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A Proactive Maintenance by Using Micro Surfacing for Pavement

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ABSTRACT

The method of mix design for microsurfacing as described by ASTM and ISSA, clearly stated that the methods for mix design should be used only as a guide. Therefore, a more exact method is needed to provide successful mix designs, based on performance-related tests included in the design method rather than relying heavily on the experience of the construction crew with these types of treatments. The two method 'Laboratory method of mixing and curing microsurfacing mixtures (TxDOT, 2004)' and "A Laboratory Investigation on Bitumen-Emulsion Mixes" (Tipnis and Pandey, 2001) have been tried in the laboratory but there were some limitations to these methods as balling could not stop completely unless a very careful mixing of the mix is taken care off. Therefore, a different mixing methodology of mixing coarse and fine aggregates with emulsion is explored and is explained. where it is found that forming of a ball during the mixing of aggregates with emulsion appeared to have been solved, and no balling was formed.

KEYWORDS: *microsurfacing, mixtures, Laboratory, mix designs, ASTM, ISSA*

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I. INTRODUCTION:

Road transport is considered to be one of the most cost-effective and preferred modes of transport for both freight and passengers. Expressways and highways constitute only about 2% of the entire road length in India, but they carry about 40% of the road traffic, leading to a strain on their capacity (NHAI, 2011).

The focus of roadway activity in the early to mid-20th century was on the construction of new pavements. In the latter part of the 20th century continuing into the 21st century, this focus has been shifted to maintenance and rehabilitation of pavement infrastructures. Maintenance includes actions that can retard or correct the deterioration of infrastructure facilities. These actions include crack sealing, resurfacing, etc. and pavements must be selected for maintenance when they are still effective. In most cases, the proper time to apply maintenance is before the need is apparent to the casual observer. This is because once pavements start to deteriorate; they deteriorate rapidly beyond the point where maintenance is ineffective. One of the solutions for preventive maintenance of pavement is micro-surfacing. (Kumar and Ryntathiang, 2016)

India has an extensive road network of 4.24 million km– the second largest in the world (Luo et al. 1989). The National Highways have a total length of 70,934 km and serve as the arterial road network of the country. It is estimated that more than 70 percent of freight and 85 percent of passenger traffic in the country is being handled by roads. (Luo et al. 1989).

For Rigid pavements, the requirements may vary considerably depending on subgrade soil type, environmental conditions, and amount of heavy truck traffic (ACPA, 1996).The terminologies such as subgrade and subbase were used in the 1993 AASHTO Design Guide to design the pavements(AASHTO, 1993).

Roads are classified into two main categories based on their structures as rigid pavements and flexible pavements. Concrete is normally used to construct the wearing surface of a rigid pavement which acts like a slab over any irregularities in the underlying supporting material. Bituminous materials are used to construct the wearing surface of flexible pavements. Safety, cost, ride quality, and performance are characteristics of pavement systems that are considered high-priority customer demands by transportation agencies throughout the world. Ride quality is the characteristic most notable to the traveling public. The growing concern of resource depletion and global pollution has challenged many researchers to seek and develop new materials relying on renewable resources. Pavement preservation is defined as a program employing a network-level, long term strategy that enhances pavement performance by using an integrated, cost-effective set of practices that extend pavement life, improve safety, and meet motorist expectations (FHWA, 2005). Actions used for pavement preservation include routine maintenance, preventive maintenance (PM), and corrective maintenance (Uzarowski and Bashir, 2007). Transportation agencies use chip seal, slurry seal, micro-surfacing, cape seal, fog seal, etc. Micro surfacing is to be applied over an existing pavement surface which is structurally sound, but the surface is showing signs of premature ageing, aggregate loss, and high degree of polishing, oxidation surface etc.

II. LITRATURE RIVEW

(Petrova et al. 2018) The adopted state strategy for the development of the construction materials' industry pays much attention to the development of modern efficient transport infrastructure (Skvortsov, 2012 with the requirements of international standards. Currently, asphalt concretes are used in road construction in Russia. The standard service life of the asphalt concrete surface is equal to approximately 10 years, however, under the influence of natural and anthropogenic factors it can decrease. In foreign countries, the share of asphalt concrete roads constantly decreases, and the share of cement concrete roads increases. Cement concrete roads are becoming the fundamental type of arterials. Their share reaches 50% in some European countries and 60% in the USA. In Russia, their share is so far no more than 2–3%. In 2017, according to Decree No. 656 of the Government of the Russian Federation dd. 30.05.2017, a goal was set to increase t road surface inter-concrete surfaces require repair approximately once in 5 years. Not only cement concrete surfaces but also surfaces made of alkali activated slag (cement-free) concrete with higher durability can serve as an alternative to asphalt concrete surfaces et al., 2017; Petrova and Prokofieva, 2015). The purpose of the study is a comparative evaluation of the corrosion resistance of alkali activated slag concrete and that o Portland cement concrete in a corrosive oil-containing medium. It is demonstrated that, during five years of observation, the absorption of the corrosive medium by concrete on alkali activated slag binder turned out to be 3.8 times lower than that by Portland cement concrete, which can be explained by the specifics o alkali activated slag concrete structure. The resistance coefficient of alkali activated slag concrete in bending tests amounts to 1.15, whereas the resistance coefficient of Portland cement concrete in bending tests amounts to 0.82. Therefore, it is established that alkali activated slag concretes have a higher durability in a corrosive oil-containing medium.

(Anonymous, 2018) Microsurfacing was applied on Brooklyn Bridge as pavement surfacing. Due to high traffic and the need for short condition timing, type III mix design was placed on the bridge steel grid deck at night and the results were satisfactory.

(Garfa, et al. 2018) In another study the effectiveness of type III microsurfacing in repairing aged asphalt rutted slabs was evaluated. The results of the study revealed that thermal aging of the slabs has a positive effect on the rutting resistance of hot mix asphalt which is rehabilitated with microsurfacing.

III. METHODOLOGY

The mix is to be a quick setting system i.e. able to accept traffic after a short period of time preferably within about two hours depending upon weather conditions. This may be used as surface sealing treatment to improve skid resistance, surface durability, seal fine and medium cracks. It is applied on existing pavement surface which is structurally sound, but the surface shows signs of premature ageing, aggregate loss, cracking, high degree of polishing etc. Generally microsurfacing is laid in single layer, but when the existing surface is highly polished, cracked, it is advisable to apply in two or more layers. Microsurfacing helps in preservation of pavement strength and can be used both for preventive and periodic renewal treatment on a preferably low and medium traffic road. It can be used for pavements in urban and rural areas, primary and inter-state routes, residential streets, highways, and toll roads. This can also be used on top of single coat surface dressing (Cap Seal) or open graded premix carpet without seal coat and also on Dense Bituminous Macadam/Bituminous Macadam.

OBJECTIVE

Best on the present study following objectives are drawn.

1. Prolongs road life, increased safety and rider comfort.
2. Provide excellent surface roughness and skid resistance.
3. Environment friendly - nonpolluting for environment since no heating or hot paving required.
4. Provides new wearing surface.

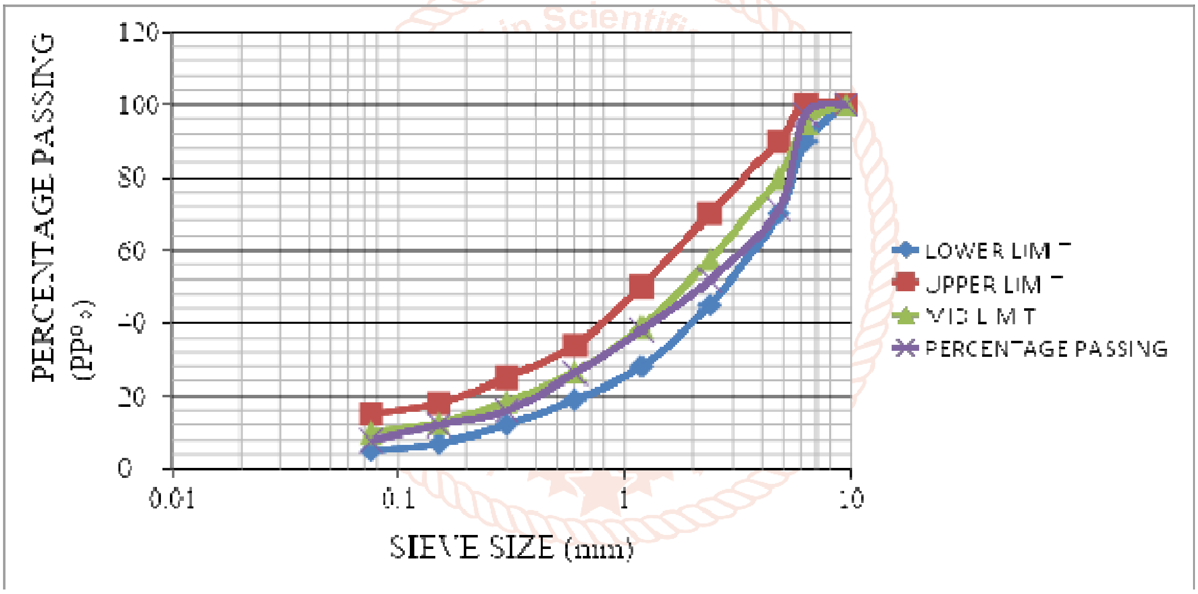
5. Saving of Natural resources.
6. To provide economical pavement preventive maintenance treatment.
7. Faster laying process.

IV. RESULT & DISCUSSIONS

Early in the project, the project staff tried to collect samples in the field to mold samples that would be tested in the laboratory using the IRC-SP-81-2008, MoRTH 5th Revision, ISSA mixture design tests. Samples of the mixture from the application machine were taken. Cohesion, wet track abrasion, and loaded wheel test samples were molded from this mixture at the job site. They were to be tested in the laboratory

Gradation of Coarse Aggregate by Sieve Analysis:-Sample-1000gm

Sieve Size-mm	Retained wt.	Cum. Wt. Retained	% Retained wt.	% Passing wt.	Specification Limit IRC	
					Lower Limit	Upper Limit
9.5	0	0	0	100	100	100
6.3	27.4	27.4	2.74	97.26	90	100
4.75	260.8	28.8.2	28.82	71.18	70	90
2.36	193.7	481.9	48.19	51.81	45	70
1.18	137.4	619.3	61.93	38.07	28	50
0.600	118.7	738	73.8	26.2	19	34
0.300	102.9	840.9	84.09	15.91	12	25
0.150	39.8	880.7	88.07	11.93	7	18
0.075	42.5	923.2	92.32	7.68	5	15



Upper, Lower, and Middle aggregate gradation curves (0-6 mm size).

Conclusion

From analysis of results, following conclusions are reported:

1. The Bio Stab MY used in this study significantly improves storage stability of quick setting bitumen emulsion under extremely acidic condition (pH 2), where most of the bitumen emulsion stabilizers undergo acid hydrolysis, and thus losing the ability to stabilize the bitumen emulsions.
2. SBS modified low penetration bitumen residue shown higher stiffness comparing the EVA modified bitumen residue, indicating more resistance against loading. This can be explained by the more elasticity of the SBS modified bitumen than EVA modified.
3. Bitumen residue obtained from unmodified low penetration bitumen emulsion was stiffer than the original PG 58-28 bitumen. This indicates the potential of forming cold mix asphalt with the same stiffness as conventional HMA mixes.
4. Huet- Sayegh analogical model (2S2P1D) was used for the modelling of linear viscoelastic properties of both EVA and SBS modified bitumen residues. SBS modified bitumen residue have shown higher stiffness and lower phase angle than the EVA modified bitumen residue. This proves more elastic behaviour for the SBS modified bitumen residue, and thus more potential to resist against loading. It was also observed that the behaviour of EVA modified bitumen residue does not follow linear

viscoelastic behaviour under small strain loading at high temperature (80 °C).

5. In both 30-min and 60-min cohesion test results, it was observed that the micro-surfacing mixture prepared with SBS modified bitumen emulsion develops more cohesion with aggregates, comparing the unmodified, EVA polymer modified samples, and Latex modified mixes (reference mix). It was also observed that the SBS modified mixture has superior properties than other mixes in terms of resistance against aggregate loss (abrasion) and rutting. This can be explained by the stiffer and more cohesive mastic formed around the aggregates, and thus stronger cohesion builds up for the mix, which improves resistance against rutting.

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