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Economical and Durable Road Resurfacing Using Micro-surfacing Technique

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Abstract – *A mixture of a polymer modified asphalt emulsion, specially graded aggregate, mineral filler, water & other additives, proportionally mixed, and spread on asphalt surface. It is used primarily to inhibit raveling and oxidation of the pavement surface along with improving surface friction, fixing minor irregularities and filling wheel ruts.Similar to painting a house, micro surfacing creates a protective layer which preserves the underlying structure and prevents the need for more expensive repairs in the future.Micro surfacing is a cost- effective polymer modified cold-mix paving system that can remedy a broad range of problems on today's streets, highways, and airfields.*

Keywords *– Micro-surfacing, Pavement preventive maintenance, thin surface treatment, crack sealing, cost benefit analysis, treatment timing.*

Micro Surfacing is a polymer modified cold-mix paving system that can remedy a broad range of problems on today's streets, highways, and airfields. Introduced in the United States in 1980, micro-surfacing now is recognized not only as the most cost-effective way to treat the surface wheel-rutting problem, but also a variety of other road surface problems. Micro-surfacing begins as a mixture of dense-graded aggregate, asphalt emulsion, water, and mineral fillers. It is applied to existing pavements by a specialized machine, which carries all components, mixes them on site, and spreads the mixture onto the road surface. The surface is initially dark brown in color and changes to the finished black surface as the water is chemically ejected and the surface cures, permitting traffic within one hour in most cases.

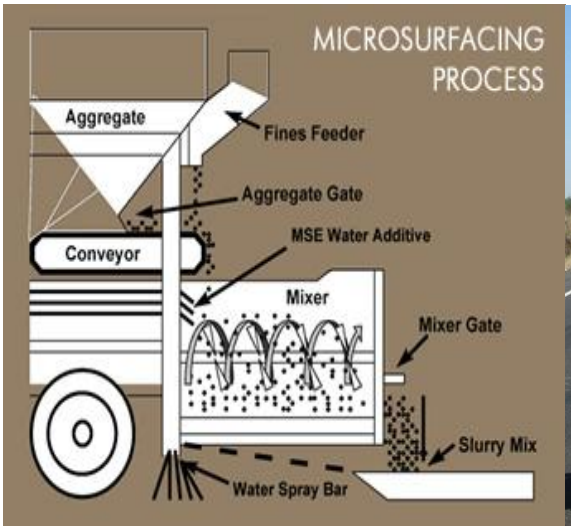

Figure 1.Micro surfacing ProcessFigure 2: Micro Surfacing

I. MATERIALS

1 Asphalt Emulsion: The asphalt emulsion is a cationic quick setting polymer modified emulsion conforming to the CQS-1H type emulsion requirements as well as other tests performed on the emulsion residue.

2 Mix Aggregate: The type of mix aggregate used in micro-surfacing must meet certain requirements of shape, size, cleanliness and gradation. The asphalt emulsion to be used and the aggregate must be compatible to ensure the asphalt-aggregate bond is effective. There are three accepted gradations for the aggregate to meet;
– Most widely used gradation on moderate trafficked roads
– used on higher volume roads such as highways
– used by MTO for heavy trafficked roads further information on the gradations can be found in the Basic Asphalt Emulsion Manual.

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3 Mineral Fillers: Mineral fillers such as Portland cement or hydrated lime may be added to aid in stabilizing and setting the mix.

4 Water: Water is used to aid in mixing and coating and controlling the consistency of the micro-surfacing. It should be potable and compatible with the mix.

5 Additives: A small amount of additive may be added to the Mixture to aid in controlling the quick set properties and improve adhesion of the micro-surfacing.

II. MIX DESIGN

The mix design of Micro surfacing is based on its ingredients & Its Test Methods.
A laboratory equipped and staffed to carry out micro-surfacing mix designs shall designate the mix proportions and prepare the job mix formula.
The compatibility of the aggregate and the polymer modified emulsified asphalt shall be confirmed by the laboratory designing the mix.
All component materials used in the mix design shall be representative of the material to be used on the Contract.
Micro-surfacing material shall only be placed after the Contract Administrator has issued confirmation in writing within 5 Business Days that the mix design has been reviewed and meets the specified requirements.
The mix design proportions shall be within the following limits.
Residual Asphalt:
6.0 to 11.5% by dry mass of aggregate
Mineral Filler:
0 to 3.0% by dry mass of aggregate
The micro-surfacing material shall be designed to carry traffic within one hour of placement.

TABLE 1
Mix Design Requirements

Test Method	Description	Requirements
ISSA TB-139	Wet cohesion –@ 30 minutes min. (Set) –@ 60 minutes min. (Traffic)	 12 kg-cm minimum 20 kg-cm minimum
ISSA TB-109	Excess asphalt by LWT sand adhesion	538 g/m2 maximum
ISSA TB-114	Wet stripping	90% minimum
ISSA TB-100	Wet track abrasion loss-one hour soak Loss-six day soak	538 g/m2 maximum 807 g/m2 maximum
ISSA TB-147 Method A	Lateral displacement Specific gravity after 1000 cycles of 57 kg	5% maximum 2.10 maximum
ISSA TB-144	Classification compatibility	(AAA, BAA) 11 Grade Points minimum
ISSA TB-113	Mix time @ 25 °C	Controllable to 120 seconds minimum

TABLE 2
Micro-Surfacing Coarse and Fine Aggregates Requirements

Micro-Surfacing Type	Application	Physical Requirements as Specified in OPSS 1003
II	Low Traffic Volume	Superpave 12.5
II	High Traffic Volume	Superpave 12.5 FC1
III	Modified N/A	Superpave 12.5 FC1
III	N/A	Superpave 12.5 FC1
Note: A. Aggregates meeting the physical requirements of Superpave 12.5 aggregates shall be produced from quarried bedrock consisting of 100 % siliceous aggregate determined in accordance with LS-609.		

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TABLE 3
Gradation Requirements

Percent Passing			
MTO Sieve Designation I	**Micro-Surfacing Type II**	**Micro-Surfacing Type III Modified**	**Micro-Surfacing Type II**
9.5 mm	100	100	100
6.7 mm	--	95-100	--
4.75 mm	90-100	80-95	70-90
2.36 mm	65-90	50-75	45-70
1.18 mm	45-70	33-55	28-50
600 µm	30-50	25-40	19-34
300 µm	18-30	15-30	12-25
150 µm	10-21	7-20	7-18
75 µm	5-15	5-15	5-15

IV. LITERATURE REVIEWS& ITS CONCLUSION

Cesare Sangiorgia, Gabriele Bitellib, Claudio Lantieria in this study it was found that Micro-surfacing are capable of extending the life-cycle of the pavement by restoring a significant contribution in terms of safety (skid resistance)

Douglas D. Gransbergin this study it was found that the Micro surfacing is best suited to address rutting, raveling, oxidation, bleeding, and loss of surface friction.

Samuel Labi, Kong SiewHwee, Geoffrey Lampteyin this study it was found that Micro surfacing generally appears to offer a greater service life when applied at non-Interstate compared to Interstate pavements.

Tara Christine Erwin in this study it was found that there is a relationship between surface friction and road safety, but very few skid data or monitors the safety effects of their surfacing treatments.

Bin Yu, XingyuGu,Fujian Ni, RuiGuoin this study it was found that Micro surfacing was shown to be effective for all levels of traffic, as well as useful in both urban and rural settings.

Rajiv Kumar,Teiborlang L. Ryntathiangin this study it was found that To minimize energy use and greenhouse gas over the life of a pavement, all preservation treatment can be done by Micro surfacing.

MasoudRobati, Daniel Perratonin this study it was found that A model was developed to predict the stiffness of the mastic at different filler concentrations. The model stipulates that the mastic complex modulus as a function of filler volume fraction follows three regions: diluted region, optimum concentrated region, and concentrated region.

Charles T. Jahren, JacobM. Thorius,Kevin R. Behlingin this study it was concluded that It is possible to develop quantitativeguidelines for use in the selection of TMS using the concept of the surface conditionon index.

Susan Tighe, Ningyuan Li, Lynne Cowe Falls, Ralph Haas in this study it was found that The safety impacts of pavement properties or attributes, including pavement friction and surface texture, pavement geometric design or cross-sectional features, pavement roughness and distress, properties of paving materials, and marking, signing, and visibility of pavements.

CONCLUSION

1) Micro-surfacing is capable of extending the life-cycle of the pavement.

2) Micro surfacing is best suited to address rutting, raveling, oxidation, bleeding, and loss of surface friction.

3) Micro-Surfacing creates a new, stable surface that is resistant to rutting and shoving in summer and to cracking in winter.

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4) Because of its quick-traffic properties, Micro Surfacing can be applied in a broad range of temperatures and weather conditions, effectively lengthening the paving season. It is particularly suitable for night applications on heavy-traffic streets, highways, and airfields.

5) Micro Surfacing's life expectancy usually exceeds seven years.

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