

BITUMEN PENETARTION TEST

AIM

To determine consistency of bitumen or the grade of the bitumen by penetration test.

THEORYN

Bitumen is the residue or by-product obtained by the refining of crude petroleum. A wide variety of refining techniques like straight distillation technique, solvent extraction technique etc are used to produce bitumen of different consistency and other desirable properties. Depending on the origin and other characteristics of the crude oils and property of bitumen required, more than one processing method may be employed. The type of construction decides the type of bitumen needs to be used. But in general good bitumen should have following properties.

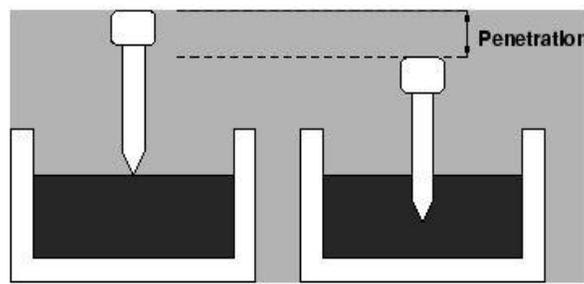
Temperature susceptibility of bitumen: the bitumen mix should not become too soft or unstable during hot weather, and not become too brittle during cold weather.

Viscosity of the bitumen: at the time of mixing and compaction should be adequate. This can be managed by the use of cutbacks or emulsions of suitable grades or heating the bitumen and aggregates prior to mixing.

Affinity and adhesion of bitumen: There should be adequate affinity and adhesion between the bitumen and aggregates used in the mix.

Penetration is a measure of consistency. It quantifies the hardness or softness of bitumen by measuring the depth in tenths of a millimeter to which a standard loaded needle will penetrate vertically in 5 seconds under specified temperature, load and duration of loading. BIS had

standardized the equipment and test procedure. The penetrometer consists of a needle assembly with weight of 100g and a device for releasing and locking in any position. The bitumen is softened to a pouring consistency, stirred thoroughly and poured into containers at a depth at least 15 mm in excess of the expected penetration. The test should be conducted at a specified temperature of 25°C. It may be noted that penetration value is largely influenced by any inaccuracy with regards to pouring temperature, size of the needle, weight placed on the needle and the test temperature. A grade of 40/50 bitumen represents the penetration value is in the range 40 to 50 at standard test conditions. Higher is the penetration of bitumen softer is the consistency. This is one of the most widely used test for classifying bituminous materials into different grades.



Penetration Test on Bitumen

The use of different grade of bitumen depends on climatic conditions and type of construction. Commonly used grades are 30/40, 60/70 and 80/100. For bituminous macadam and penetration macadam, IRC suggests bitumen grades 30/40, 60/70, 80/100. Generally, in warmer regions, lower penetration grades are preferred to avoid softening and in colder regions bitumen with higher penetration grades like 180/200 are used to prevent the occurrence of excessive brittleness. The test is not intended to estimate consistency of softer materials like cut back which are usually graded by viscosity test. High penetration grade is used in spray application works.

The penetration value of bitumen is measured by distance in tenths of mm that a standard needle would penetrate vertically into bitumen sample under standard conditions of test. By this test we can determine the hardness or softness value of bitumen.

In this test, firstly heat the bitumen above its softening point and pour it into a container of depth atleast 15mm. bitumen should be stirred wisely to remove air bubbles. Then cool it to room temperature for 90 minutes and then placed it in water bath for 90 minutes.

Then place the container in penetration machine adjust the needle to make contact with surface of sample. Make dial reading zero and release the needle for exactly 5 seconds and note down the penetration value of needle for that 5 seconds. Just repeat the procedure thrice and note down the average value.

Relevant Indian Standard for Penetration Test on Bitumen:

IS 1203-1978 Edition 2.2 (1989-03): Methods for Testing Tar and Bituminous Materials :
Determination of Penetration

PROCEDURE

1. The bitumen is softened to a pouring consistency, stirred well and poured into the test containers.
The depth of bitumen in container is kept **at least 15mm** more than the expected penetration.
(I.S. 1203-1978).

2. Now the sample containers are placed in a temperature controlled water bath at a temperature of 25 c for one hour.
3. Then at the end of one hour, the sample is taken out of water bath and the needle is brought in contact with the surface of bitumen sample at that time reading of dial is set at zero or the reading of dial noted, when the needle is in contact with the surface of the sample.
4. After that the needle is released and the needle is allowed to penetrate for **5 seconds** and the final reading is recorded. On that sample at least three penetration observations should be taken at distances at least **10 mm** apart. After each test, the needle should be disengaged, wiped with benzene and dried. The amount of penetration is recorded.
5. The main value of three measurements is reported is the penetration test.
6. The accuracy of the test depends upon pouring temperature, size of needle, weight placed on the needle, and test temperature.
7. Te **grade of bitumen** is specified in terms of penetration value. For example, 30/40 grade bitumen indicates the penetration value of the bitumen in the range of 30 to 40 at standard test conditions.
8. Readings are taken as units of penetration

Where, **1 unit = (1/10) mm**

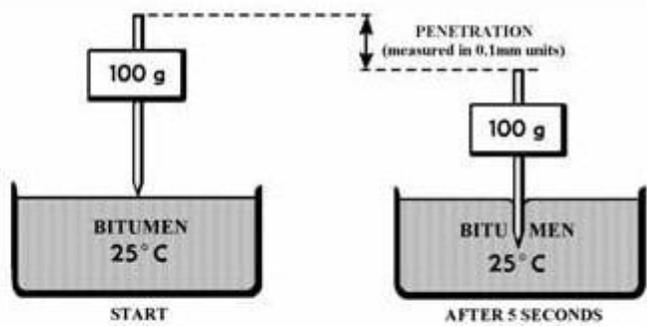


Fig:- Penetration apparatus and concept of penetration test.

Precautions during Penetration Test

- The container should not be moved while needle penetrates into sample.
- The sample should be free from any external materials.
- Benzene is used to clean up the needle and dried before penetration.
- Penetration test of bitumen is applied exclusively to bitumen. Tars being soft, penetration test on these materials cannot be carried out.

Penetration value of different types of bitumen used in road construction range between 20 to 225 . However 30/40 and 80/100 grade bitumen are more common for road construction depending upon the type of construction and climate conditions. In hot 30/40 bitumen is preferred.

The value of temperature affects the use of the bitumen. Lower penetration grade is used in warm climate condition to avoid softening and high penetration grade range of 180/210 are used in cold climate condition to prevent it from excessive brittleness.

In the last word, the Penetration test of Bitumen is used for the Grade of bitumen material in terms of its hardness. A 70/100 grade bitumen shows that its penetration value lies between 70 & 100.

Video link:- <https://www.youtube.com/watch?v=9HZE6DNfF5U>