Bitumen penetration test report discussion

(AASHTO name: T-49) In this test, the consistency of the bitumen sample is examined, specifying the distance in tenths of a millimetre that a standard needle passes vertically through the bituminous sample under known load, time and temperature conditions. This is the most widely used method of measuring the consistency of bitumen material at a given temperature. This is a classification tool rather than a quality measure. APPARATUS: Penetration device Needle tank Water bath thermometer water bath stop clock principle: Measures the hardness or softness of bitumen by measuring the depth of a tenth of a millimeter, which is a standard filled needle penetrates vertically for 5 seconds. PROCEDURE: Heat the sample until it is in liquid. Pour into a container to the depth to which the depth of the sample, cooled, is at least 10 mm greater than the expected penetration. Allow to cool at atmospheric temperature. Clean the needle and place a weight over the needle. Use the water bath to maintain the sample temperature. Mount the needle on the bitumen to just touch the bitumen surface. Then start the stopwatch and let the penetration needle penetrate freely for 5 seconds at a time. After 5 seconds, stop the intrusion. Result will be the grade bitumen. At least three readings. USE AND SIGNIFICANCE: Penetration testing is used to measure bitumen consistency to be classified into standard quality. A higher value of penetration indicates a softer consistency. Generally higher penetration bitumen is beneficial for use in cold climates and smaller penetration bitumen is used in warm climate areas. Measures the hardness or softness of bitumen, measuring the tenth of a millimetre to which a standard loaded needle penetrates vertically in 5 seconds The penetrometer consists of a needle unit with a total weight of 100 g and a device that releases and locks it in any position Bitumen softens tithing, thoroughly mixes it and pours it into containers at a depth exceeding the expected penetration. The test should be carried out at a specified temperature of 25 °C It should be noted that the penetration value is greatly influenced by inaccuracies in needle size, needle weight and test temperature: 40/50 bitumen quality means penetration value is in the range of 40 to 50 under normal test conditions, favouring lower penetration quality in hot climates. Classification of bitumen based on test results Let us know in the comments what you think of the concepts in this article! Academia.edu uses cookies to personalize content, personalize ads, and improve the user experience. By using our site, you agree to our collection of information by using cookies. For more information, see our privacy policies.× Bitumen test specifications, bitumen tests, and Bitumen bitumen properties material that has a complex response to astres. Each bitumen exhibits more or less pronounced viscoelastic behavior. their resistance to deformation depends on both the temperature and the time of exertion of the force. Bitumen can only act as a typical flexible solid under extreme conditions (very short loading time at low temperatures) or viscous liquid (high temperature, long loading time). Under normal temperature conditions, both viscous and flexible behavior play a role. Since both temperature and load time in practice vary. Bitumen temperature and time sensitivity are important performance factors. The zsúp of several bituminous classes has been developed to develop a number of test methods. Initially, these tests were aimed at measuring an arbitrary mechanical property that allowed different bitumens to be distinguished. The limits within which such properties had to be well known on the basis of practical experience. Examples of such methods characterization and their appropriate consistency are as follows: – Fraass breakpoint fragility Penetration semi-solid range softening point at the beginning of fluidity Viscosity fluidity range Penetration index temperature sensitivity There are generally accepted specifications bitumen, cutback bitumen, or bitumen emulsions. The text discusses the specifications for the relevant UK standards: however, other bituminous specifications apply in the same way, differing only in detailed specification tests or in the test ranges of different grades. In Europe, national bitumen specifications are consolidated into a single CEN specification, while astm specifications are commonly used in much of the world. Most bitumen specifications have a degree of commonality that is centered around the use of penetration and softening point values, while the remaining specification properties vary. Bitumen standards specification tests Since an almost infinite range of bitumens can be manufactured, tests are required that can characterise different grades. The two main tests most commonly used to characterise bitumens are penetration and softening points. These two tests are used to determine the different degrees of bitumen. Although these are arbitrary empirical tests, it can be estimated from them important engineering properties, such as high temperature viscosity and low temperature stiffness. The characterization of bitumen consistency is the use of the penetration test in the 19th century. Since penetration and softening point tests are empirically derived, it is essential that they are always carried out under exactly the same conditions. The Institute of Petroleum (IP), the American Society for Testing and Materials (ASTM). british standards (BS) standard methods for testing bitumen. In many cases, the methods are the same therefore, the methods are published jointly. However, some methods differ in detail, such as ip and ASTM softening point methods, and in these cases a correction factor should be applied to the test results obtained using these two test methods. Most of the methods used to assess the acceptability of test results include quotations. Accurate data shall be determined for the results (repeatability) obtained by the single operator and for the results (reproducibility) obtained by different operators in different laboratories. Thus, tolerance allows for differences between operators and equipment operating in different locations. Bitumen tests A number of tests to evaluate the properties of bituminous substances. The following tests are usually carried out to evaluate the different properties of bituminous materials. Penetration Test Plasticization Test Softening Point Test Specific Gravity Test Viscosity Test Flash and FirePoint Test Floating test Water content test Loss of heating test bitumen penetration test- Penetration test Measures bitumen hardness or softness by measuring depth in tenths of a millimeter to which the standard filled needle penetrates vertically in 5 seconds. The BIS has standardised the equipment and the test procedure. The penetrometer consists of a needle unit with a total weight of 100 g and a device for remission and locking in any position. The test shall be carried out at a specified temperature of 25 °C. It should be noted that the penetration value is greatly influenced by inaccuracies in the pouring temperature, needle size, weight placed on the needle and test temperature. A 40/50 bitumen fall means that the penetration value is between 40 and 50 under standard test conditions. In hot climates, we prefer lower penetration quality. The following shall be replaced by the following: Bitumen tests- Plasticity Test plasticity is a property of bitumen that allows you to go through great deformation or elongation. Fluidity is the distance in cm to which the standard pattern or briquette of the material elongated without breaking. The size of the briquettes thus formed exactly 1 cm square. Heat the bitumen sample and pour it into the mould placed on the plate. These mould samples are cooled in the air and then in a water bath at 27 °C. The excess bitumen is cut, and the surface is matched with a hot knife. Then the mould containing the assembly containing the sample is kept in the water bath of the fluidity machine for approximately 90 minutes. The sides of the moulds are removed, the jaws are hanged on the machine and the machine is operated. The value of the productivity reported in cm up to the point of the thread break. The value of fluidity is influenced by factors such as temperature, test temperature, The BIS, etc., defines a minimum mousse value of 75 cm. Figure 0.1 shows the fluidity of forms to be filled bitumen. Bitumen tests- Softening point Test softening point indicates the temperature at which bitumen achieves a certain level of softening as required by the test. The test shall be carried out by ring and ball apparatus. A brass ring containing a test sample of bitumen shall be suspended in liquids such as water or glycerin at a given temperature. A steel ball is placed on the bitumen sample and the liquid medium is heated by 5 °C per minute. Temperature is observed when the softened bitumen touches the sheet metal, which is a specified distance below it. In general, the higher softening point indicates a lower temperature sensitivity and is preferable in hot climates. The following shall be replaced by the following: Bitumen tests- Specific gravity test Paving works, classifying binder, density property is of great use. In most cases bitumen is measured, but when used with aggregates bitumen is converted to volume using density values. The density of bitumen is greatly influenced by its chemical composition. An increase in aromatic type mineral impurities causes an increase in specific gravity. The specific gravity of bitumen is the ratio of the given volume of bitumen of known content to the mass of an equal water volume of 27 °C. The specific weight may be measured either by pycnometer or by the preparation of a bituminous cube sample in a semi-solid or solid state. Bitumen has a specific weight of between 0.97 and 1.02. Bitumen tests- Viscosity test viscosity indicates the liquid property of the bitumen material, and this measure of resistance to flow. At the application temperature, this characteristic greatly affects the strength of the resulting paving mixtures. During compression or mixing, low or high viscosity was observed, resulting in lower stability values. With high viscosity, it is resistant to compactive effort and thus the resulting mixture is heterogeneous, resulting in low stability values. And with low viscosity, instead of providing a uniform foil over aggregates, it lubricates aggregate particles. Viscometers of the orifice type are used to indirectly find viscosity of liquid binders such as cut-offs and emulsions. Viscosity expressed in seconds is the time that the 50 ml bitumen material keeps for passage through the cup opening under normal test conditions and at a specified temperature. The viscosity of the reduction can be measured with an opening of 4.0 mm at 25° C or a 10 mm opening at 25 or 40 °C. And these volatile substances ignite a fire, which is very dangerous, and therefore it is essential to classify this temperature to all bituminous degrees. The BIS defined the flashpoint as the temperature at which bitumen vapour momentarily burst into flames in the form of a flash under test conditions. The point of fire is the lowest temperature under specified test conditions when the bitumen material ignites and burns. Bitumen tests- Float test Generally, the consistency of bitumen material can be measured by penetration test or viscosity test. However, for certain consistencys, these tests are not applicable and a float test is used. The device consists of an aluminum float and a brass collar filled with bitumen. The entire test unit shall be floated in the water bath at 50 °C and the time required for the water to pass through the sample stopper shall be recorded in seconds and expressed as the float value. Bitumen tests - Water content test It is desirable that bitumen contain a minimum water content to prevent bitumen from foaming when heated above the boiling point of the water. The water in bitumen is determined by mixing the known mass of the sample in pure petroleum distillates free of water, heating and distillates of water. The mass of condensed and collected water is expressed as a percentage by mass of the original sample. The maximum permissible water content shall not exceed 0,2 % by weight. Bitumen tests- Loss of heating test If the bitumen is heated, it loses volatility and hardens. Approximately 50 gm of the sample is measured and heated to 163 °C for 5 hours in a specific oven designed for this test. The sample sample shall be re-weighed after the heating period and the loss of weight expressed as a percentage by mass of the original sample. Bitumen used in sidewalk mixtures do not indicate more than 1% weight loss, but bitumen that have penetration values of 150-200 up to 2% weight loss is allowed. Bitumen tests IS codes summarizing requirements for bitumen as a binder and its various forms have been discussed. Various tests are carried out on bitumen to assess its consistency, gradation, viscosity, temperature sensitivity, and safety. Standard testing procedures for bitumen are also included in this chapter. Problems The minimum level of productivity specified by the BIS for bitumen The maximum water content allowed in bitumen shall not exceed 2 % by weight by weight of 0,2 % by weight 2,5 % by weight 5 % by weight of European standard CEN bitumen tests RABIT mission is to promote the efficient, economical, efficient and safe use of bitumen. Harmonised standards are the basis for defining consistent and effective standards for bitumen supply worldwide. By participating in the CEN working groups, RABIT contributes to the development of standards and test methods to ensure that bitumen specifications are fit for purpose. Different basic test methods are used for the technical classification and evaluation of the different bitumen types, which primarily determine the consistency between different Domains. Annealing point - Ring and ball method (EN 1427) This method is used to test bitumen behaviour at high operating temperatures according to European standard EN 1427. The temperature determines where a layer of bitumen, a brass ring, experiences some deformation under the weight of a steel ball as the temperature rises. This test method has been used for more than a hundred years. Needle blade (EN 1426) A test method used for decades, now described in EN 1426. The penetration of the needle is determined by the depth measured in 1/10 mm to which a 100 g needle penetrates the bitumen in 5 seconds at a temperature of 25 °C. It is used to test the bitumen behavior at intermediate operating temperature. This test method is suitable for all bitumen types. The penetration index (EN 1427) Penetration index is not a test method, but is obtained by calculation from the ring and ball softening point and needle penetration. The calculation formula is based on the assumption that the penetration of the binder is 800 0,1 mm at its softening point. This is correct for most conventional binders, but not for polymer modified and special binders. The original calculation was based on determining the penetration of the needle at different temperatures. Fraass breakpoint (EN 12593) The determination of the fraass break point is described in test standard EN 12593. It describes the binder's transition from elastic to fragile and ensures the temperature at which a thin layer of bitumen cracks on a steel plate during uniform cooling when it bends under specified conditions. The test shows the behavior of bitumen at low operating temperatures. Flexible recovery (EN 13398) The elastic recovery test modifies the binders to elastomer and is used to demonstrate the modification of the binder. The sample shall be stretched to a maximum of 20 cm at a fixed temperature and speed and then desipped. After a prescribed period, the degree of elastic recovery shall be determined in relation to the original length. Force malleability (EN 13589) Further development of the well-known plasticity test is used to determine the cohesive characteristics of the binder, the test being used in the standard of polymer-modified bitumen. The sample shall be stretched at a fixed temperature and speed and the required traction force shall be continuously measured and recorded. The data shall be used, inter alia, to calculate the deformation energy, maximum tensile force or length of the sample to breakage. Further possibilities for interpreting data are currently being explored and discussed. Phase 1 - Dynamic shear rheometer (DSR) (EN 14770) Dynamic shear rheometer (DSR) is a device used to test bitumen properties under different load conditions and temperatures. DSR may apply controlled stress to the test and measure the response from which the calculates properties such as complex shear modulus G* and phase angle. The test using DSR is described in test method EN 14770. The DSR test is typically carried out at a number of test temperatures and/or load frequencies, called temperature and frequency sweeps. The fixed data complex shear modulus G* and the phase angle (δ) are calculated at a specific temperature/frequencies. Multiple stress creep and recovery test (MSCRT) (EN 16659) The dynamic shear rheometer (DSR) test tool can also be used to perform multiple stress creep and recovery tests. This test method is described in test standard EN 16659 and deals with the flexible response of bitumen binders and their sensitivity to permanent deformation of bitumen binders, as well as stress dependence. The binder sample shall be placed between two parallel plates and loaded with a constant voltage of exactly 1,0 s and then 9,0 s without load. Ten cycles of creep and recovery are carried out from which the percentage recovery and non-recoverable compliance of the binder is calculated. The test uses different stress levels, hence the name; Multiple-rate creep and recovery test. Bending beam rheometer (EN 14771) The bending beam rheometer (BBR) is a means of treating bitumen behaviour at low operating temperatures, as described in test standard EN 14771. The sample shall be placed under constant load under a low-temperature, constant load for a specified period of time. The creep stiffness of the sample is calculated from the voltage used and the time exertion. The test provides information on the stiffness of the binder at low temperatures and the ability to dissipate or relax from stress. Short-term aging: RTFOT method (EN 12607-1) The rolling thin film oven test (RTFOT) is a conditioning process rather than a test method described in EN 12607-1. RTFOT simulates the combined effect of heat and air on a thin film of bitumen binder. The purpose of the procedure is to simulate aging during the mixing and transport process of hot mixtures. In the case of paving grade binders, a reasonable correlation shall be reported with the m ripening of bitumen during the asphalt mixture production. However, standard conditioning parameters may not be applicable to modified binders, which may have too high a viscosity to provide a moving film. Long-term ageing: pressure ageing vessel (PAV) method (EN 14769) For RTFOT, pave aging is a conditioning process designed to provide information on long-term ageing sensitivity. It is usually performed after RTFOT conditioning. Although there are still questions about the applicability of the ageing process, due to the persistent high temperature experienced by the binder, PAV is the current reference long-term described in EN 14679. The sample shall be exposed to a high air pressure (2,1MPa) applied to a thin bitumen binder film at high temperatures, temperatures, Time. PAV aging is designed to simulate the degree of age hardening that the binder experiences over several years. For more information on bitumen tests please click on the links: Penetration test Softening point test Penetration test severed bituminous viscosity Solubility test loss in heating test distillation test Flashpoint test Firepoint test Autoignition temperature test Rheological test methods methods