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Bitumen and bituminous binders — Determination of dynamic viscosity of modified bitumen by cone and plate method

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Bitumen and bituminous binders - Determination of dynamic viscosity of modified bitumen by cone and plate method

Bitumes et liants bitumineux - Détermination de la viscosité dynamique des bitumes modifiés - Méthode cône et plateau

Bitumen und bitumenhaltige Bindemittel - Bestimmung der dynamischen Viskosität von modifiziertem Bitumen - Platte-Kegel-Verfahren

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Foreword

This document (EN 13702:2010) has been prepared by Technical Committee CEN/TC 336 “Bituminous binders”, the secretariat of which is held by AFNOR/BNPé.

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of an identical text or by endorsement, at the latest by November 2010, and conflicting national standards shall be withdrawn at the latest by November 2010.

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This document was formerly known as EN 13702 – Part 1. As Part 2 of this standard was merged with another standard into EN 13302, this standard was renumbered into EN 13702.

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1 Scope

This European Standard specifies a method for determining the dynamic viscosity of a modified bituminous binder over a range of temperatures by means of a cone and plate viscometer. Although the method has been developed for modified binders, it is also suitable for other bituminous binders.

NOTE Unlike penetration grade bitumen, polymer modified bitumens (PMBs) may not show a straight line on the Heukelom-Diagram. This implies that in order to obtain information about the temperature susceptibility of PMBs, viscosity should be measured at different temperatures.

WARNING — The use of this European Standard can involve hazardous materials, operations and equipment. This European Standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this European Standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

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.

EN 58, *Bitumen and bituminous binders — Sampling bituminous binders*

EN 12594, *Bitumen and bituminous binders — Preparation of test samples*

3 Principle

The sample is placed on a plate, a cone is pressed onto the sample and the system is brought to the test temperature. A stress is applied to the sample by rotation. The torque is measured from the applied shear rate and dynamic viscosity is calculated by:

$$\eta = \tau / \gamma \tag{1}$$

where

γ is the shear rate expressed in s^{-1};

τ is the stress expressed in Pa, calculated by:

$$\tau = A \times M_{\mathrm{d}} \tag{2}$$

where

A is the cone factor expressed in m^{-3};

M_{d} is the torque in expressed $N \cdot m$.

NOTE The advantages of this method are the use of a very small sample and the speed of the method, especially regarding thermal conditioning of the specimen.

4 Apparatus

Cone and plate viscometer, with the following minimum capabilities:

— range of shear rate: 5×10^{-2} s^{-1} to 5×10^{2} s^{-1};

— range of viscosity: 5×10^{-2} Pa · s to 10^{5} Pa · s;

— range of temperature: 60 °C to 150 °C.

The sample temperature shall be maintained within ± 0,5 °C up to 100 °C and within ± 1,0 °C above 100 °C.

5 Sampling

Take the sample in accordance with EN 58 and prepare the sample in accordance with EN 12594.

6 Procedure

Select the appropriate size (diameter and angle) of cone to allow measurement at the selected shear rate.

Place the sample on the plate and press the selected cone onto the sample. Remove any surplus sample and bring the system to the test temperature.

Commence the first measurement at the lowest temperature:

— Temperature: (60 ± 0,5) °C;

— Shear rate: 5×10^{-2} s^{-1}.

Check the reading after a delay of 15 min when reaching the temperature and note the temperature, the cone size, the shear rate and the reading.

Repeat the test and calculate the result as an average of two tests.

Replace the specimen and increase the temperature to the next test temperature. Commence the second measurement:

— Temperature: (100 ± 0,5) °C;

— Shear rate: 5×10^{1} s^{-1}.

Replace the specimen and increase the temperature to the next test temperature. Commence the third measurement:

— Temperature: (150 ± 1,0) °C;

— Shear rate: 5×10^{2} s^{-1}.

It should be ensured that the complete specimen has reached the test temperature before starting the test.

The sample should not contain any filler.

NOTE In addition to these test temperatures and shear rates any other temperature and shear rate can be used.

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7 Expression of results

Record the results of the measurement of dynamic viscosity with the corresponding shear rate and the test temperature.

Express the viscosity values in Pa · s as follows: (1,000 x 10^{x}) Pa · s.

8 Precision

NOTE The following precision data are the best currently estimated and are proposed until results of further round robin tests are available.

8.1 Repeatability

The difference between two successive results, obtained by the same operator with the same apparatus under constant operating conditions on identical test material would, in the long run, in the normal and correct operation of the test method, differ by more than 5 % in only one case in twenty.

8.2 Reproducibility

The difference between two single and independent results, obtained by different operators working in different laboratories on identical test material would, in the long run, in the normal and correct operation of the test method, differ by more than 15 % in only one case in twenty.

9 Test report

The test report shall contain at least the following information:

a) type and complete identification of the sample under test;

b) reference to this European Standard;

c) temperature, shear rate and the result of the test (see Clause 7);

d) diameter and angle of the cone;

e) date of the test;

f) any deviation, by agreement or otherwise, from the specified procedure.

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