VISCOSITY TESTING

EN 13302: Bitumen and bituminous binders – Determination of dynamic viscosity of bituminous binder using a rotating spindle apparatus

Overview

This test method is used to determine the dynamic viscosity of bitumen and bituminous binders by means of a rotating spindle or coaxial viscometer.

The method is applicable to a variety of bituminous binders, e.g. modified and unmodified bituminous binders, or recovered from bituminous emulsions, cut-back and fluxed bituminous binders.

Experience suggests that the method is more suitable to test the viscosity of some polymer modified bitumens (PMB) than the current reference method EN 12596.

Definition and Terminology

Dynamic viscosity: measure of the resistance of a liquid to flow, expressed in Pa · s. It is the constant ratio of applied shear stress to the velocity gradient of the liquid.

Kinematic viscosity: measure of a liquid's resistance to flow under gravity, expressed in mm^2/s.

Newtonian liquid: liquid with a viscosity that is independent of the rate of shear. If the ratio of applied shear stress to the velocity gradient (shear rate) of the liquid is not constant, the liquid is non-Newtonian.

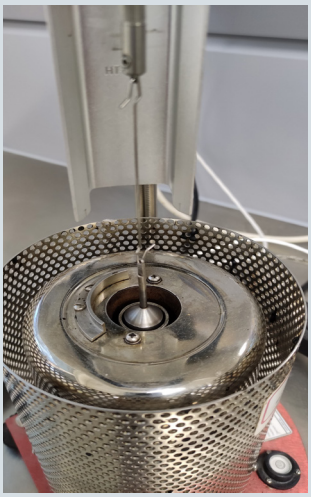
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At the time of publication of this document, EN 13302:2018 `Bitumen and bituminous binders - Determination of dynamic viscosity of bituminous binder busing a rotating spindle apparatus` was the reference for testing. This document does not overrule the test standard EN 13302 but is intended to help users of the standard to be aware of the important factors. However, the reference for testing remains EN 13302. Temperatures, times, and dimensions and their tolerances must be strictly observed, that is checked for accuracy and for maintaining the tolerance during application.

Practical Information:

The test system must be selected carefully.

- Section 5.1 of EN 13302 suggests that a shear rate range of 1 to 10^4 s^{-1} is needed to cover most bituminous products.
- The right spindle size should always be selected to obtain dynamic viscosity readings under torsion torque values in the upper working range for the chosen test conditions.
- The cylinder is specific for the rotating spindle viscometer and should ensure that the equipment works in coaxial mode controlling shear rate.
- In general, testing is done using a rotating spindle viscometer. However, testing can also be carried out in other devices, e.g. a Dynamic Shear Rheometer as described in EN 14770.



The test temperature must be selected carefully.

- The test temperature depends on the bituminous binder tested.
- Maintain the temperature during the test at within ± 0,5 °C up to 100 °C and ± 1 °C above 100 °C.
- The accuracy of the temperature control device must be checked at regular intervals and, if necessary, adjusted.



The sample needs to be prepared for testing.

- The sample preparation is described in EN 12594 and section 7.2.1 of EN 13302.
- The testing needs to be completed within 4 h.
- The cylinder should be removed from the heating device prior to filling.

Testing and expression of results.

- Preheating and filling the cylinder are described in 7.2.2 of EN 13302.
- Once the spindle is lowered into the sample, allow the spindle to rotate during the pre-heating time at a very low shear rate.
- Pre-heating time is approximately between 15 min to 30 min. It may be extended to 1 hour in case of unheated spindle (see 7.2.2 of EN 13302).
- The shear rates and spindle speeds must be suitable for the product under test, see sections 7.2.3, 7.3 and 7.4 of EN 13302.
- Take a dynamic viscosity reading after stabilizing for a period of 60 ± 5 s for paving grade and polymer modified bitumens, and 30 ± 5 s respectively for bituminous emulsions, cut-back or fluxed bituminous binders.
  If the reading has not stabilized sufficiently before, then take a reading after 15 min.
- From experience, cylinders can easily be cleaned by inverting them and allowing the binder to flow out.
  In the case of paving grade and polymer modified bitumens as well as for fluxed bituminous binders, this operation should be carried out in an oven.
  In the case of bituminous emulsions, the cylinder should be emptied and rinsed with a suitable surfactant solution, followed by rinsing with water.
  In the case of cut-back bituminous binders, the cylinder should be emptied and rinsed with a suitable solvent until the washings are clear.



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