

Chapter 5

Bitumen

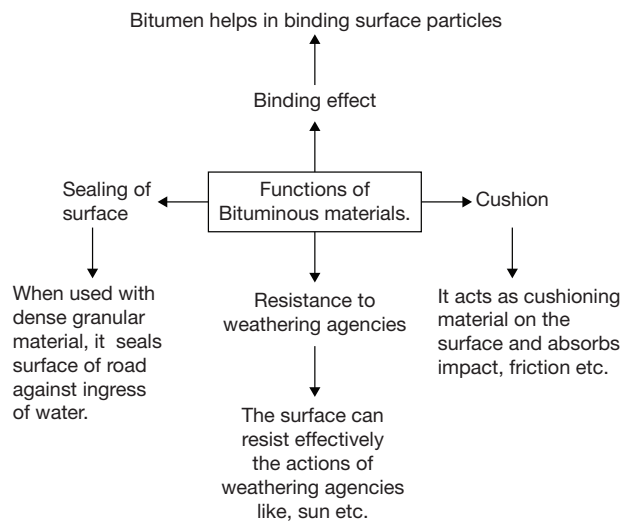
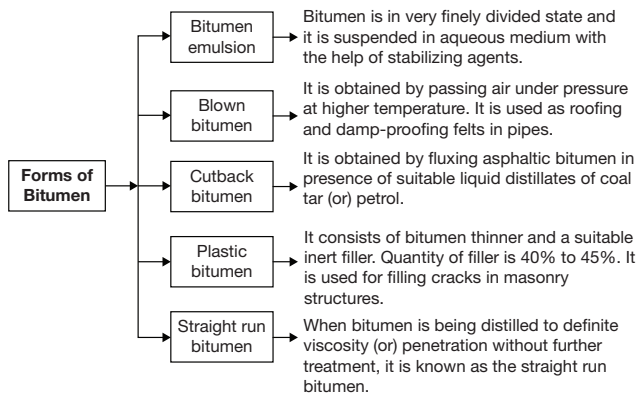
CHAPTER HIGHLIGHTS

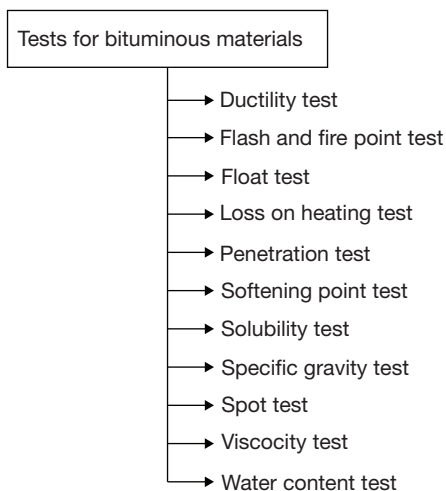
Introduction

INTRODUCTION

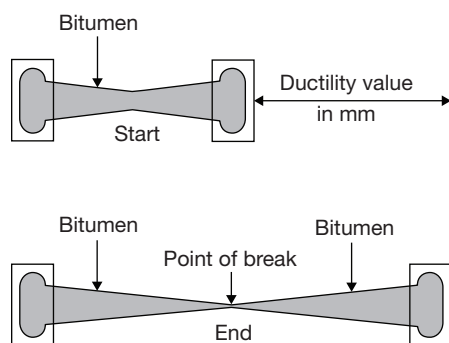
Bitumen is the binding material which is present in asphalt. It is also called 'mineral tar'. It is insoluble in water, but dissolves completely in carbon disulphide, chloroform, benzol, etc.

Bitumen = 87% carbon + 11% hydrogen + 2% oxygen





1. Ductility test: The sample is cast in a briquette mould whose cross-section at the minimum width is 10 mm × 10 mm. The test is conducted at a temperature of $27^{\circ}\text{C} \pm 0.5^{\circ}\text{C}$ at a rate of pull of $50 \text{ mm} \pm 2.5 \text{ mm}$ per minute. Ductility is the value which is expressed as the distance in centimetres to which a standard briquette of bitumen can be stretched before the thread breaks.



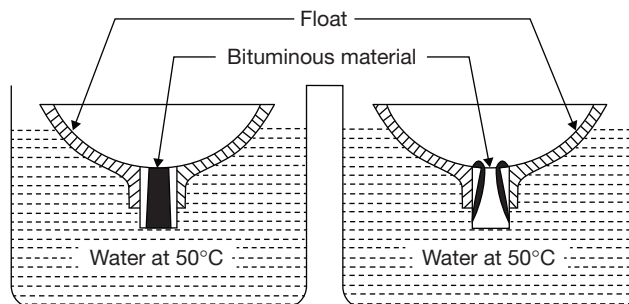
Ductility test

Ductility varies from 0.5–100, where bitumen with ductility > 50 is good bitumen.

2. Flash and fire point test:

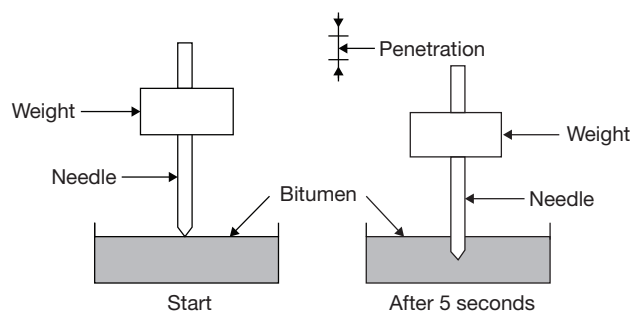
- (a) The flash point is the lowest temperature at which the vapour of a substance momentarily takes fire in the form of flash under conditions of rest.
- (b) The fire point is the lowest temperature at which the material gets ignited and burns under specified conditions of rest.

3. Float test: This test is used to find the consistency of the bituminous material. It is helpful when the material has consistency range which cannot be effectively defined either by orifice viscometer test or penetration test. A float of aluminium is filled with specimen material and is allowed to float. The time required for the water to force its way through the bitumen plug is noted and is indicated as float value.



4. Loss on heating test: The bitumen when heated, the volatiles present in it are evaporated and the bitumen becomes hard. The bitumen to be used in pavement mix should not indicate more than 1% loss in weight on heating.

5. Penetration test: The penetration test is used to find the hardness or softness of bitumen used in road construction by measuring the distance in tenths of millimetre to which a standard needle will penetrate vertically into the sample of bitumen under conditions of temperature.



Concept of penetration test

The grade of bitumen is specified in terms of penetration value. 80/100 range of penetration value means penetration ranging from 80–100. For hot climates, bitumen grades of low penetration are preferred, and for cold climates higher penetration grades of bitumen are preferred.

- 6. Softening point test:** As the temperature of the material rises, there is a gradual and imperceptible change from a brittle or exceedingly thick and slow-flowing condition to a softer and less viscous state. Softening point of bitumen is usually determined by ring and ball test.
- 7. Solubility test:** Pure bitumen is completely soluble in solvents like carbon disulphide or carbon tetrachloride. A known weight of the sample is taken and dissolved in excess quantity of solvent. Then the solution is filtered for removal of the probable insoluble materials.
- 8. Specific gravity test:** The specific gravity of bitumen is the ratio of mass of given volume of substance to the mass of equal volume of water.

The specific gravity is found by:

(a) Pycnometer method:

$$\text{Specific gravity} = \frac{(c - a)}{(b - a) - (d - c)}$$

Where

a = Weight of empty bottle

b = Weight of bottle filled with distilled water

c = Weight of bottle half filled with material

d = Weight of bottle half filled with material and rest filled with distilled water

(b) Balance method:

In this method specimen is weighed in air and then in water. The specific gravity is calculated by:

$$\text{Specific gravity} = \frac{e}{e - f}$$

Where

e = Weight of dry specimen

f = Weight of specimen immersed in distilled water

- For pure bitumen, specific gravity ranges from 1.01–1.03
- For tars specific gravity ranges from 1.1–1.25

9. Spot test: It is done for detecting overheated (or) cracked bitumen. A 2 g of bitumen is dissolved in 10 ml of naphtha. A drop of solution is taken out after one hour, and it is placed on a filter paper. A second drop of solution is taken out after 24 hours, and it is placed on a filter paper. If the spots on the filter paper are of uniform colour, the bitumen is treated as uncracked, otherwise it is called 'cracked bitumen'.

10. Viscosity test: The resistance to flow by liquid is known as viscosity, and it is thus the inverse of fluidity. At high fluidity, the viscosity is low and at low fluidity, the viscosity is high. Viscosity at any specified temperature is measured by recording the time in seconds for a given quantity of product at the same temperature to flow through an orifice of standard dimensions into a receiver. The higher the viscosity of binder, more time will be recorded and, lower the viscosity of binder, less time will be recorded.

11. Water content test: This test is conducted to know the content of water in a sample of bitumen.

EXERCISES

1. Bitumen in
 - (A) solid state, is called asphalt.
 - (B) semi fluid state, is called mineral tar.
 - (C) fluid state, is called petroleum.
 - (D) All of these
2. According to ISI, bitumen is classified into
 - (A) 2 grades
 - (B) 4 grades
 - (C) 6 grades
 - (D) 10 grades
3. Bitumen is generally obtained from
 - (A) organic material
 - (B) synthetic material
 - (C) petroleum product
 - (D) coal
4. Bitumen may be dissolved in
 - (A) carbon dioxide
 - (B) water
 - (C) sodium chloride
 - (D) carbon disulphide
5. Plastic bitumen is generally used for
 - (A) road pavements.
 - (B) expansion joints.
 - (C) crack filling.
 - (D) None of these
6. Bitumen emulsion is
 - (A) a liquid containing bitumen in suspension.
 - (B) a paint.
 - (C) used as anti-corrosive paint.
 - (D) All of these
7. Mastic asphalt is normally used for
 - (A) sound insulation.
 - (B) water proofing.
 - (C) fire proofing.
 - (D) None of these
8. The filler used in plastic bitumen, is
 - (A) shale powder
 - (B) talc powder
 - (C) asbestos powder
 - (D) plastic powder

ANSWER KEYS

Exercises

1. D 2. D 3. C 4. D 5. C 6. D 7. B 8. C