# LAB MANUAL

## TRANSPORTATION ENGINEERING LAB

## DEPARTMENT OF CIVIL ENGINEERING

## K D K COLLEGE OF ENGINEERING

**GREAT NAG ROAD, NANDANVAN, NAGPUR - 440009**

# TRANSPORTATION ENGINEERING LAB

LAB MANUAL

**(FOR B. E. PROGRAMME)**

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**Name :**

**Branch :**

**Roll No. :**

**Section :**

**Batch No. :**

**DEPARTMENT OF CIVIL ENGINEERING**

**K D K COLLEGE OF ENGINEEIRNG, NAGPUR**

**Laboratory Manual for**

**TRANSPORTATION ENGINEERING LAB**

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| **2** | **TO DETERMINE SPECIFIC GRAVITY OF AN AGGREGATE** |
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# Part – A
# Tests on Aggregate

# EXPERIMENT 2

**Aim of the experiment**:

To determine the specific gravity of given Bituminous material.

**Apparatus required:**

(i) Specific gravity bottle,

(ii) Weighing balance

(iii) Distilled water.

**Theory and Scope:**

In paving jobs, to classify a binder, density property is of great use. In most cases bitumen is weighed, but when used with aggregates, the bitumen is converted to volume using density values. The density of bitumen is greatly influenced by its chemical composition. Increase in aromatic type mineral impurities cause an increase in specific gravity. The specific gravity of bitumen is defined as the ratio of mass of given volume of bitumen of known content to the mass of equal volume of water at 27 $^{o}$C. The specific gravity of bitumen varies from 0.99 to 1.02.

**Procedure:**

- The clean, dried specific gravity bottle is weighed let that be $W_1$ gm
- Than it is filled with fresh distilled water and then kept in water bath for at least half an hour at temperature 27 $^{o}$C±0.1 $^{o}$C.
- The bottle is then removed and cleaned from outside. The specific gravitybottle containing distilled water is now weighed. Let this be $W_2$gm.
- Then the specific gravity bottle is emptied and cleaned. The bituminous material is heated to a pouring temperature and the material is poured half the bottle; by taking care to prevent entry of air bubbles. Then it is weighed. Let this be $W_3$ gm.
- The remaining space in specific gravity bottle is filled with distilled water at 27 $^{o}$C and is weighed. Let this be $W_4$ gm. Then specific gravity of bituminous material is given by the following formula

$$(W_3 - W_1) / [(W2-W1) - (W4-W3)]$$

- Three tests are conducted and the mean value is reported as specific gravity of the bitumen.

**Observation and Calculation:**

| Sl No | Details of sample | No of observations | | |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| 1 | Weight of the empty specific gravity bottle=$W_1$ gm | | | |
| 2 | Weight of the specific gravity bottle filled with water=$W_2$ gm | | | |
| 3 | Weight of the specific gravity bottle half filled with bitumen=$W_3$ gm | | | |
| 4 | Weight of specific gravity bottle half filled with bitumen & remaining part filled with water=$W_4$ gm | | | |
| 5 | Specific Gravity | | | |
| 6 | Mean Specific Gravity | | | |

**Result:**

The specific gravity of given bituminous binder is_____.

**Discussion:**

# EXPERIMENT 3

**Aim of the experiment**:

To determine the water absorption of coarse aggregates as per IS: 2386 (Part III) - 1963.

**APPARATUS**

i) Wire basket - perforated, electroplated or plastic coated with wire hangers for suspending it from the balance
ii) Water-tight container for suspending the basket
iii) Dry soft absorbent cloth - 75cm x 45cm (2 nos.)
iv) Shallow tray of minimum 650 sq.cm area
v) Air-tight container of a capacity similar to the basket
vi) Oven

**SAMPLE**

A sample not less than 2000g should be used.

**PROCEDURE**

i) The sample is thoroughly washed to remove finer particles and dust, drained and then it placed in the wire basket and it is immersed in distilled water at a temperature between 22 and 32$^{o}$C.
ii) After immersion, the entrapped air is removed by lifting the basket and allowing it to drop 25 times in 25 seconds.
iii) The basket and sample is remained immersed for a period of 24 + ½ hrs after wards.
iv) The basket and aggregates should then be removed from the water, allowed to drain for a few minutes, after which the aggregates is gently emptied from the basket on to one of the dry clothes and gently surface-dried with the cloth, transferring it to a second dry cloth when the first would remove no further moisture.
v) The aggregates is spread on the second cloth and exposed to the atmosphere away from direct sunlight till it appears to be completely surface-dry.
vi) The aggregates are weighed (Weight 'A').

vii) The aggregates are placed in an oven at a temperature of 100 to 110°C for 24hrs.

viii) It is removed from the oven, cooled and weighed (Weight 'B').

**REPORTING OF RESULTS**

Water absorption = $\frac{A-B}{B} \times 100\%$

Two such tests should be done and the individual and mean results should be reported.

| Sl No | Determination No | I | II | III |
|---|---|---|---|---|
| 1 | Weight of saturated surface-dried sample in g (A) | | | |
| 2 | Weight of oven dried sample is g (B) | | | |
| 3 | Water absorption = $\frac{A-B}{B} \times 100\%$ | | | |
| Average value | | | | |

**CONCLUSION**

# EXPERIMENT 4 & 5

Objective**:** Determine the Flakiness and Elongation index of coarse aggregates.

Apparatus required:

i) Flakiness gauge

ii) Elongation gauge

iii)Tray

Theory: The particle shape of the aggregate mass is determined by the percentage of flaky and elongated particles in it. Aggregates which are flaky or elongated are detrimental to higher workability and stability of mixes.

- Shape of crushed aggregates determined by the percentage of flaky and elongated particles.
- Shape of gravel determined by its angularity number.
- Flaky and elongated aggregate particles tend to break under heavy traffic loads.
- Rounded aggregates preferred in cement concrete pavements as more workability at less water cement ratio.
- Angular shape preferred for granular courses/flexible pavement layers due to better interlocking and hence more stability.

- Flakiness Index is the percentage by weight of particles in it, whose least dimension (Thickness) is less than three-fifths of its mean dimension. The test is not applicable to particles Smaller than 6.3 mm in size.

- Elongation Index is the percentage by weight of particles in it, whose largest dimension (Length) is greater than one and four-fifths times its mean dimension. The test is not applicable to particles smaller than 6.3 mm in size.

**Procedure for using Gauge for Flakiness Index:**

1. The sample is sieved through IS sieve sizes 63, 50, 40, 31.5, 25, 20, 16, 12.5, 10 and 6.3 mm

2. Minimum 200 pieces of each fraction to be tested are taken and weighed (W1 gm).
3. Separate the flaky material by using the standard thickness gauge

**Flakiness**

The amount of flaky material is weighed to an accuracy of 0.1 percent of the test sample

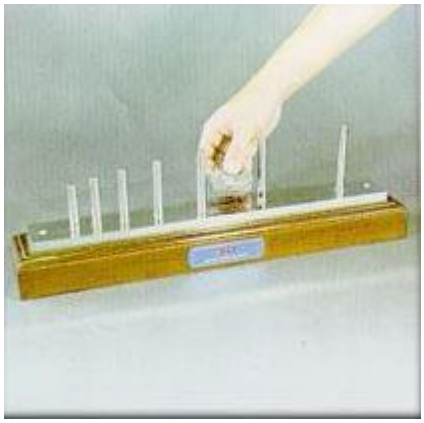
If W1, W2… Wi are the total weights of each size of aggregates taken

If x1 x2….Xiare the weights of material passing the different thickness gauges then:

## Observation sheet (Flakiness Index):

| Passing through I.S. Seive, (mm) | Retained on I.S. Seive, (mm) | Wt. Of the fraction consisting of at least 200 pieces (gm) | Thickness gauge size, (0.6 times the mean sieve) (mm) | Weight of aggregate in each fraction passing thickness gauge (gms) |
|---|---|---|---|---|
| 25 | 20 | W1 | 13.5 | X1 |
| 20 | 16 | W2 | 10.8 | X2 |
| 16 | 12.5 | W3 | 8.55 | X3 |
| 12.5 | 10 | W4 | 6.75 | X4 |
| 10 | 6.3 | W5 | 4.89 | X5 |
| | | W total= | | X total= |

**Flakiness index=x/w*100**



**Length Gauge for Elongation Index**

**Thickness Gauge for Flakiness Index**

**Procedure for using Gauge Elongation index：**

1. The sample is sieved through sieve sizes, 50, 40, 25, 20,16, 12.5, 10 and 6.3
2. Minimum 200 pieces of each fraction to be tested are taken and weighed (W1 gm
3. Separate the elongate material by using the standard length gauge.

## Elongation Index

The amount of elongated material is weighed to an accuracy of 0.1 percent of the test sample

If W1, W2, …, Wi are the total weights of each size of aggregates taken

If x1,x2, …, Xiare the weights of material retained on different length gauges then

| Passing through I.S. Seive, (mm | Retained on I.S. Seive, (mm) | Wt. Of the fraction consisting of at least 200 pieces (gm) | Length gauge size, (1.8 times the mean sieve) (mm) | Weight of aggregate in each fraction retained on length gauge gms |
|---|---|---|---|---|
| **25** | **20** | **W1** | **40.5** | **X1** |
| **20** | **16** | **W2** | **32.4** | **X2** |
| **16** | **12.5** | **W3** | **25.5** | **X3** |
| **12.5** | **10** | **W4** | **20.2** | **X4** |
| **10** | **6.3** | **W5** | **14.7** | **X5** |
| | | **Total W=** | | **Total X=** |

**Elongation index=X/W*100**

# Conclusion:

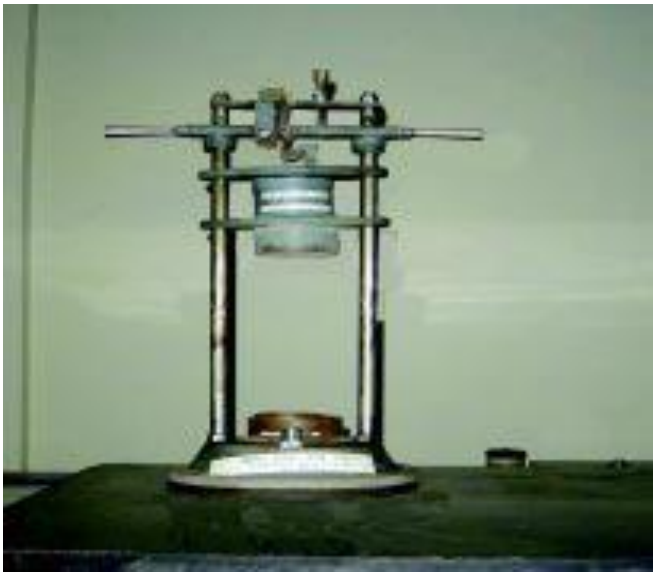
# EXPERIMENT 06

## OBJECTIVE

To determine the aggregate impact value of coarse aggregates as per IS: 2386 (Part IV) - 1963.

## APPARATUS

i) Impact testing machine conforming to IS: 2386 (Part IV) - 1963
ii) IS Sieves of sizes - 12.5mm, 10mm and 2.36mm
iii) A cylindrical metal measure of 75mm dia. and 50mm depth
iv) A tamping rod of 10mm circular cross section and 230mm length, rounded at one end
v) Oven



**AGGREGATE IMPACT TEST MACHINE**

**PREPARATION OF SAMPLE**

i) The test sample is conformed to the following grading: - Passing through 12.5mm IS Sieve 100% - Retention on 10mm IS Sieve 100%

ii) The sample is oven-dried for 4hrs. at a temperature of 100 to 110$^{o}$C and cooled.

iii) The measure is about one-third full with the prepared aggregates and tamped with 25 strokes of the tamping rod.

i) A further similar quantity of aggregates is added and a further tamping of 25 strokes given. The measure is finally to be filled to overflow, tamped 25 times and the surplus aggregates struck off, using a tamping rod as a straight edge.

ii) The net weight of the aggregates in the measure is determined to the nearest gram (Weight 'A').

**PROCEDURE**

i) The cup of the impact testing machine is fixed firmly in position on the base of the machine and the whole of the test sample is placed in it and compacted by 25 strokes of the tamping rod.

ii) The hammer is raised to 380mm above the upper surface of the aggregates in the cup and allowed to fall freely onto the aggregates.

iii) The test sample is subjected to a total of 15 such blows, each being delivered at an interval of not less than one second.

iv) The sample is removed and sieved through a 2.36mm IS Sieve. The fraction passing through is weighed (Weight 'B').

v) The fraction is retained on the sieve should also be weighed (Weight 'C') and if the total weight (B+C) is less than the initial weight (A) by more than one gram, the result is discarded and a fresh test done.

vi) The ratio of the weight of the fines formed to the total sample weight is expressed as a percentage.

vii) Aggregate impact value is obtained by the relation (B/A) x 100%

viii) Two such tests is carried out and the mean of the results is reported. A sample proforma for the record of the test results is given in

**OBSERVATION**

| Sl No | Net weight of Aggregate in the Measure in gm (A) | The fraction Passing through 2.36 mm IS sieve in gm (B) | The fraction Retained on 2.36 mm IS Sieve in gm (C) | Aggregate Impact value = (B/A)*100% |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| Average value | | | | |

**CONCLUSION**

# EXPERIMENT 07

**Aim of the Experiment:**

To determine crushing strength of a given aggregate

**Apparatus Required:**

- A steel cylinder of internal diameter 15.2 cm (Steel cylinder with open ends).
- A square base plate, plunger having a piston diameter of 15 cm.
- A cylindrical measure of internal diameter of 11.5 cm and height 18 cm.
- Steel tamping rod having diameter of 1.6 cm length 45 to 60 cm.
- Balance of capacity 3 kg with accuracy up to 1 gm.
- Compression testing machine capable of applying load of 40 tonnes at a loading rate of 4 tonnes per minute

**Theory and Scope:**

This is one of the major Mechanical properties required in a road stone. The test evaluates the ability of the Aggregates used in road construction to withstand the stresses induced by moving vehicles in the form of crushing. With this the aggregates should also provide sufficient resistance to crushing under the roller during construction and under rigid tyre rims of heavily loaded animal drawn vehicles. The crushing strength or aggregate crushing value of a given road aggregate is found out as per ***IS-2386 Part- 4***.

The aggregate crushing value provides a relative measure of resistance to crushing under a gradually applied compressive load. To achieve a high quality of pavement aggregate possessing low aggregate crushing value should be preferred. The aggregate crushing value of the coarse aggregates used for cement concrete pavement at surface should not exceed 30% and aggregates used for concrete other than for wearing surfaces, shall not exceed 45% as specified by Indian Standard (IS) and Indian Road Congress (IRC).

**Procedure:**

- The aggregate in surface-dry condition before testing and passing 12.5 mm sieve and retained on 10 mm sieve is selected.
- The cylindrical measure is filled by the test sample of the aggregate in three layers of approximately equal depth, each layer being tamped 25 times by the rounded end of the tamping rod.
- After the third layer is tamped, the aggregates at the top of the cylindrical measure

- are leveled off by using the tamping rod as a straight edge. Then the test sample is weighed. Let that be $W_1$ gm.
- Then the cylinder of test apparatus is kept on the base plate and one third of the sample from cylindrical measure is transferred into cylinder and tamped 25 times by rounded end of the tamping rod.
- Similarly aggregate in three layers of approximately equal depth, each layer being tamped 25 times by rounded end of the tamping rod.
- Then the cylinder with test sample and plunger in position is placed on compression testing machine.
- Load is then applied through the plunger at a uniform rate of 4 tonnes per minute until the total load is 40 tonnes and the load is released.
- Aggregates including the crushed position are removed from the cylinder and sieved on a 2.36mm IS sieve and material which passes this sieve is collected and weighed. Let this be $W_2$ gm.
- The above step is repeated with second sample of the same aggregate.
- Then the aggregate crushing value is defined as the ratio of weight of fines passing the specified IS sieve($W_2$ gm) to the total weight of the sample ($W_1$ gm)
- Two tests are done and the average value to the nearest whole number is reported as aggregate abrasion value.

Aggregate crushing value= $( W_2 / W_1)x100$

**Observation and Calculation:**

| No of observations | Total weight of dry aggregate sample($w_1$gm) | Weight of fines passing through 2.36 mm IS Sieve($w_2$gm) | Aggregate Crushing Value (%) | Mean Value |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |

**Result:**
The mean (average) of the crushing value aggregate is_____%

**Discussion:**

# EXPERIMENT 08

## OBJECTIVE

To determine the abrasion value of coarse aggregates as per IS: 2386 (Part IV) - 1963.

## APPARATUS

i) Los Angles abrasion testing machine

ii) IS Sieve of size - 1.7mm

iii) Abrasive charge - 12 nos. cast iron or steel spheres approximately 48mm dia. and each weighing between 390 and 445g ensuring that the total weight of charge is 5000 + 25g

iv) Oven

**LOS ANGLES MACHINE**

## PREPARATION OF SAMPLE

The test sample should consist of clean aggregates which has been dried in an oven at 105 to 110$^{o}$C to a substantially constant weight and should conform to one of the gradings shown in the table below:

**Grading of test samples**

| **Sieve size (square hole)** | | **Weight of g of test sample for grade** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **A** | **B** | **C** | **D** | **E** | **F** | **G** |
| Passing Through (mm) | Retained on (mm) | | | | | | | |
| 80 | 63 | - | - | - | - | 2500* | - | - |
| 63 | 50 | - | - | - | - | 2500* | 5000* | |
| 50 | 40 | - | - | - | - | - | 5000* | 5000* |
| 40 | 25 | 1250 | - | - | - | - | - | 5000* |
| 25 | 20 | 1250 | - | - | - | - | - | - |
| 20 | 12.5 | 1250 | 2500 | - | - | - | - | - |
| 12.5 | 10 | 1250 | 2500 | - | - | - | - | - |
| 10 | 6.3 | - | - | 2500 | - | - | - | - |
| 6.3 | 4.75 | - | - | 2500 | - | - | - | - |
| 4.75 | 2.36 | - | - | - | 5000 | - | - | - |

**PROCEDURE**

i) The test sample and the abrasive charge is placed in the Los Angles abrasion testing machine and the machine is rotated at a speed of 20 to 33 revolutions/minute for 1000 revolutions.

ii) At the completion of the test, the material is discharged and sieved through 1.70mm IS Sieve.

iii) The material coarser than 1.70mm IS Sieve is washed dried in an oven at a temperature of 100 to 110$^{o}$C to a constant weight and weighed (Weight 'B').

iv) The proportion of loss between weight 'A' and weight 'B' of the test sample is expressed as a percentage of the original weight of the test sample. This value is reported as,

Abrasion value = $\frac{A-B}{A} \times 100\%$

**OBSERVATION AND TABULATION**

| Sl No | Sample passing Through IS sieve In mm | Sample retained on IS sieve in mm | Weight of Sample taken In gm (A) | No of charges | Weight of sample retained on 1.7 mm IS sieve after test in gm (B) | Abrasion value = $\frac{A-B}{A} \times 100\%$ |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| | | | | | | |
| 2 | | | | | | |
| | | | | | | |
| 3 | | | | | | |
| | | | | | | |
| Average value | | | | | | |

**CONCLUSION**

# EXPERIMENT 09

## OBJECTIVE

To determine the penetration of bitumen as per IS: 1203 - 1978.

## THEORY

The penetration of a bituminous material is the distance in tenths of a mm, that a standard needle would penetrate vertically, into a sample of the material under standard conditions of temperature load and time.

## APPARATUS REQUIRED

i) Penetrometer

ii) Water bath

iii) Bath thermometer - Range 0 to 44$^{o}$C, Graduation 0.2$^{o}$C

**PENETROMETER**

**SAMPLE**

Bitumen should be just sufficient to fill the container to a depth of at least 15mm in excess of the expected penetration.

**PROCEDURE**

i) The bitumen above the softening point (between 75 and 100$^{o}$C) is softened. It is stirred thoroughly to remove air bubbles and water.

ii) It is poured into a container to a depth of at least 15mm in excess of the expected penetration.

iii) It is cooled at an atmospheric temperature of 15 to 30$^{o}$C for 2 1 hrs. Then it is placed in a transfer dish in the water bath at 25.0 + 0.1$^{o}$C for 2 1

iv) The container is kept on the stand of the penetration apparatus.

v) The needle is adjusted to make contact with the surface of the sample.

vi) The dial reading is adjusted to zero. Is adjusted.

vii) With the help of the timer, the needle is released for exactly 5 seconds.

viii) The dial reading is recorded.

ix) The above procedure is repeated for thrice.

**OBSERVATION**

**CONCLUSION**

# EXPERIMENT 10

## OBJECTIVE

To determine the softening point of asphaltic bitumen and fluxed native asphalt, road tar, coal tar pitch and blown type bitumen as per IS: 1205 - 1978.

## APPARATUS

i) Ring and ball apparatus

ii) Thermometer - Low Range : -2 to 80$^{o}$C, Graduation 0.2$^{o}$C

High Range : 30 to 200$^{o}$C, Graduation 0.5$^{o}$C

**RING AND BALL APPARATUS**

## THEORY

It is the temperature at which the substance attains a particular degree of softening under specified condition of the test.

**PREPARATION OF SAMPLE**

i) The sample is just sufficient to fill the ring. The excess sample is cut off by a knife.

ii) The material is heated between 75 and 100$^{o}$C. Stir it to remove air bubbles and water, and filter it through IS Sieve 30, if necessary.

iii) The rings are heated and glycerin is applied. The material is filled in it and is cooled it for 30 minutes.

iv) The excess material is removed with the help of a warmed, sharp knife.

**PROCEDURE**

A) Materials of softening point below 80$^{o}$C:

i) The apparatus is assembled with the rings, thermometer and ball guides in position.

ii) The beaker is filled with boiled distilled water at a temperature 5.0 ± 0.5$^{o}$C per minute.

iii) With the help of a stirrer, stir the liquid and heat is applied to the beaker at a temperature of 5.0 ± 0.5$^{o}$C per minute.

iv) The heat is applied until the material softens and the ball is allowed to pass through the ring.

v) The temperature is recorded at which the ball touches the bottom, which is nothing but the softening point of that material.

B) Materials of softening point above 80$^{o}$C:

i) The procedure is the same as described above. The only difference is that instead of water, glycerine is used and the starting temperature of the test is 35$^{o}$C.

**OBSERVATION**

**CONCLUSION**

# EXPERIMENT 11

## OBJECTIVE

To determine the flash point and the fire point of asphaltic bitumen and fluxed native asphalt, cutback bitumen and blown type bitumen as per IS: 1209 - 1978.

## APPARATUS REQUIRED

A) Pensky-Martens apparatus

B) Thermometer- Low Range : -7 to 110$^{o}$C, Graduation 0.5$^{o}$C

High Range : 90 to 370$^{o}$C, Graduation 2$^{o}$C

## THEORY

Flash Point - The flash point of a material is the lowest temperature at which the application of test flame causes the vapors from the material to momentarily catch fire in the form of a flash under specified conditions of the test.

Fire Point - The fire point is the lowest temperature at which the application of test flame causes the material to ignite and burn at least for 5 seconds under specified conditions of the test.

**PENSKY - MARTENS APPARATUS**

**PROCEDURE**

*A) FLASH POINT*

i) The bitumen is softened between 75 and 100$^{o}$C. It is stirred thoroughly to removed air bubbles and water.

ii) The cup is filled with the material to be tested up to the filling mark. It is placed on the bath. The open clip is fixed thermometer is inserted of high or low range as per requirement and also the stirrer, to stir it.

iii) The test flame is lighted, and it is adjusted.

i) The heat is supplied at such a rate that the temperature is increased; the thermometer is recorded neither less than 5$^{o}$C nor more than 6$^{o}$C per minute.

ii) Open flash point is taken as that temperature when a flash first appears at any point on the surface of the material in the cup.

iii) Care is taken so that the bluish halo that sometimes surrounds the test flame is not confused with the true flash. Discontinue the stirring during the application of the test flame.

iv) Flash point is taken as the temperature read on the thermometer at the time the flash occurs.

*B) FIRE POINT*

i) After flash point, heating is continued at such a rate that the increase in temperature is recorded by the thermometer is neither less than 5$^{o}$C nor more than 6$^{o}$C per minute.

ii) The test flame is lighted and adjusted so that it is of the size of a bead 4mm in dia.

**OBSERVATION**

**CONCLUSION**

# EXPERIMENT 12

## OBJECTIVE

To determine the ductility of distillation residue of cutback bitumen, blown type bitumen and other bituminous products as per IS: 1208 - 1978.

## THEORY

The ductility of a bituminous material is measured by the distance in cm to which it will elongate before breaking when a standard briquette specimen of the material is pulled apart at a specified speed and a specified temperature.

## APPARATUS

i) Standard mould

ii) Water bath

iii) Testing machine

iv) Thermometer - Range 0 to 44$^{o}$C, Graduation 0.2$^{o}$C

**TESTING MACHINE**

**PROCEDURE**

i) The bituminous material is tested is completely melt by heating it to a temperature of 75 to 100$^{o}$C above the approximate softening point until it becomes thoroughly fluid.

ii) The mould is assembled on a brass plate and in order the material is prevented under test from sticking, thoroughly coat the surface of the plate and the interior surfaces of the sides of the mould with a mixture of equal parts of glycerine and dextrin.

iii) While filling, the material is poured in a thin stream back and forth from end to end of the mould until it is more than level full. It is leaved to cool at room temperature for 30 to 40 minutes and then it is placed in a water bath maintained at the specified temperature for 30 minutes, after which cut off the excess bitumen by means of a hot, straight-edged putty knife or spatula, so that the mould is just level full.

iv) The brass plate and mould is placed with briquette specimen in the water bath and it is kept at the specified temperature for about 85 to 95 minutes. The briquette is removed from the plate; detach the side pieces and the briquette immediately.

v) The rings are attached at each end of the two clips to the pins or hooks in the testing machine and the two clips are pulled apart horizontally at a uniform speed, as specified, until the briquette ruptures.

vi) The distance is measured in cm through which the clips have been pulled to produce rupture.

vii) While the test is being done, the specimen both above and below by at least 25mm is covered with water in the tank of the testing machine and the temperature is maintained continuously within ± 0.5$^{o}$C of the specified temperature.

**OBSERVATION**

**CONCLUSION**

**VISCOSITY TEST OF BITUMINOUS MATERIAL**

**Aim of the Experiment**:

To determine the viscosity of a given bituminous binder.

# Apparatus required:

(i) A orifice viscometer (one of 4.0mm diameter used to test cut back grades 0 and 1 and 10 mm orifice to test all other grades),

(ii) water bath,

(iii) Stirrer

(iv) Thermo meter.

# Theory and Scope:

Viscosity denotes the fluid property of bituminous material and it is a measure of resistance to flow. At the application temperature, this characteristic greatly influences the strength of resulting paving mixes. Low or high viscosity during compaction or mixing has been observed to result in lower stability values. At high viscosity, it resists the compactive effort and thereby resulting mix is heterogeneous, hence low stability values. And at low viscosity instead of providing a uniform film over aggregates, it will lubricate the aggregate particles. Orifice type viscometers are used to indirectly find the viscosity of liquid binders like cutbacks and emulsions. The viscosity expressed in seconds is the time taken by the 50 ml bitumen material to pass through the orifice of a cup, under standard test conditions and specified temperature. Viscosity of a cutback can be measured with either 4.0 mm orifice at 25 $^{o}$C or 10 mm orifice at 25 $^{0}$C or 40 $^{o}$C.

# Procedure:

- Adjust the tar viscometer so that the top of the tar cup is leveled.
- Select the test temperature. Heat the water in water bath to the temperature specified for the test and maintains it within ±0.1$^{0}$C of the specified temperature throughout the duration of test. Rotate the stirrer gently at frequent intervals or perfectly continuously
- Clean the tar cup orifice of the viscometer with a suitable solvent and dry thoroughly
- Warm and stir the material under examination to 20 $^{0}$C above the temperature specified for test and cool, while continuing the stirring. When the temperature falls slightly above the specified temperature, pour the tar into the cup until the leveling peg on the valve rod is just immersed when the latter is vertical.

- Pour into the graduated receiver 20 ml of mineral oil, or one percent by weight solution of soft soap, and place it under the orifice of the tar cup.
- Place the other thermometer in the tar and stir until the temperature is within ±0.1 $^0$C of the specified temperature. When this temperature has been reached, suspend the thermo meter coaxially with the cup and with its bulb approximately at the geometric center of the tar.
- Allow the assembled apparatus to stand for five minutes during which period the thermometer reading should remain within 0.05 $^0$C of the specified temperature.
- Remove the thermometer and quickly remove any excess of tar so that the final level ison the central line of the leveling peg when the valve is in vertical position.
- Lift the valve and suspend it on valve support
- Start the stop watch when the reading in the cylinder is 25 ml and stop it when it is 75 ml. note the time in seconds
- Report the viscosity as the time taken in seconds by 50 ml of tar to flow out at the temperature specified for the test.
- Three tests are conducted and mean of the three observations recorded as viscosity of bituminous material.

# Observations and Calculations

| Sl No | Details of sample | No of observation | | |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| 1 | Test Temperature | | | |
| 2 | Time taken to flow 50cc of the binder | | | |
| 3 | Viscocity (sec) | | | |
| 4 | Mean Viscocity | | | |

**Results:**

The Viscosity value of given bitumen sample is_____sec

# Discussion: