IS 3117 (2004): Bitumen Emulsion for Roads and Allied Applications (Anionic Type) [PCD 6: Bitumen Tar and their Products]

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सड़कों के लिए बिटुमेन पायस (ऋकयनीय टाईप) — विशिष्टि

(पहला पुनरीक्षण)

Indian Standard

BITUMEN EMULSION FOR ROADS AND ALLIED APPLICATIONS (ANIONIC TYPE) — SPECIFICATION

(First Revision)

ICS 93.080.20

BUREAU OF INDIAN STANDARDS
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Price Group 6

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Bitumen, Tar and Their Products Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

Most bituminous binders used in the construction of roads and allied applications are viscous semi-solids at normal temperatures. For surface dressing, mulch treatment, etc, they must be brought to a fluid state by heating before being applied in thin films to road and allied surfaces. The lack of adequate heating facilities in remote areas led to a demand for binders which could be used cold. The use of emulsions, which not only flow readily at atmospheric temperatures but can also be applied to damp and wet road surfaces, therefore, came into vogue.

Bitumen emulsions are dispersions of very fine bitumen particles in an aqueous medium. They are easy to handle and find wide applications in road construction and maintenance; soil stabilization, grouting, tack coating; re-treading, seal coating, premixing, dust-spraying, mulch treatment and in various other special circumstances where cold application of bitumen is desirable.

This standard was first published in 1965. In this revision, the following modifications have been made:

a) Title and scope has been changed to cover the requirements of bitumen emulsion for allied applications besides roads.

b) Definition for anionic emulsion has been included.

c) In Table 1, water content requirement has been deleted and the bitumen content requirement has been introduced along with the corresponding test method.

d) Various test methods (Annex A to Annex K) prescribed in this standard have been updated.

In the formulation of this standard due weightage has also been given to international coordination among the standards and practices prevailing in other countries and this has been met by deriving assistance from the following publications:

BS 434-1 : 1984 'Bitumen road emulsions (anionic and cationic):

Part 1 Specification for bitumen road emulsions', issued by British Standards Institution, UK

ASTM D 244 : 1997 'Standard test methods and practices for emulsified asphalts', issued by American Society for Testing and Materials, USA

ASTM D 977 : 1998 'Standard specification for emulsified asphalt', issued by American Society for Testing and Materials, USA

ASTM D 2397 : 1998 'Standard specification for cationic emulsified asphalt', issued by American Society for Testing and Materials, USA

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

BITUMEN EMULSION FOR ROADS AND ALLIED APPLICATIONS (ANIONIC TYPE) — SPECIFICATION

(First Revision)

1 SCOPE

This standard covers the physical and chemical requirements of bitumen emulsion (anionic type) for roads and allied applications.

2 REFERENCES

The following standards contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revisions and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
73 : 1992	Specification for paving bitumen (*second revision*)
269 : 1989	Specification for 33 grade ordinary portland cement (*fourth revision*)
334 : 2002	Glossary of terms relating to bitumen and tar (*third revision*)
460 : (Part 1) 1985	Specification for test sieves : Part 1 Wire cloth test sieves (*third revision*)
878 : 1975	Graduated measuring cylinders (*first revision*)
1201 : 1978	Methods for testing tar and bituminous materials — Sampling (*first revision*)
1211 : 1978	Methods for testing tar and bituminous materials : Determination of water content (Dean and Stark method) (*first revision*)
1212 : 1978	Methods for testing tar and bituminous materials : Determination of loss on heating (*first revision*)
1997 : 1982	Burettes (*second revision*)
2619 : 1993	Glass beakers (*second revision*)

3 TERMINOLOGY

For the purpose of this standard the definition given in IS 334 and the following shall apply.

3.1 Anionic Emulsion — An emulsion in which anion of the emulsifier is at the interface with the bitumen particles that is negatively charged and the aqueous phase is alkaline.

4 MATERIALS

4.1 Bitumen

The bitumen straight run or fluxed, used for the manufacture of the emulsion, shall comply with IS 73 and the following requirements:

a) Penetration shall be between 100 and 350;
b) Softening point (Ring and ball) shall not higher than 48°C;
c) Solubility in trichloroethylene shall not be less than 99.0 percent; and
d) Loss of mass after heating for 5 h at 163°C shall not exceed two percent of the original mass. After carrying out this test the penetration of bitumen shall not be less than 60 percent of its original value.

4.1.1 If it is desired to modify the performance of the emulsion during periods of low temperature, fluxing the bitumen with the addition of a quantity of fluxing agent not exceeding five percent by mass of bitumen shall be permitted. Unless otherwise agreed to between the manufacturer and the purchaser, the fluxing agents shall comply with the following requirements:

a) Initial boiling point not less than 140°C; and
b) Distillate at 350°C not less than 90 percent by volume.

4.2 Emulsifying Agent

The emulsifying agent, in the proportion in which it is present in the bitumen emulsion, shall not have any deleterious effect upon the properties of the bitumen.

5 TYPES

5.1 Emulsified bitumen shall be of the following three types:

a) Rapid setting : Type RS
b) Medium setting : Type MS
c) Slow setting : Type SS

5.1.1 *Applications*

The uses of three types of bitumen are given below:

a) *Type RS* — A quick setting emulsified bitumen used for penetration, surface treatment, tack coating and mulch treatment.

b) *Type MS* — A medium setting emulsified bitumen used for plant mixes with coarse aggregate, all of which is retained on 2.80 mm IS Sieve with practically no material passing 75 micron IS Sieve.

c) *Type SS* — A slow setting emulsified bitumen used for fine aggregate mixes in which a substantial quantity of aggregate passes a 2.80-mm IS Sieve and a portion may also pass a 75 micron IS Sieve.

NOTE — These types are to be used only at temperature above 4°C. Below 4°C the utility of the bitumen emulsion is likely to be impaired because of freezing, as such they should preferably be stored above 4°C.

6 REQUIREMENTS

6.1 Bitumen emulsion shall be homogeneous. Within one year after manufacture it shall show no undispersed bitumen after thorough mixing.

6.2 The physical and chemical requirements of the three types of bitumen emulsion shall comply with the requirements specified in Table 1.

NOTE — Care shall be exercised to see that materials used in the manufacture of bitumen shall not have any toxic effects on the plant or animal life.

7 SAMPLING

7.1 For the purpose of testing, the size of the sample and the sampling procedure from drums, barrels or bulk supply shall be as described in IS 1201 subject to the following:

a) *From Drums or Barrels* — The contents of drum or barrel from which the sample is to be taken shall be thoroughly mixed by rolling the container to and fro for a period of 2 to 3 min, successively in opposite direction, allowing at least five revolutions of the container on each direction and then up-ending the container through two revolutions, first in one direction and then in the opposite direction.

b) *From Bulk* — Where practicable, bulk deliveries of bitumen emulsion shall be agitated by forced circulation or air agitation, before sampling.

c) The sample of bitumen emulsion shall be drawn within 24 h after delivery and tested within 7 days from the date of drawing, unless otherwise specified.

7.1.1 *Preparation of Samples*

Before carrying out any of the tests, the sample shall be mixed by gentle shaking to ensure uniformity.

7.2 If the single sample from a single run or batch fails to fulfill the test requirements under **6**, samples shall be drawn on the basis of **7.1** for testing in the same manner. If these samples conform to the requirements of **6**, the lot shall be accepted, otherwise the lot shall be rejected.

8 TESTS

Unless specified otherwise, tests shall be carried out as described by methods referred in Table 1.

9 MARKING

9.1 Each container shall be legibly and indelibly marked with the following:

a) Name and type of the material;
b) Indication of the source of manufacture;
c) Month and year of manufacture;
d) Batch number;
e) Net mass; and
f) Date of expiry.

9.2 BIS Certification Marking

The container may also be marked with the Standard Mark.

9.2.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

Table 1 Requirements of Bitumen Emulsion
(*Clauses* 6.2 *and* 8)

Sl No.	Characteristic	Rapid Setting	Medium Setting	Slow Setting	Method of Test, Ref to Annex
(1)	(2)	(3)	(4)	(5)	(6)
i)	Viscosity by Saybolt Furol viscometer, in second at 25°C	20-100	20-100	20-100	A
ii)	Bitumen content, percent by mass, *Min*	65	65	57	B
iii)	Settlement, 5 days, percent, *Max*	3	3	3	C
iv)	Demulsibility, 35 ml of 0.02 N calcium chloride, percent, *Min*	60	—	—	D
v)	Miscibility[1)] in water, coagulation in 2 h	—	Nil	—	E
vi)	Modified miscibility with water difference of bitumen content, *Max*	—	—	4.5	F
vii)	Cement mixing test, percent, *Max*	—	—	2.0	G
viii)	Coating ability and water resistance:				
	a) Coating dry aggregate	—	Good	—	H
	b) Coating after spraying	—	Fair	—	
	c) Coating wet aggregate	—	Fair	—	
	d) Coating after spraying	—	Fair	—	
ix)	Sieve test, percent, *Max*	0.10	0.10	0.5	J
x)	Particle charge	Negative	Negative	Negative	K

[1)] If the sample of emulsified bitumen being tested fails to conform to the requirement, the sample shall be tested for 5-day settlement and for miscibility and if the numerical difference between the average percentage of residue in the 5-day settlement test is less than 3, and if the miscibility test shows no appreciable coagulation in 2 h, then the emulsified bitumen shall be considered conforming to this standard.

ANNEX A

[*Table* 1, *Sl No.* (i)]

VISCOSITY TEST (SAYBOLT FUROL)

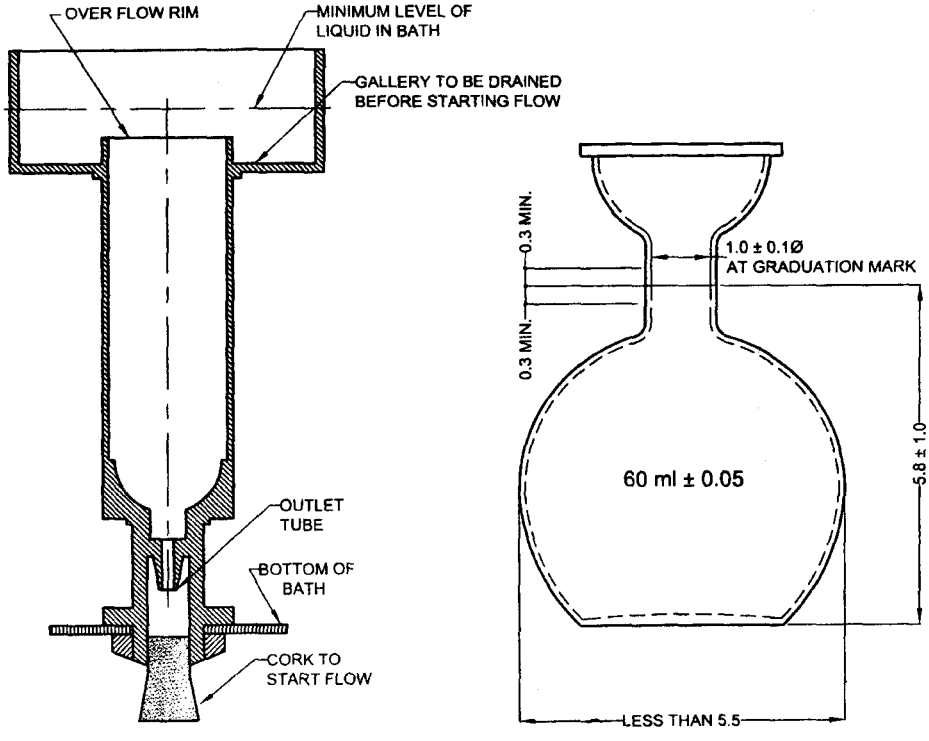
A-1 APPARATUS

A-1.1 Oil Tube — The oil tube shall be made entirely of corrosion-resistant metal as shown in Fig.1, with or without plating, conforming to the dimensional requirements shown below:

Requirements	*Minimum*	*Normal*	*Maximum*
	mm	mm	mm
(1)	(2)	(3)	(4)
Inside diameter of outlet tube	3.13	3.15	3.17
Outside diameter of outlet tube at lower end	4.0	4.3	4.6
Length of outlet tube	12.15	12.25	12.35
Height of overflow rim above bottom of outlet tube	124.0	125.0	126.0
Outside diameter of overflow rim, at the top (*see* Note)	32.0	—	33.0
Diameter of container	29.55	29.75	29.95
Depth of cylindrical part of container	88.0	—	—
Diameter of container between bottom of cylindrical part of container and top of outlet tube	9.0	—	—

NOTE — The section of overflow rim shall be bounded by straight lines, except that a fillet is permissible at the junction with the bottom of gallery.

The lower end of the tube shall be provided with a nut for locking it in place in the bath and with a cork or other suitable device to prevent flow before the test is started. A string may be attached to the cork to facilitate its rapid removal.



All dimensions in centimetres.

FIG. 1 SAYBOLT FUROL VISCOMETER — OIL TUBE AND RECEIVER

A-1.1.1 Calibrate the oil tube using oils of known furol viscosity in seconds, or use a tube certified by the National Physical Laboratory or any other institution authorized by the Government of India to issue such a certificate, or calibrate the tube by comparison with such a certified tube and apply any correction in excess of 0.2 percent.

A-1.2 Bath — Bath equipped with a stirring device and with means for heating or cooling, serves as a support to hold the oil tube in the vertical position and as a container for the bath liquid. The source of heat or refrigeration shall be more than 3 cm from the oil tube; and if an external heater is used, it shall be more than 5 cm from the oil tube.

A-1.2.1 The bath temperature necessary to maintain thermal equilibrium, while the liquid in the oil tube is swell stirred by the oil-tube thermometer, shall vary to within ± 0.1°C, for the specified test temperatures given below:

Temperature Range	*Temperature of Test*
°C	°C
19 to 27	25

A-1.2.2 The level of the bath liquid shall be not lower than 0.5 cm above the overflow rim of the oil tube.

A-1.3 The receiver shall be of glass with the shape, dimensions and tolerances as shown in Fig.1.

A-1.4 Oil Tube Thermometers — Four thermometers graduated in °C, the ranges being chosen to include the temperatures used in testing as given in **A-1.2.1**.

A-1.4.1 The thermometer shall conform to the requirements as prescribed in Table 2.

A-1.4.2 The contraction chamber shall be of the long narrow type; the top shall be not more than 60 mm above the bottom of the bulb and the mercury shall stand in the contraction chamber at 0°C.

A-1.4.3 The expansion chamber shall permit of heating the thermometer to 50°C above the highest temperature on the scale and in all cases shall permit of heating to 100°C.

A-1.4.4 To prevent contact of the thermometer with the orifice in the oil tube a suitable support shall be attached to the enlargement of the thermometer stem.

A-1.5 Timing Device — A stop-watch graduated in divisions of 0.2 s or less and accurate to within 0.1 percent when tested over a 60 min period; or other equivalent timing device.

Table 2 Requirements for Thermometers
(*Clause* A-1.4.1)

Sl No. (1)	Characteristic (2)	Requirement (3)
i)	Liquid	Mercury
ii)	Filling above liquid	Nitrogen gas
iii)	Subdivisions	0.1°C
iv)	Longer graduations line at each	0.5°C
v)	Graduation numbers at each multiple of	1°C
vi)	Immersion	Total
vii)	Total length	252 to 256 mm
viii)	Bulb length	25 to 35 mm
ix)	Bulb diameter	Not less than 5.0 mm
x)	Stem diameter	6.0 to 7.0 mm
xi)	Distance of bottom of bulb to first graduation line (corresponding to the beginning of temperature range)	135 to 150 mm
xii)	Distance of top of thermometer to last graduation line (corresponding to the end of temperature range)	20 to 35 mm
xiii)	Top finish	Glass ring
xiv)	Scale error at any point, *Max*	0.1°C

A-1.5.1 Electrical timing devices are permissible provided they are accurate and capable of being read to 0.2 s.

A-1.6 Withdrawal Tube or Pipette — Used for draining the gallery, with a smooth tip of about 3 mm outside diameter and about 2 mm inside diameter.

A-2 PROCEDURE

A-2.1 Make the viscosity determinations in a room free from draughts and rapid changes in temperature.

A-2.1.1 Determinations shall not be made at temperature below the dew point of the atmosphere surrounding the instrument.

A-2.1.2 For standardization, the room temperature shall be between 20°C and 30°C and the actual temperature shall be recorded.

A-2.1.3 For routine tests, temperatures up to 38°C may prevail without introducing errors in excess of one percent.

A-2.2 Clean the oil tube with a solvent, such as benzene, and remove excess solvent from the gallery. Pass the entire material through a 150 micron wire strainer before introducing into the oil tube. After the tube is cleaned, pour into the tube a quantity of the material to be tested, sufficient to wet the entire surface of the tube. Allow to

drain out. The plunger commonly supplied with the viscometer shall never be used on instruments maintained as standards. Insert the cork stopper not less than 6.0 mm and not more than 9.5 mm into the lower end of the air chamber at the bottom of the oil tube, taking care that the cork fits tightly enough to prevent the escape of air, as tested by the absence of oil on the cork after it is withdrawn. If the test temperature is above that of the room, heat the material to not more than 1.5°C above the temperature of test, and if the temperature is below that of the room, cool it to not more than 1.5°C below the temperature of test.

A-2.3 Pour the material into the oil tube until it ceases to overflow into the gallery. Keep it well stirred with the oil tube thermometer, care being taken to avoid touching the outflow tube. Adjust the bath temperature until the temperature of the material remains constant.

A-2.3.1 After thermal equilibrium has been attained, no further adjustments shall be made in the bath temperature. The test results shall be discarded if the indicated bath temperature varies by more than ± 0.03°C.

A-2.4 After the temperature of the material in the oil tube has remained constant with ± 0.02°C of the desired temperature for 1 min with constant stirring, withdraw the oil tube thermometer and remove the surplus liquid quickly from the gallery by means of the withdrawal tube so that the level of the material in the gallery is below the level in the oil tube proper. Insert the tip of the withdrawal tube at one point in the gallery.

A-2.4.1 The test shall be started over again if the tip of the withdrawal tube touches the overflow rim. Under no condition shall the excess liquid be removed by rotating the withdrawal tube around the gallery.

A-2.5 Place the receiving flask in position so that the stream of liquid from outlet tube strikes the neck of the flask, care being taken that the graduation mark on the receiving flask is not less than 10 cm, not more than 13 cm, from the bottom of the bath. Snap the cork from its position and at the same instant start the timer. Stop the timer when the bottom of the meniscus of the liquid reaches the mark on the neck of the receiving flask.

A-3 REPORTING RESULTS

A-3.1 Time in seconds as determined by the prescribed procedure, with the proper calibration correction, is the Saybolt Furol Viscosity of the material at the temperature at which the test is made.

A-3.2 Report the results to the nearest 0.1 s for viscosity values below 200 s and to the nearest whole second for values 200 s or above.

A-4 REPRODUCIBILITY OF RESULTS

With proper attention to details of method of procedure, results in different laboratories with different operations under referee conditions of testing shall not differ by more than 0.5 percent.

ANNEX B

[*Table* 1, *Sl No.* (ii)]

METHOD FOR DETERMINATION OF BITUMEN TO CONTENT

B-1 APPARATUS

B-1.1 Glass Beakers — low form of 1 000 ml capacity made of borosilicate glass.

B-1.2 Glass Rods — With flame polished 6.4 mm in diameter and 177.7 mm in length.

B-1.3 Balance — of 500 g capacity and accurate to ± 0.1g.

B-1.4 Oven — Thermostatically controlled at a temperature of 163 ± 2.8°C.

B-2 PROCEDURE

Weigh 50 ± 0.1 g of thoroughly mixed bitumen emulsion into each of three beakers each of which has previously been weighed with the glass rod. Place the beaker along with the rod in the oven at 163 ± 2.8°C for 2 h. At the end of this period remove each beaker and stir the bitumen thoroughly. Replace in the oven for another 1 h then remove and cool at room temperature, weigh the beakers along with the rods.

B-3 CALCULATION

B-3.1 Bitumen content = $2(A - B)$

where

A = mass of beaker and bitumen, in g; and
B = tare mass of beaker and rod, in g.

B-3.2 Take the average of three values obtained for bitumen content percent.

ANNEX C

[*Table* 1, *Sl No.* (iii)]

SETTLEMENT TEST

C-1 APPARATUS

C-1.1 Cylinders — Two 500-ml graduated cylinders (*see* IS 878) with pressed or moulded glass bases and cork or glass stoppers.

C-1.2 Glass Pipette — A 60-ml siphon, glass tube pipette or optional form.

C-2 PROCEDURE

Place a 500 ml sample in each of the two glass cylinders. Stopper the cylinders in an airtight manner and allow them to stand undisturbed, at laboratory ambient temperature, for 5 days. After standing for this 5-day period, remove approximately the first 55-ml of emulsion by means of the pipette or siphon from the top of each cylinder without disturbing the balance of its contents. Weigh exactly 50 g of each of the two samples, after each has been thoroughly mixed separately, into separate 600-ml low-form glass heaters and determine the bituminous residue by evaporation at 163°C for 3 h in the apparatus described in IS 1212. After removal of the first sample siphon off approximately the next 390 ml from each of the cylinders. Mix the residue remaining in the cylinders thoroughly and weigh out exactly 50 g from each of them, and determine for the two samples the amount of bitumen residue (all sediment, if any, included) by evaporation as before.

C-3 CALCULATION AND REPORT

The average of bitumen residue of the top two samples and also the bottom two samples shall be expressed as percentages by mass. The difference between the two averages (top and bottom) shall be reported as the settlement.

ANNEX D

[*Table* 1, *Sl No.* (iv)]

DEMULSIBILITY TEST

D-1 APPARATUS

D-1.1 Wire Cloth — Three pieces of 1.40 mm IS Sieve iron wire cloth approximately 13 cm^2, unframed conforming to IS 460 (Part 1).

D-1.2 Beakers — Three metal beakers of 600 ml capacity each.

D-1.3 Rods — Three metal rods with rounded ends approximately 8 mm in diameter.

D-1.4 Burette — A 50-ml glass burette graduated in 0.1 ml intervals (*see* IS 1997).

D-2 REAGENTS

The following are the reagents required for the test:

a) Calcium chloride solution (0.02 N), and
b) Calcium chloride solution (0.10 N).

D-3 PROCEDURE

Determine the percentage of water content by mass as described in IS 1211. Record the mass of each assembly of beaker, rod and wire cloth. Weigh exactly 100 g of the emulsified bitumen into each of the three 600-ml tared beakers. Over a period of approximately 2 min, add to each beaker, from a burette, 35 ml of 0.02 N calcium chloride solution, if quick setting emulsion is being tested or 50 ml of 0.10 N calcium chloride solution, if medium setting type is being tested. While adding the solution of calcium chloride, stir the contents of the beaker continuously and vigorously, kneading lumps against the sides of the beaker to ensure thorough mixing of the reagent with the emulsion. Perform this operation after bringing the weighed sample of emulsion and the reagent to the standard temperature of 27 ± 1°C. Fit one of the wire cloths of the assembly over a beaker or other suitable vessel and pour the mixture of emulsion and reagent from the appropriate beaker through the wire cloth. Rinse the beaker containing the sample and metal rod with distilled water, knead and break up all lumps, and continue washing the beaker, rod and wire cloth until there is no longer any appreciable colour imparted to the wash water. After washing as directed, place the beaker, rod and wire cloth used in each individual test in drying oven, and dry to constant mass at 163°C.

D-4 CALCULATION

The mass thus obtained less the total tare mass of the beaker, rod and wire cloth is the mass of the residue by the demulsibility test. Calculate the percentage demulsibility of the samples tested as follows:

$$\text{Demulsibility} = \frac{A}{B} \times 100 \text{ percent}$$

where

A = average mass of residue in grams from three tests of each individual sample of emulsified bitumen, and

B = mass of residue in g per 100 g of emulsion obtained from the test described in IS 1211.

ANNEX E

[*Table* 1, *Sl No.* (v)]

METHOD OF TEST FOR MISCIBILITY IN WATER

E-1 PROCEDURE

To about 50 ml of the emulsion, gradually add about 150 ml of distilled water, stirring the mixture while adding the water. The temperature shall preferably be between 21°C and 25°C. Allow the mixture to stand for 2 h and then examine it for any appreciable coagulation of bitumen content of the emulsion.

ANNEX F

[*Table* 1, *Sl No.* (vi)]

METHOD OF TEST FOR MODIFIED MISCIBILITY IN WATER

F-1 APPARATUS

F-1.1 Cylinder — 50 ml graduated cylinder (*see* IS 878).

F-1.2 Beaker — 400 ml glass beaker (*see* IS 2619).

F-1.3 Glass Tube — Three glass tubes, 7 mm in outside diameter, 5 mm in inside diameter and 15 cm in length fitted with suitably bored corks, adjusted as described in **F-2.1.**

F-1.4 Supporting Strip — Three strips of metal or wood, approximately 15 cm in length, 2.5 cm in width, and 0.5 cm in thickness, with a hole 10 mm in diameter in the centre.

F-1.5 Crucibles — Three 15 or 25-ml porcelain crucibles or three 30 ml beakers of heat-resistant glass.

F-1.6 Oven — of constant temperature.

F-1.7 Balance — accurate to 0.1 mg.

F-2 ASSEMBLY OF APPARATUS

Adjust the position of the corks on the glass tubes by measuring 200 ml of distilled water at 20 to 25°C into the 400 ml beaker. Place the supporting strip across the top of the beaker, inserting a tube through the hole, and adjust the position of the cork so that when the tube is supported by the cork resting on the strip, the lower end of the tube is immersed in the water to a depth of 1 cm below the surface. In the same manner, adjust the second and third tubes so that the depth of immersion is 2.5 cm and 4.6 cm respectively.

NOTE — Depending on the depth of the beaker the tubes shall be so adjusted that the third tube shall project into the emulsion so that the tip is within 1 to 1.5 mm of the bottom of the beaker.

F-3 PROCEDURE

F-3.1 Measure 50 ml of the emulsion at a temperature of 20 to 25°C into the graduated cylinder and transfer to the 400 ml beaker. Wash the cylinder with three 50 ml portions of distilled water at 20 to 25°C and add the washings to the beaker, bringing the final volume to 200 ml. Stir the emulsion and water with a glass rod until uniformly mixed, cover the beaker with a watch-glass, and allow the mixture to stand undisturbed for 2 h.

F-3.2 Weigh the three crucibles (or 30-ml beakers), and a watch-glass for each, to the nearest 0.1 mg. After the diluted emulsion has stood for 2 h, remove the watch-glass and place the supporting strip across the top of 400 ml beaker. Take a sample of approximately 1 g from the top layers and transfer to one of the crucible or beakers, using the first 1 cm depth tube as a pipette. Close the top of tube with the finger, insert the tube to the proper depth, remove the finger while the emulsion rises in the tubes and then replace the finger on top of the tube so that when the tube is removed its contents of emulsion will be pippetted from the beaker. After removal, wipe off the adhering liquid on the outside of the tube with filter paper before transferring the sample to the crucible. In like manner, take samples from the middle and bottom of the diluted emulsion using the second and third tubes respectively. Weigh the crucibles with their samples of emulsion, and determine the mass of each of the three samples by difference. While weighing cover with watch-glass to retard evaporation.

F-3.3 Remove the watch-glasses from the crucibles and place the samples in the oven at 163°C for 2 h, then remove, cool and weigh.

F-4 CALCULATION AND REPORT

The percentage of residue in top, middle and bottom levels shall be calculated. The maximum numerical difference in percentage of bitumen content between any two of the three levels shall be reported.

ANNEX G

[*Table* 1, *Sl No.* (vii)]

CEMENT MIXING TEST

G-1 APPARATUS

G-1.1 Sieves — 180 micron and 1.40 mm IS Sieves made of iron wire cloth having wire diameter and openings conforming to IS 460 (Part 1).

G-1.2 Dish — A round-bottom dish or kitchen saucepan of approximately 500 ml capacity.

G-1.3 Stirring Rod — A steel rod with rounded ends approximately 12 mm in diameter.

G-1.4 Cylinder — A 100-ml graduated cylinder (*see* IS 878).

G-2 CEMENT

The ordinary Portland cement used in the test shall conform to the requirement of IS 269.

G-3 PROCEDURE

Dilute the emulsion to be tested with distilled water to a total water content of 55 percent as determined at 163°C (*see* IS 1211). Sieve a portion of the cement through 180-micron IS Sieve and weigh 50 g of the cement into the dish. Add 100 ml of the diluted emulsion to the cement in the dish and weigh the dish with contents. Stir the mixture at once with the steel rod, using a circular motion, making 60 complete revolutions during 1 min. Immediately at the end of the 1 min. mixing period, add 150 ml of distilled water, and continue the stirring for 3 min. Maintain the ingredients and apparatus at a temperature of approximately 27°C during the mixing period. Pour the mixture through the tared 1.4 mm IS Sieve of approximately 75 mm diameter and rinse by pouring distilled water from a receptacle held at a height of approximately 150 mm. Place the sieve in a tared shallow pan, heat at 163°C in an oven until dry, and weigh.

G-4 REPORT

The mass in grams of the material retained on the sieve and in the pan as the percentage of the emulsion broken.

ANNEX H

[*Table* 1, *Sl No.* (viii)]

COATING ABILITY AND WATER RESISTANCE

H-1 GENERAL

This test covers the coating of loose aggregates with bituminous emulsion. This test is applicable only to emulsions containing a bitumen base of seamy solid consistency. It is not applicable to rapid setting emulsion.

H-2 APPARATUS AND MATERIAL

H-2.1 Sieves — Standard 19 mm sieve and 6.3 mm sieve conforming to IS 460 (Part 1).

H-2.2 Spatula — A steel spatula or its equivalent having a blade approximately 230.2 mm in length.

H-2.3 Dish — A round bottomed iron dish or a kitchen saucepan of approximately 1 litre capacity.

H-2.4 Stone — A supply of reference stone aggregate has been washed with water and dried before using. All aggregates shall pass through the 19 mm IS Sieve and not more than 5 percent shall through the 6.3 mm sieve.

H-2.5 Balance — Capable of weighing 1 000 g to within 0.01 g.

H-3 PROCEDURE

H-3.1 Weigh 465 ± 0.1 g of stone aggregate into the metal pan. Add 35 ± 0.1 g of the emulsion to the stone in the pan and mix vigorously with the spatula for 3 min.

H-3.2 Record whether or not there is appreciable separation of the bituminous base from the emulsion water and whether or not the stone is uniformly and thoroughly coated with the emulsion. The coating ability shall be expressed as good, fair or poor.

ANNEX J

[*Table* 1, *Sl No.* (ix)]

SIEVE TEST

J-1 APPARATUS

J-1.1 Sieve — 850 micron IS Sieve having a frame 7.5 ± 0.5 cm inside diameter and a depth from the top of frame to the cloth of 2.0 cm. The frame shall be of brass and the joint between the cloth and the sieve shall be smoothly filled with solder or so made that the material being sieves will not catch.

J-1.2 Pan — A tin box cover or shallow metal pan or appropriate size to fit over the bottom of the sieve.

J-2 REAGENT

The reagent required for the test is 2 percent of pure sodium oleate in distilled water.

J-3 PROCEDURE

Record the mass of the sieve and pan, and then wet the wire cloth of the sieve with the 2 percent solution of sodium oleate. Weigh and pour exactly 1 000 g of the emulsified bitumen through the wire sieve, thoroughly washing the container and the residue on the sieve with the sodium oleate solution until the washings run clear. Place the pan under the sieve and heat for 2 h in a drying oven at 105°C, then cool in a desiccator and weigh.

J-4 CALCULATION

The total mass of the sieve, pan and residue in grams less the combined tare mass of the sieve and pan, is the mass of the residue by the sieve test. From this mass, calculate the percentage of residue retained on the sieve.

ANNEX K

[*Table* 1, *Sl No.* (x)]

TEST FOR PARTICLE CHARGE

K-1 APPARATUS

The following apparatus are required for the test:

a) A 12-volt battery,
b) Rheostat 2 000 ohms capacity,
c) An ammeter 0.1 ampere capacity,
d) Two 25 mm × 75 mm copper plates, and
e) A glass container of sufficient capacity and diameter.

K-2 PROCEDURE

K-2.1 Take sufficient quantity of a representative sample of bitumen emulsion in a glass container. Immerse two polished copper plates 25 mm × 75 mm, which are connected to a 12-volt battery circuit through a single pole singe throw switch, a rheostat and an ammeter, to a depth of 25 mm in the emulsion and the positive and negative plates are marked.

K-2.2 Close the switch and adjust the rheostat such that the current in the circuit is more than 4 milliamperes. Open the circuit after 2 min and remove the plates. Gently wash the plates, if necessary with distilled water to remove unbroken emulsion and then examine.

K-2.3 An appreciable layer (continuous opaque film) of deposited bitumen on the positive plate with a relatively clean, bitumen-free negative plate indicates a negative particle charge.

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