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Bitumenske zmesi - Preskusne metode - 52. del: Kondicioniranje za zagotovitev oksidativnega staranja

Bituminous mixtures - Test methods - Part 52: Conditioning to address oxidative ageing

Asphalt - Prüfverfahren - Teil 52: Konditionierung, um der oxidativen Alterung Rechnung zu tragen

Mélange bitumineux - Méthodes d'essai - Partie 52 : Conditionné pour traiter le vieillissement oxydatif

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Bituminous mixtures - Test methods - Part 52: Conditioning to address oxidative ageing

Mélanges bitumineux - Méthodes d'essai - Partie 52 : Conditionnement pour l'obtention d'un vieillissement par oxydation

Asphalt - Prüfverfahren - Teil 52: Konditionierung, um der oxidativen Alterung Rechnung zu tragen

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European foreword

This document (CEN/TS 12697-52:2017) has been prepared by Technical Committee CEN/TC 227 “Road material”, the secretariat of which is held by DIN.

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1 Scope

This Technical Specification specifies two sets of procedures for conditioning of bituminous mixtures in terms of oxidative ageing. Procedures A.1 and A.2 can be applied on loose bituminous mixture before compaction of specimens, procedures B.1 and B.2 on compacted specimens. Material conditioned by this Technical Specification can be used for further testing to assess the effect of oxidative ageing on characteristics of bituminous mixtures and thus on their durability and recyclability. Alternatively, binder can be extracted from conditioned mixture to assess the effect of oxidative ageing on binder characteristics taking into account potential effects of mineral aggregates on ageing.

This Technical Specification is applicable to bituminous mixtures manufactured in the laboratory or in a mixing plant. Procedures B.1 and B.2 is applicable to specimens from laboratory production or samples taken from the field.

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 12697-3, *Bituminous mixtures - Test methods for hot mix asphalt - Part 3: Bitumen recovery: Rotary evaporator*

EN 12697-4, *Bituminous mixtures - Test methods - Part 4: Bitumen recovery: Fractionating column*

EN 12697-5, *Bituminous mixtures - Test methods for hot mix asphalt - Part 5: Determination of the maximum density*

EN 12697-6, *Bituminous mixtures - Test methods for hot mix asphalt - Part 6: Determination of bulk density of bituminous specimens*

EN 12697-8, *Bituminous mixtures - Test methods for hot mix asphalt - Part 8: Determination of void characteristics of bituminous specimens*

EN 12697-18, *Bituminous mixtures - Test methods - Part 18: Binder drainage*

EN 12697-27, *Bituminous mixtures - Test methods - Part 27: Sampling*

EN 12697-29, *Bituminous mixtures - Test method for hot mix asphalt - Part 29: Determination of the dimensions of a bituminous specimen*

EN 12697-30, *Bituminous mixtures - Test methods for hot mix asphalt - Part 30: Specimen preparation by impact compactor*

EN 12697-31, *Bituminous mixtures - Test methods for hot mix asphalt - Part 31: Specimen preparation by gyratory compactor*

EN 12697-32, *Bituminous mixtures - Test methods for hot mix asphalt - Part 32: Laboratory compaction of bituminous mixtures by vibratory compactor*

EN 12697-33, *Bituminous mixtures - Test methods - Part 33: Specimen prepared by roller compactor*

EN 12697-35, *Bituminous mixtures - Test methods - Part 35: Laboratory mixing*

3 Terms and definitions

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

3.1
ageing
alteration of asphalt mixtures over time due to the superposed impact of different environmental conditions (e.g. oxygen, other oxidation agents, UV and moisture) that lead to altering characteristics of the binder, additive and aggregate component over time

Note 1 to entry: Changes in binder characteristics are mainly increasing stiffness and brittleness leading to increased risk of low-temperature and fatigue cracking of asphalt mixtures. Impacts of fine and coarse aggregates on the ageing behaviour of asphalt mixtures are still topic of scientific discussion. Ageing can be divided into short-term ageing (STA) during production and compaction of asphalt mixtures and asphalt layers and into long-term ageing (LTA) of compacted pavement layers over the years.

3.2
asphalt durability
maintenance of the structural integrity of compacted material over its expected service-life when exposed to the effects of the environment (water, oxygen, sunlight,…) and traffic loading

3.3
pavement durability
retention of a satisfactory level of performance over the structure's expected service-life without major maintenance for all properties that are required for the particular road situation in addition to asphalt durability

4 Principle

One of two sets of methods is used for asphalt mixture conditioning. In the first set of methods (Procedures A.1 and A.2), loose asphalt mixture is conditioned. The loose mixture is placed into a pan and conditioned within a heating cabinet with forced air ventilation for a specific duration at elevated temperature to accelerate ageing due to oxidation. Additionally pressure can be applied for further acceleration of conditioning. Procedure A.1 address the short-term ageing potential, procedure A.2 the long-term ageing potential.

In the second set of methods (Procedures B.1 and B.2) compacted specimens from bituminous mixtures prepared in the laboratory or coming from the plant or samples from the field are conditioned. Two options for conditioning are available. Either specimens are placed into a pan and conditioned within a heating cabinet with forced air ventilation for a specific duration at a specific temperature (Procedure B.1), or specimens are placed within a triaxial cell (comparable to triaxial cells used for permeability tests on soils) and a forced flow of gaseous oxidant agent (ozone enriched compressed air) through the specimen is used to condition the specimen for a specific duration at a specific temperature (Procedure B.2).

NOTE Methods B.1 and B.2 result in different results in subsequent testing of conditioned specimens or extracted binder.

5 Procedure A — Conditioning of loose asphalt mixture

5.1 Apparatus

5.1.1 One or more pans with dimensions large enough to ensure that the loose mixture can be spread on it with a thickness of the mixture of up to 60 mm.

To increase the oxidative ageing effect by enhanced air flow through the mixture, a pan with a perforated plate with a maximum mesh size of 0,7 mm can be applied.

5.1.2 Heating cabinet with forced air ventilation able to maintain the conditioning temperature with an accuracy of ± 1 °C.

5.1.3 Thermometer, capable of measuring temperatures from room temperature to 180 °C, readable to 1 °C with an accuracy of ± 0,5 °C.

5.1.4 Watch or timer, accurate and readable to 1 min.

5.1.5 In the case of conditioning of loose mixture by applying temperature and pressure, a device able to maintain the conditioning temperature and pressure with an accuracy of ± 1 °C for the temperature and of ± 100 kPa for the pressure.

NOTE The Pressure Ageing Vessel (PAV) as described in EN 14769 meets the requirements for conditioning of loose mixture under temperature and pressure.

5.2 Procedure

5.2.1 General

Procedure A.1 (for short-term ageing) shall not be applied on loose mix coming from the field as this step has already been taken in the mixing plant.

5.2.2 Preparation

Prepare the bituminous mixture according to EN 12697-35, or take samples from the production of a plant according to EN 12697-27. Determine the maximum density according to EN 12697-5.

Preheat the device in which the mixture is to be conditioned and the pan to the conditioning temperature for at least 60 min.

5.2.3 Conditioning for short-term ageing potential (Procedure A.1)

Fill the loose mixture into the pan and spread it so that a homogeneous layer of mixture with a thickness of (25 ± 5) mm is in the pan. Before placing the pan in the conditioning device, allow the mixture to cool down to the set conditioning temperature. Use the thermometer to check the mixture temperature regularly. When the mixture has reached the conditioning temperature, place the pan into the conditioning device. Condition the mixture for the set conditioning time ± 10 min, keeping temperature and pressure within accuracy limits.

To reduce the danger of binder drainage, it is recommended to carry out preliminary tests according to EN 12697-18 at the desired conditioning temperature to analyse whether binder drainage occurs. If so, lower the temperature until no binder drainage occurs.

Thicknesses between 25 mm and 60 mm are generally used for the loose mix to put in place.

To maintain a uniform conditioning it is recommended to stir the mixture at regular time intervals so as to avoid segregation, e.g. each 48 hour.

NOTE The method for short-term ageing of laboratory prepared asphalt mixtures suggested by SHRP-A-383 [1] report sets a conditioning temperature of 135 °C for 4 h.

After conditioning:

— the mixture is compacted to specimens according to EN 12697-30, EN 12697−31, EN 12697−32, or EN 12697−33 for testing of mixture characteristics after conditioning; or

— the binder is extracted from the mixture according to EN 12697-3 or EN 12697−4 for testing of binder characteristics after mixture conditioning.

— the mixture is further conditioned for long-term ageing according to 5.2.4.

5.2.4 Conditioning for long-term ageing potential (Procedure A.2)

Only mixture prepared in the laboratory and conditioned according to 5.2.3 (short-term ageing) or mixture coming from a mixing plant shall be further conditioned to long-term ageing as described within this clause.

Fill the loose mixture into the pan and spread it so that a homogeneous layer of mixture with a thickness of (25 ± 5) mm is in the pan. Before placing the pan in the conditioning device, allow the mixture to cool down to the set conditioning temperature. Use the thermometer to check the mixture temperature regularly. When the mixture has reached the conditioning temperature, place the pan into the conditioning device. Condition the mixture for the set conditioning time ± 0,5 h, keeping temperature and pressure within accuracy limits.

To reduce the danger of binder drainage, it is recommended to carry out preliminary tests according to EN 12697-18 at the desired conditioning temperature to analyse whether binder drainage occurs. If so, lower the temperature until no binder drainage occurs.

To maintain a uniform conditioning it is recommended to stir the mixture at regular time intervals, so, as to avoid segregation, e.g. every 48 hours for conditioning times up to 96 hours, and every 72 hours for longer conditioning times.

NOTE The BRRC ageing method [2] sets a conditioning temperature of 60 °C for 336 h. The RILEM ageing method sets a conditioning temperature of 85 °C for 216 h [3] on a non-perforated plate. The Brunswig Ageing (BSA) method sets a conditioning temperature of 80 °C for 96 h on a pan with a perforated plate [4]. Research shows that the RILEM method is more severe than the BRRC method [3]. The application of increased air pressure (e.g. 2,1 MPa) as applied in PAV method according to EN 14769 results in a more rapid ageing. When applied with a temperature of 90 °C the ageing level reached within 20 h is similar to the level after RILEM ageing [3].

After conditioning, the binder is extracted from the mixture according to EN 12697-3 or EN 12697−4 for testing of binder characteristics after mixture conditioning.

5.3 Test report

The test report shall make reference to this Technical Specification and include the following:

a) name and address of the testing laboratory;

b) start date of the conditioning;

c) mixture type;

d) the source of the mixture (laboratory mixed or plant mixed);

e) mixing duration and temperature;

f) maximum density of the mixture;

g) mass of mixture used for conditioning;