an alternative to the pyknometer method in Clause 8.

NOTE 1 The wire basket method can also be used for single aggregate particles retained on the 63 mm sieve.

NOTE 2 The pyknometer method described in Clause 8 can be used as an alternative for aggregates passing the 4 mm sieve and retained on the 2 mm sieve.

The reference methods for lightweight aggregates are:

— a pyknometer method for aggregate particles passing the 31,5 mm test sieve and retained on the 4 mm test sieve (Annex C). Three different particle density parameters (oven-dried particle density, saturated and surface-dried particle density and apparent particle density) and water absorption are determined after pre-drying and a soaking period of 24 h;

— a method for aggregate particles passing the 4 mm test sieve, mixed with water and filtered in a Büchner funnel (Annex D). The three particle densities and water absorption are determined using a vacuum in the range of 50 mbar to 100 mbar for at least five minutes.

Three other methods for normal weight aggregates can be used to determine the pre-dried particle density, as specified in normative Annexes A and H:

— a wire basket method for aggregate particles passing the 63 mm test sieve and retained on the 31,5 mm test sieve (A.3);

— a pyknometer method for aggregate particles passing the 31,5 mm test sieve and retained on the 0,063 mm test sieve (A.4);

— a pyknometer method for aggregate particles passing the 31,5 mm test sieve, including the 0/0,063 mm size fraction (Annex H).

NOTE 3 If water absorption is less than about 1,5 %, the apparent particle density can be assessed using the pre-dried particle density method as defined in Annex A.

The quick method in normative Annex E can be used in factory production control to determine the apparent particle density of lightweight aggregates.

The method in informative Annex F can be used to determine the particle density and water absorption of aggregates particles passing the 4 mm test sieve.

Data on the density of water at various temperatures is specified in normative Annex G.

Guidance on the significance and use of the various density and water absorption parameters is given in informative Annex I.

Annex J (informative) contains precision data.

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 932-1, *Tests for general properties of aggregates — Part 1: Methods for sampling*

EN 932-2, *Tests for general properties of aggregates — Part 2: Methods for reducing laboratory samples*

EN 932-5, *Tests for general properties of aggregates — Part 5: Common equipment and calibration*

EN 933-2, *Tests for geometrical properties of aggregates — Part 2: Determination of particle size distribution — Test sieves, nominal size of apertures*

EN 1097-5, *Tests for mechanical and physical properties of aggregates — Part 5: Determination of the water content by drying in a ventilated oven*

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
apparent particle density
ρ_a
ratio obtained by dividing the oven-dried mass of an aggregate sample by the volume it occupies in water, including the volume of any internal sealed voids but excluding the volume of water in any water accessible voids

Note 1 to entry: For lightweight aggregates the symbol ρ_{La} is used.

3.2
constant mass
mass determined after successive weighings at least 1 h apart not differing by more than 0,1 %

Note 1 to entry: In many cases, constant mass can be achieved after a test portion has been dried for a pre-determined period in a specified oven at (110 ± 5) °C. Test laboratories can determine the time necessary to achieve constant mass for specific types and sizes of sample dependent upon the drying capacity of the oven used.

3.3
oven-dried particle density
ρ_{rd}
ratio obtained by dividing the oven-dried mass of an aggregate sample by the volume it occupies in water, including the volume of any internal sealed voids and the volume of any water accessible voids

Note 1 to entry: For lightweight aggregates the symbol ρ_{Lrd} is used.

3.4
pre-dried particle density
ρ_{p}
ratio obtained by dividing the pre-dried mass of an aggregate sample by the volume it occupies in water, including the volume of any internal sealed voids but excluding the volume of water in any water accessible voids

Note 1 to entry: Test conditions in terms of pre-drying of the test sample and the shorter immersion period differ from the ones for apparent particle density.

Note 2 to entry: Pre-dried particle density is a rapid test.

3.5
saturated and surface-dried particle density
ρ_{ssd}
ratio obtained by dividing the sum of the oven-dried mass of an aggregate sample and the mass of water in any water accessible voids by the volume it occupies in water, including the volume of any internal sealed voids and the volume of any water accessible voids

Note 1 to entry: For lightweight aggregates the symbol ρ_{Lssd} is used.

3.6
test portion
sample used as a whole in a single test

3.7
test specimen
sample used in a single determination when a test method requires more than one determination of a property

3.8
water absorption
mass of absorbed water, expressed as a percentage of the oven-dried mass of the aggregate sample

4 Principle

Particle density is calculated from the ratio of mass to volume. The mass is determined by weighing the test portion in the saturated and surface-dried condition and again in the oven-dried condition. Volume is determined from the mass of the water displaced, either by mass reduction in the wire basket method or by weighings in the pyknometer method.

Due to the influence on the absorption, no artificial heating of the test portion should be applied before testing. However, if such material is used, this fact should be stated in the test report.

For porous aggregates, the values of absorption and density depend on the size fractions that are tested. For this reason, the size fractions tested should be stated in the test report.

If the aggregate consists of a number of different size fractions, it may be necessary to separate the various fractions before preparing the test portion. The percentage of each size fraction shall be stated in the test report.

5 Materials

Water, which is boiled and cooled before use.

Fresh tap water and demineralized water are both suitable. The water should be free from any impurity (e.g. dissolved air) that could significantly affect its density. Dissolved air can also be removed by applying a vacuum.

6 Apparatus

All apparatus, unless otherwise stated, shall conform to the general requirements of EN 932-5.

6.1 Apparatus for general purposes

6.1.1 Ventilated oven, thermostatically controlled to maintain a temperature of (110 ± 5) °C.

6.1.2 Balance, accurate to 0,1 % of the mass of the test portion and of sufficient capacity to enable the wire basket containing the sample to be suspended and weighed in water.

6.1.3 Water bath, thermostatically controlled, capable of being maintained at (22 ± 3) °C.

6.1.4 Thermometer, accurate to 0,1 °C.

6.1.5 Test sieves, 0,063 mm, 4 mm, 31,5 mm and 63 mm, with apertures as specified in EN 933-2.

6.1.6 Trays, which can be heated in a ventilated oven without change in mass.

6.1.7 Dry soft absorbent cloths.

6.1.8 Washing equipment.

6.1.9 Timer.

6.2 Special apparatus for the wire basket method (Clause 7 and A.3 and Annex B)

6.2.1 Wire basket, or perforated container of suitable size to enable suspension from the balance. The basket or container shall be resistant to corrosion.

6.2.2 Watertight tank, containing water at (22 ± 3) °C, in which the basket may be freely suspended with a minimum clearance of 50 mm between the basket and the sides of the tank.

NOTE A watertight tank can be used instead of the water bath specified in 6.1.3.

6.3 Special apparatus for pyknometer method for aggregate particles passing the 31,5 mm test sieve and retained on the 4 mm test sieve (Clause 8)

6.3.1 Pyknometer, consisting of a glass flask or other suitable vessel with volume between 1 000 ml and 5 000 ml, constant to 0,5 ml for the duration of the test.

The volume of the pyknometer should be chosen to suit the size of the test portion. It is recommended that the test portion occupies about half of the pyknometer volume. Two smaller pyknometers can be used instead of one large, by summing the weighings before calculating the density of the aggregate.

6.4 Special apparatus for pyknometer method for aggregate particles passing the 4 mm test sieve and retained on the 0,063 mm test sieve (Clause 9 and Annex F)

6.4.1 Pyknometer, consisting of a glass flask or other suitable vessel with volume between 500 ml and 2 000 ml, constant to 0,5 ml for the duration of the test.

The volume of the pyknometer should be chosen to suit the size of the test portion. It is recommended that the test portion occupies about half of the pyknometer volume. Two smaller pyknometers can be used instead of one large one, by summing the weighings before calculating the density of the aggregate.

6.4.2 Metal mould, in the form of a frustum of a cone (40 ± 3) mm at the top, (90 ± 3) mm at the bottom and (75 ± 3) mm high. The metal shall have a minimum thickness of 0,8 mm.

6.4.3 Metal tamper, of mass (340 ± 15) g and having a flat circular tamping face of diameter (25 ± 3) mm, for use with the metal mould.

6.4.4 Funnel, plain glass (alternative to use of the metal mould and tamper).

6.4.5 Shallow tray, of non-water absorbing material having a plane bottom of area not less than 0,1 m^2 and an edge of not less than 50 mm in height.

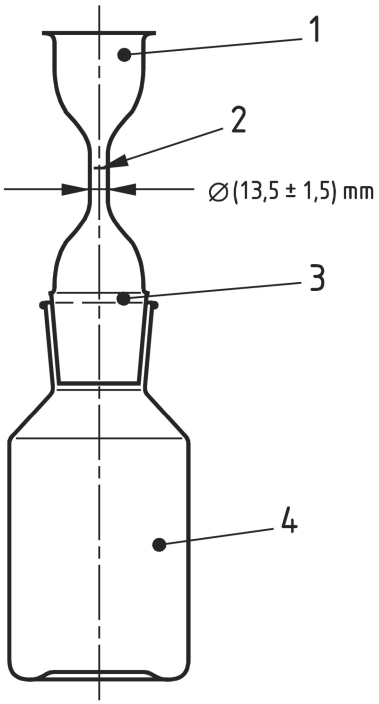
6.4.6 Warm air supply, such as a hair dryer.

6.5 Special apparatus for the pyknometer method for aggregate particles passing the 31,5 mm test sieve and retained on the 0,063 mm test sieve (A.4)

6.5.1 Pyknometer, consisting of a glass flask with a volume between 250 ml and 5000 ml, constant to 0,5 ml for the duration of the test, and a corresponding glass funnel.

Choose the pyknometer to suit the size of the test specimen. It is recommended that the test specimen occupies about half of the pyknometer volume.

NOTE An example of a suitable pyknometer is shown in Figure 1.



Key

ss funnel

ırk

)und section to fit the wide-neck flat bottom flask

de-neck flat bottom flask

Figure 1 — Example of pyknometer

6.6 Special apparatus for the determination of particle density and water absorption of coarse aggregates saturated to constant mass (Annex B)

6.6.1 Container, of similar capacity to the wire basket specified in 6.2.1 for storage of the sample in water.

6.7 Special apparatus for the determination of particle density and water absorption of coarse lightweight aggregates (Clause C.1)

6.7.1 Pyknometer, consisting of a glass flask with a volume between 1 000 ml and 2 000 ml and a corresponding funnel (Figure 1). If appropriate, the pyknometer shall contain a flexible grid to prevent aggregates from floating.

The size of the funnel should enable the release of any air bubbles.

The volume of the pyknometer should be chosen to suit the size of the test portion. It is recommended that the test portion occupies about half of the pyknometer volume.

6.8 Special apparatus for the determination of particle density and water absorption of fine lightweight aggregates (Annex D)

6.8.1 Balance, accurate to 0,1 g.

6.8.2 Glass graduated measuring cylinder, with a measuring volume of 1 000 ml.

6.8.3 Funnel, of suitable size to transfer the test specimen into the glass measuring cylinder.

6.8.4 Cylinder, for transferring surface-dried material from the Büchner funnel to the glass measuring cylinder.

6.8.5 Büchner funnel, with a diameter of 150 mm and minimum 60 mm height.

6.8.6 Erlenmeyer flask, with tap for the Büchner funnel.

6.8.7 Filter paper, of type Ø 150 mm-range for filtration speed from 10 s to 25 s (Herzberg).

6.8.8 Glass rod or spatula, for stirring in the Büchner funnel. The length should be greater than the depth of the Büchner funnel.

6.8.9 Vacuum pump, capable of maintaining a vacuum of 50 mbar to 100 mbar with wet filter only (without sample) and the same range of vacuum at the end of the test (with wet sample).

6.8.10 Connection hoses.

6.8.11 Manometer or gauge, to measure the vacuum.

6.9 Special apparatus for the determination of the apparent particle density of coarse lightweight aggregates with cylinder method (Annex E)

6.9.1 Glass graduated measuring cylinders, with a measuring volume of 1 000 ml.

6.9.2 Steel plunger (Figure 2), with a perforated base and vertical rod, to prevent aggregate particles from floating to the surface of the water. The difference between the internal diameter of the measuring cylinder and the diameter of the steel plunger base shall be less than the smallest aggregate particles to be tested. The vertical rod of the plunger shall be marked so that the volume it occupies in water is constant.

The dimensions of the holes in the perforated base should be less than the smallest aggregate particles to be tested, but large enough to enable the release of entrapped air.