SLOVENSKI STANDARD
oSIST prEN 12697-7:2021

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Bitumenske zmesi - Preskusne metode - 7. del: Ugotavljanje gostote bitumenskih preskušancev z žarki gama

Bituminous mixtures - Test methods - Part 7: Determination of the bulk density of bituminous specimens by gamma rays

Asphalt - Prüfverfahren - Teil 7: Bestimmung der Raumdichte von Asphalt-Probekörpern mit Gamma-Strahlen

Mélanges bitumineux - Méthodes d'essai pour mélange hydrocarboné à chaud - Partie 7: Détermination de la masse volumique apparente des éprouvettes bitumineuses par les rayons gamma

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English Version

Bituminous mixtures - Test methods - Part 7: Determination of the bulk density of bituminous specimens by gamma rays

Mélanges bitumineux - Méthodes d'essai pour mélange hydrocarboné à chaud - Partie 7: Détermination de la masse volumique apparente des éprouvettes bitumineuses par les rayons gamma

Asphalt - Prüfverfahren - Teil 7: Bestimmung der Raumdichte von Asphalt-Probekörpern mit Gamma-Strahlen

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 227.

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

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European foreword

This document (prEN 12697-7:2020) has been prepared by Technical Committee CEN/TC 227 "Road materials", the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 12697-7:2014.

The main changes compared to the previous edition are listed below:

— the title no longer refers to hot mix asphalt;

— [ge] editorial update according to current standard template;

— [1] scope clarified according the CEN/CENELEC Internal Regulations Part 3:2019, 14.5;

— [4] the exponential law including equation deleted. Added reference to Clause 8;

— [5.1] footnote 1) amended to NOTE. Existing NOTE amended to normal text;

— [6] NOTE 1: The period for when specimens are considered to be dry amended to 4h in line with other parts;

— [6] footnote 2) amended to NOTE 2. Existing NOTE amended to NOTE 1;

— [7.3.3] formula for consistency test deleted and replaced with reference to Formula (1);

— [8] editorial adjustments, renumbered formulas and addition of references to formulas.

A list of all parts in the EN 12697 series can be found on the CEN website

Introduction

Bulk density measurement in the laboratory using gamma rays is a method which does not affect the properties of the material. It can be included in a series of tests carried out on a given sample. It allows the plotting of a density chart or gradient.

The safety regulations applicable to the use of gamma rays should be applied.

1 Scope

This document specifies a method for measuring the bulk density of pavement mixtures using a transmission-type gamma radiation test bench.

This method applies to cylindrical specimens or blocks, prepared in a laboratory or cut from a pavement, the thickness and the mass absorption coefficient which is a function of the chemical composition are known. The thickness of the specimen body traversed by the radiation shall be between 30 mm and 300 mm.

The method cannot be applied to materials containing slags, with variable metal content or chemical composition.

NOTE Material containing metal or chemical compositions can affect the absorption of gamma rays.

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 12697-6, *Bituminous mixtures - Test methods - Part 6: Determination of bulk density of bituminous specimens*

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 https://www.iso.org/obp

3.1
precision
closeness of agreement between independent test results obtained under stipulated conditions

Note 1 to entry: Precision depends only on the distribution of random errors and does not relate to the true value or the specified value.

Note 2 to entry: The measure of precision is usually expressed in terms of imprecision and computed as a standard deviation of the test results. Less precision is indicated by a larger standard deviation.

Note 3 to entry: “Independent test results” means results obtained in a manner not influenced by any previous result on the same or similar test sample. Quantitative measures of precision depend critically on the stipulated conditions. Repeatability and reproducibility conditions are particular sets of extreme conditions.

3.2
repeatability
precision under repeatability conditions

3.3
repeatability conditions
conditions where independent tests results are obtained with the same method on identical test items in the same laboratory by the same operator using the same equipment within short intervals of time

3.4
reproducibility
precision under reproducibility conditions

3.5
reproducibility conditions
conditions where test results are obtained with the same method on identical test items in different laboratories with different operators using different equipment

4 Principle

The method is based upon the absorption of gamma radiation by the material. Under the conditions of the test described in this document and for materials such as bituminous mixtures. The method follows an exponential law according to Clause 8, Formulae (3) and (4).

The specimen is placed in the path of a gamma ray beam coming from an emitting unit containing a radioactive source and having a collimation corridor. A photomultiplier in the receiving unit transforms the incident photons into pulses with amplitudes proportional to their energy. An electronic system performs the functions allowing the different applications.

5 Apparatus

5.1 Emitter-source unit and receiving unit, at a fixed distance in relation to each other during the measurement. The axis of the gamma radiation beam and that of the receiver shall coincide.

NOTE A radioactive source of Cs 137 with an energy level of 0,662 MeV is suitable for this purpose.

Two cases are possible:

— the emitter and receiver are fixed and the specimens move between them;

— the specimens are fixed and the emitter-receiver assembly moves in relation to them.

In both cases, during the measurement the apparatus allows the rotation of cylindrical specimens about themselves or the relative translation of the specimens having at least one flat side.

5.2 Several lead collimators, whose diameter is known to within 1 %.

5.3 Measurement chain including a count unit and a processing chain. The count unit and the processing chain shall be stabilized electronically against the effect of temperature variations.

5.4 Technical note, with nomograms allowing the determination of the measurement time yielding the requested precision.

The calibration coefficient (k) of the apparatus shall be checked periodically using a specimen with a known density according to the instructions given in the equipment user's manual: it shall be between 0,990 and 1,010 and shall remain constant to within 0,005, for a given diameter of the gamma radiation beam.

6 Preparation of specimens

Specimens shall have a known water content or be dry. If necessary, dry them at ambient temperature.

NOTE 1 Specimens are considered to be dry when the relative mass variation is less than 0,1 % per period of 4 h.

Specimens with one or more bituminous mix layers shall be placed on a flat and horizontal surface to avoid any deformation. The height of the part of each specimen on which density can be measured shall be noted on the test sheet.

In the case of specimens made in the laboratory, the top of the specimens shall be marked.

The surfaces analysed shall be rid of any foreign matter that may be clinging to them.

The thickness of material penetrated by the radiation shall be measured to within 0,1 mm.

NOTE 2 The uncertainty on the measurement of density is larger than the uncertainty on the measurement of the thickness of the material.

7 Procedure

7.1 Prior adjustments

Before performing a bulk density measurement or a series of measurements on a specimen, the following adjustments shall be carried out in accordance with instructions given by the manufacturer and in particular:

— alignment of different elements (if required);

— adjustment of the measurement chain.

7.2 Choice of beam diameter

At the outlet of the source support, place, as required, a collimator with a diameter equal or slightly smaller than that of the source.

In front of the detection unit place a 10 mm collimator, or, if the apparatus is such that the collimator can be changed, place:

— a 5 mm collimator to measure the density of layers of thickness less than or equal to 40 mm in the direction perpendicular to the beam;

— a 10 mm collimator for thicknesses greater than 40 mm in the direction perpendicular to the beam with materials whose maximum size is less than or equal to 14 mm;

— a 20 mm collimator for layer thicknesses greater than 40 mm in the direction perpendicular to the beam, with materials whose maximum size is greater than 14 mm.

7.3 Measurement procedure

7.3.1 Measurement mode

Either of the following methods shall be used:

a) continuous measurements: During the measurement, the specimen to be analysed is moved along a direction perpendicular to the radiation;

b) localized or point measurements: There is no movement of the material during the measurement except for the axial rotation of cylindrical specimens explored radially.

7.3.2 Continuous measurements

— Measure the count rate in the absence of the material to be tested C_{01}.

— Calculate the integration time constant and the speed of the specimen in relation to the beam that yields the required accuracy, using the nomograms furnished in the test bench instructions.

— Set the sample on the specimen passer.

— Record the count rate (C) through the material during the movement of the specimen.

— Measure the count rate in the absence of the material to be tested C_{02} under the same conditions as the determination of C_{01}.

— The counts in the absence of the material to be tested shall be determined immediately before (C_{01}) and immediately after (C_{02}) passing the specimen.

— The count consistency test is given by Formula (1):

$$\frac{\left|C_{01} - C_{02}\right|}{\sqrt{\frac{C_{01} + C_{02}}{t}}} \leq 1{,}96 \qquad (1)$$

where

C_{01}, C_{02} is the count rate (ratio of N_{01} or N_{02} to count time) in the absence of the material to be tested (in the air or in a reference specimen body, e.g. aluminium) before penetration into the material in counts per second, during the measurement number 1 or 2;

N_{01}, N_{02} is the number of gamma photons of the incident radiation measured in the absence of the material to be tested (in the air or in a reference specimen body, e.g. aluminium) before penetration into the material in counts per second, during the measurement number 1 or 2;

t is the measurement time, in seconds (s).

shall be verified.

7.3.3 Localized or point measurements

— Measure the count rate in the absence of the material to be tested C_{01}. Using the nomograms of the test bench instructions, in which the parameters are the count rate in the absence of material to be tested, the estimated density and the thickness of the specimen, determine the count time in absence of the material and through the material compatible with the required accuracy.

— In the case of a cylindrical specimen, ensure that the measurement is carried out during the rotation of the specimen. The specimen shall make at least one revolution, at constant speed, during the measurement.

— Carry out the measurement of (C) in the specimen making sure the edge of the gamma ray beam is at a distance of more than 3 mm from the sides of the specimen.

— Measure (C_{02}) in the absence of the material to be tested to check for drift.

— The count consistency test according to Formula (1) shall be verified.