IRC:SP:100-2014

USE OF COLD MIX TECHNOLOGY IN CONSTRUCTION AND MAINTENANCE OF ROADS USING BITUMEN EMULSION

INDIAN ROADS CONGRESS
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Table 6.9 Properties of Aggregates

Properties	Test Method	Specification
Sand Equivalent Value	IS:2720 (Part 37)	Min. 50
Water Absorption*	IS:2386 (Part 3)	Max. 2.0%
Soundness (with Sodium Sulphate)	IS:2386 (Part 5)	Max. 12%
Soundness (with Magnesium Sulphate)		Max. 18%

* In case water absorption exceeds 2 percent but is less than 4 percent, the same may be permitted subject to conformity of soundness test and wet stripping test.

Table 6.10 Mix Design Criteria for Slurry Seal Mix

Requirements	Specification	Test Method
Mix Time, Minimum	180 s	Appendix-2
Consistency, Maximum	3 cm	Appendix-3
Wet Cohesion (within 60 min), Minimum	20 kg.cm	Appendix-4
Wet Stripping, Value minimum	90	Appendix-5
Wet Track Abrasion Loss (one hour soak), Maximum	800 g/m^2	Appendix-6

6.8 Microsurfacing

6.8.1 *Introduction*

The Microsurfacing shall consist of mixture of modified (Polymer or Rubber Latex) bitumen emulsion, well graded mineral aggregate, water, filler and additive (if needed) proportioned, mixed and uniformly spread over a properly prepared surface. The finally laid microsurfacing shall have a homogeneous mat, adhere firmly to the prepared surface and provide friction resistant surface texture throughout its service life. The mix is to be a quick setting system i.e. it should be able to receive traffic after a short period of time preferably within about one hours of its laying depending upon weather conditions.

It is applied on an existing pavement surface which is structurally sound but is showing the signs of functional distress such as loss riding quality, cracking and polishing. Generally, microsurfacing is laid in single layer, but when the existing surface is highly polished and/ or cracked, it is advisable to apply it in two or more layers. Microsurfacing can be used for surface treatment on roads, taxi ways and runways. Normally two layers of microsurfacing are advisable on cement concrete surface.

As a surface treatment, micro-surfacing imparts protection to the underlying pavement and provides renewed surface. Special emulsifiers in micro-surfacing emulsions contribute to the quick setting characteristics. Minor re-profiling can be achieved with multiple applications. Special equipment permits the filling of wheel ruts up to 40 mm deep in one pass.

6.8.2 *Benefits of microsurfacing*

The major benefits of microsurfacing technology are given as under:

- Quick application (One lane- km in 35 minutes)
- Minimum traffic hold up (work is done in lane wise manner) quick opening to traffic
- Life span exceeds the life span of ordinary Bituminous Concrete
- Non-polluting for environment since no heating or hot paving is required
- Does not require sensor paver or compaction equipments
- Longer life since oxidation is reduced
- Waterproof Surface – Protection from rains
- Ideal for surface sealing treatment since it improves skid resistance and provides surface durability
- Does not increase pavement height significantly (This saves from water logging, drainage and other associated problems)
- Cost effective as compared to Hot-Mix (Almost 40% saving in Cost)
- Reduces noise caused by movement of traffic
- Environment friendly (reduced emissions)
- No change in road furniture or drainage
- Savings in natural resources

Microsurfacing helps in preservation of pavement strength and can be used both as a preventive maintenance treatment or and periodic renewal treatment on a preferably low, medium or heavy traffic. It can be used for pavements in urban and rural areas, primary and inter-state routes, residential streets, highways, and toll roads. It can also be used on the top of single coat surface dressing (Cape Seal), on open graded premix carpet without seal coat and also on Dense Bituminous Macadam/Bituminous Macadam. Various types of microsurfacing that can be used for different applications; quantity of microsurfacing mix and the residual binder content in each type are presented in **Table 6.11**.

Table 6.11 Different Types of Microsurfacing

Items	Type II (4-6 mm)**	Type III (6-8 mm)**
Applications	For roads in urban and rural areas, residential streets, as preventive and renewal treatment (< 1500 CVPD)	For primary and inter-state routes, highways and runways to give maximum skid resistance, preventive and renewal treatment (> 1500 CVPD)
Quantity* of Microsurfacing (Kg/m²)	8.4 to 10.8	11.1 to 16.3
Residual binder (percent by weight of dry aggregate)	6.5 to 10.5	5.5 to 10.5

* By weight of dry aggregate

** Indicative only

6.8.3 *Constituent materials*

Bitumen emulsion shall be a modified (polymer modified/latex modified) conforming to requirements, as specified in **Table 6.12**. The modifier shall be polymer/ rubber preferably synthetic or natural rubber latex blended into bitumen or aqueous phase of emulsion prior to or during the emulsification process. It may also be required to be specifically designed bitumen emulsion for a particular with regard to the quantity and grading of aggregates. The grading of aggregates is presented in **Table 6.13**.

Table 6.12 Requirements of Modified Bitumen Emulsion for Microsurfacing

Requirement		Specification	Method of Test
Residue on 600 µm IS Sieve (Percent by mass), maximum		0.05	IS:8887
Viscosity by SayboltFurol Viscometer, at 25°C, second		20-100	IS:8887
Coagulation of emulsion at low temperature		Nil	IS:8887
Storage Stability after 24 h (168h), %, maximum		2(4)	IS:8887
Particle charge, + ve / -ve		+ ve	IS:8887
Tests on Residue:			
a)	Residue by evaporation, % minimum	60	IS:8887
b)	Penetration at 25°C /100 g/5 s	40-100	IS:1203
c)	Ductility at 27°C, cm, minimum	50	IS:1208
d)	Softening Point °C, minimum	57	IS:1205
e)	Elastic Recovery*, %, minimum	50	IS:15462
f)	Solubility in Trichloroethylene, %, minimum	97	IS:1216

* In case, elastic recovery is tested for Torsional Elastic Recovery as per **Appendix-7**, the minimum value shall be 20 percent.

Table 6.13 Grading Requirements for Microsurfacing and Slurry Sealing

Sieve Size (mm)	Percentage by Mass Passing (Minimum Layer Thickness)		
	Type I	Type II	Type III
9.5	-	-	100
6.3	-	100	91-100
4.75	100	90-100	70-90
2.36	90-100	65-90	45-70
1.18	65-90	45-70	28-50
0.600	40-65	30-50	19-34
0.300	25-42	18-30	12-25
0.150	15-30	10-21	7-18
0.075	10-20	5-15	5-15

The mineral aggregate shall consist of crushed stone dust, clean hard, durable, uncoated, dry particles and shall be free from dust, soft particles, organic matter or other deleterious

substances. Mineral filler shall be Ordinary Portland Cement (OPC). The quantity of filler shall be preferably in the range of 0.5 to 2 percent by the weight of dry aggregate. The water shall be potable, free from harmful salts and contaminants. The pH value of water shall be in the range of 6 to 7. Chemical additive may be used to accelerate or retard the break-set time of the micro-surfacing mix or to improve the resulting finished surface. The quantity of additive, if used, shall be decided by undertaking the mix design and is o be adjusted as per the field/climate conditions such as humidity and temperature at site. The specification of additive needed shall be supplied by suppliers of emulsion. The additive and emulsion shall be compatible with each other.

6.8.4 *Design of microsurfacing mix*

The mix design of Microsurfacing shall be prepared in a fully equipped laboratory and the Job Mix Formula so evolved shall be approved by the client. The compatibility of aggregate, emulsion, filler and additive shall be verified by mix design for the selected grading (Type II or Type III), as specified in **Table 6.14**. The indication values at the ingradients for Microsurfacing mixture is specified in **Table 6.15**. and proposed Microsurfacing mixture shall conform to the requirements specified, when tested in accordance with specified tests. The mix design report shall clearly show the proportions of aggregate, filler, water, and residual bitumen content based on the dry weight of aggregates and additive used (if any).

Table 6.14 Mix Design Criteria for Microsurfacing Mix

Requirement	Specification	Method of Test
Mix Time, minimum	120 s	Appendix-2
Consistency, maximum	3 cm	Appendix-4
Wet Cohesion, within 30 min, minimum	12 kg.cm	Appendix-3
Wet Cohesion, within 60 min, minimum	20 kg.cm	Appendix-3
Wet Stripping Value, % minimum	90	Appendix-6
Wet Track Abrasion Loss (one hour soak), maximum	538 g/m²	Appendix-7

Table 6.15 Indicative Limits of Ingredients in Mix

Ingredients	Limits (Per cent by weight of aggregate)
Residual Bitumen	6.5 to 10.5 for Type II 5.5 to 10.5 for Type III
Mineral Filler	0.5 to 3.0
Additive	As needed
Water	As needed

Aggregate, modified bitumen emulsion, water and additive (if used), shall be proportioned by weight of aggregate utilizing the mix design approved by the Engineer-in-Charge. If more than one type of aggregate is used, the correct amount of each type of aggregates which have been used to produce the required grading, shall be proportioned separately prior to adding other materials of the mixture, in a manner that will result in a uniform and homogeneous blend. Final/completed mixture, after addition of water and any additive, if used, shall be such

that the microsurfacing mixture has proper workability and permits traffic within one hour depending upon the weather conditions, without occurrence of raveling and bleeding. Trial mixes shall be prepared and laid for the designed mix and observed for breaking time and setting time. The wet track abrasion test is used to determine the minimum residual bitumen content. Procedure for calibration of microsurfacing machine is given in **Appendix-8**.

Details of Microsurfacing application are given in IRC:SP:81.

6.9 Cape Seal

Cape seal involves application of a slurry seal or micro-surfacing to a newly-constructed single coat surface dressing treatment. The slurry or microsurfacing application helps to fill the voids between the chips. Cape seals provide highly durable surface treatment. The slurry or microsurfacing bonds the chips to prevent loss of the chips due to traffic abrasion. For a successful cape seal, it is important to have single coat surface treatment with lower residual bitumen content than a traditional chip seal. The most critical element to avoid in a cape seal is an excess of slurry that eliminates the desired knobby surface texture. Curing time of four to ten days should be allowed between placement of the broomed surface after surface dressing and before application of slurry seal or microsurfacing to remove loose cover material or other foreign material that would prevent adherence. **Table 6.16** gives quantities of bitumen emulsion and aggregates required to execute a cape seal. For surface dressing RS-2 emulsion shall be used. For slurry seal SS-2 grade emulsion shall be used. Polymer modified emulsion shall be used if microsurfacing is used as top layer.

Table 6.16 Quantities of Bitumen Emulsion and Aggregate for Cape Seal

Thickness of Cape Seal	Nominal Size of Aggregate	Quantity of Aggregate (kg/m²)	Quantity of Emulsion (kg/m²)	Slurry Mixture (Type 1), kg/m²
12.5 mm Thick	9.5 to 2.36 mm	14-16 (25-30)	1.4-2.0 (0.30-0.45)	2.7-4.5 (6-10)
19.0 mm Thick	19.0 to 9.5 mm	22-27 (40-50)	1.8-2.3 (0.40-0.50)	3.5-5.5 (8-12)

Details of construction of chip seal and slurry seal are given in IRC:110 and IRS:SP:81. respectively.

7 COLD MIXES

A cold mix is defined as a mixture of bitumen emulsion and aggregate that is mixed together at ambient temperature. Bitumen emulsion being liquid at room temperature, there is no need to heat or dry the mineral aggregate. Cold mix is useful in the areas, where there is long distance between the job site and plant and temperature of climate is low and moderate (<40°C). Further, the versatility of cold mix allows it to be mixed in-place at the job site as well as at a plant site and then subsequently transported to the job site. Cold mix may be used in bituminous base (BM), binder course (BM/SDBC) as well as wearing course (SDBC) of

Annexure-I

Choice/Selection of Cold Mix Treatments for Different Climate/Traffic Conditions (Warrants)

Title of Treatment	Traffic (CVPD)	Climate		Choice of Emulsion
		Temperature	Rainfall	
Prime Coat	No Limit	No Limit	No Limit	SS-1
Tack Coat	No Limit	No Limit	No Limit	RS-1
Seal Coat	<1500	No Limit	No Limit	SS-2
Sand Seal	<1500	No Limit	No Limit	SS-2
Cap Seal	<3000	No Limit	No Limit	RS-2 , SS-2 and Modified
Chip Seal	<1500	Avoid in Cold Climate	No Limit	RS-2, Modified
Slurry Seal	<1500	No Limit	No Limit	SS-2
Microsurfacing	No Limit	No Limit	No Limit	Modified
OGPC	<1500	Moderate & cold climate (maximum air temperature 40°C)	Medium	MS/SS-2 and Tailormade
MSS	<1500	Moderate & cold climate (less than 40°C)	Low	MS/SS-2 and Tailormade
BM	<1500	Moderate & cold climate (maximum air temperature 40°C)	Low	MS/SS-2/ Tailormade
SDBC	<3000	Moderate & cold climate (maximum air temperature 40°C)	Low	SS-2/Tailormade
Half Warm Mix (DBM, SDBC, BC)	<4500	Moderate & cold climate (maximum air temperature 40°C)	No limit	SS-2/Tailormade
Cold Recycling	No limit	Moderate and cold climate	No limit	SS-2/Tailormade
Patching	No Limit	No Limit	No limit	MS/SS-2/ Tailormade