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Environmentally Friendly Pavement Preventive Maintenance that is Affordable Environmentally Sound

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ABSTRACT—

In a time when infrastructure is expanding quickly, it is crucial to regularly maintain current infrastructure, particularly highways. Performing micro surfacing is a type of preventative maintenance that tries to make the most economical changes possible in pavement quality and life) using bitumen aggregate with a size range of three to six millimeters that has been coated with a unique emulsion. The layer is precisely applied to the portion of road that needs maintenance. This essay intends to highlight the contributions made by scholars on the topic of micro surfacing as a method for repairing and maintaining pavement. Although the method is only recently becoming popular in the Indian subcontinent, it is nevertheless widely regarded as a necessary tool for preventive pavement care and should be utilized to prolong the life of.

Keywords— infrastructure**,** preventative**,** maintenance**,** contributions**,** pavement**.**

I. INTRODUCTION

In a specialised microsurfacing machine, a homogeneous mixture of polymerized bitumen emulsion, specially graded fine aggregates, cement, water, and necessary additives is mixed. The mixture is then immediately spread evenly over a properly prepared surface using a spreader box attached behind the machine. It is a cold mix application treatment that is applied over an existing pavement surface that is structurally sound but prematurely ages, loses aggregate, cracks, has a high degree of polishing, etc. Microsurfacing can be utilised for both preventive maintenance and routine replacement, maintaining the pavement's structural integrity. Factors that supposedly restrict the use of Microsurfacing includes both accepted and debatable constraints that may serve more as usage suggestions. It has been demonstrated that microsurfacing works best in specific circumstances [1]. On medium to high traffic roads, microsurfacing treatments should last at least seven years [2]. Microsurfacing is highly effective on both low and high traffic routes and is advised for use at night on busy streets [3]. In the early to mid-20th century, new pavement construction was the main focus of roadway activities. This focus has turned to pavement infrastructure maintenance and restoration in the second half of the 20th century and into the 21st century. Actions taken as part of maintenance include those that can stop or slow down the deterioration of infrastructure facilities. The best time to choose pavements for repair is when they are still functional. These maintenance procedures include crack sealing, resurfacing, etc. The best time to perform maintenance is typically before the need becomes obvious to the untrained eye. This is due to the fact that once pavement deterioration begins, it happens quickly and beyond the point at which maintenance is useless. Microsurfacing is one method for performing preventive maintenance on pavement. In 2016 (Kumar and Ryntathiang),According to Luo et al. (1989), India has the second-largest road network in the world with a total length of 4.24 million km. The National Highways, which span a distance of 70,934 kilometres, are the the nation's network of major thoroughfares. Roads are thought to handle more than 70% of the nation's freight traffic and 85% of its passenger traffic. 1989 (Luo et al.).The specifications for rigid pavements may change significantly depending on the subgrade soil type, the surrounding environment, and the volume of heavy truck traffic (ACPA, 1996).The 1993 AASHTO create Guide used terms like subgrade and subbase to create the pavements (AASHTO, 1993).

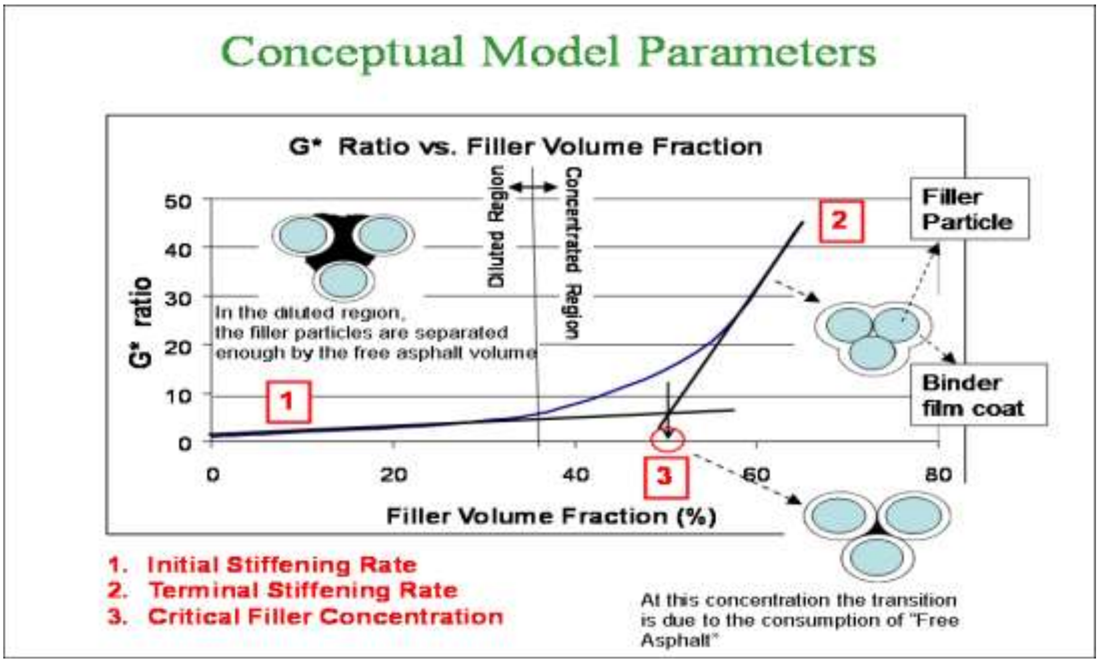

Fig 1 Schematic of the progress of stiffness in terms of filler influence Extracted from Faheem, A., and H. Bahia (2010, p. 10).

II. Literature review

(Robati et al., 2012) Actually, these techniques consider the same test methodologies for both systems without distinguishing between Slurry Seal and Microsurfacing mix design. Studies conducted by the Texas Transport Institute (TTI) demonstrated the issues with applying the current micro-surfacing techniques and recommended the creation of a thorough mix design tailored specifically for micro-surfacing (TTI, 1995). In order to develop a logical mix design process, the California Department of Transportation (Caltrans) has also researched both the Slurry Seal and Micro-surfacing technologies in combination. The transport minister. The province of Quebec (MTQ) has created its own micro-surfacing definition. Similar standards and guidelines are used in the European Union to design Slurry Seal and Micro-surfacing. Slurry Seal and Micro-surfacing systems have been used in several nations, including Germany, France, the United Kingdom, and South Africa, which have created particular rules for their use. ISSA and ASTM are the standards that are most frequently utilised internationally among all of these others.

(Petrova et al. 2018) The creation of a contemporary, effective transport infrastructure that complies with international standards is given significant consideration in the governmental strategy adopted for the growth of the construction materials sector (Skvortsov, 2012). In Russia, asphalt concretes are currently employed in the construction of roads. The asphalt concrete surface has a typical service life of around 10 years, however this can be affected by both natural and man-made influences, resulting in a shorter service life. In foreign nations, cement concrete roads are becoming more prevalent while asphalt concrete roads are steadily declining in percentage. Roads made of cement and concrete are increasingly used as arterials. In some European nations, their percentage approaches 50%, while in the USA, it reaches 60%. Their share in Russia is currently zero. greater than 2–3%. Decree No. 656 of the Government of the Russian Federation, dated 30 May 2017, established the target of increasing the interval between road surface inter-concrete surfaces that need to be repaired, from one to five years. Asphalt concrete surfaces can be replaced with more durable surfaces composed of alkali activated slag (cement-free) concrete in addition to cement concrete surfaces (et al., 2017; Petrova and Prokofieva, 2015). The aim of the study is to compare the corrosion resistance of Portland cement concrete and alkali activated slag concrete in corrosive oil-containing media. It is shown that, after five years of observation, concrete's ability to absorb the corrosive medium on an alkali activated slag binder was found to be Alkali activated slag concrete's particular properties can be used to explain Portland cement concrete. In bending testing, alkali activated slag concrete has a resistance value of 1.15 while Portland cement concrete has a resistance coefficient of 0.82. Therefore, it is proven that concretes made of alkali activated slag are more durable in corrosive oil-containing mediums

(Anonymous,2018) On the Brooklyn Bridge, microsurfacing was used for the pavement surfacing. The type III mix design was installed on the bridge's steel grid deck at night, and the results were satisfactory due to the heavy traffic and the requirement for quick condition timing.

(Garfa, et al. 2018) Another study assessed the efficiency of type III microsurfacing in restoring old, rutted asphalt slabs. According to the study's findings, thermal ageing of the slabs improves the rutting resistance of hot mix asphalt that has undergone microsurfacing rehabilitation.

(Salleh, et al 2019) Microsurfacing was used to restore the LATAR roadway as part of a Malaysian project. The results after 36 months of operation revealed that microsurfacing significantly improved rutting, roughness, and skid resistance.

III. Mix Design for Microsurfacing

Table 1: Microsurfacing Sample preparation

Particulars	Type II 4-6mm	Type III 6-8mm
Premium quality aggregate	8.4 to 10.8 kg per sqm	11.1 to 16.3 kg per sqm.
Binder (polymer modified emultion)	13 – 15% by weight of Aggregate.	10 – 15% by weight of Aggregate.
Additive	Up to 2% by wt of Aggregate.	Up to 2% by wt of Aggregate.
Cement/Filler	0.5 – 2.0% by weight of Aggregate.	0.5 – 2.0% by weight of Aggregate.
Water	13 – 15% by weight of aggregate.	10-15 % by weight of aggregate

For Type II Microsurfacing:-

Weight of Aggregate 1000 gm

(6 mm Aggregates 30% + Crushed sand 70% =100%)

Weight of Emulsion = 13% of Aggregate

=1000*13/100

= 130 gm

Weight of Cement =1% of Aggregate

= 1000*1/100 = 10 gm

Weight of Water = 15% of Aggregate

= 1000*15/100

= 150 gm

Weight of Additive = Depends on Ambient temperature at site.

For Type III Microsurfacing:-

Weight of Aggregate 1000 gm

(6 mm Aggregates 30% + Crushed sand 70% =100%)

Weight of Emulsion = 15% of Aggregate

= 1000*15/100

= 150 gm

Weight of Cement =2% of Aggregate

= 1000*2/100 = 20 gm

Weight of Water = 15% of Aggregate

= 1000*15/100

= 150 gm

Weight of Additive = Depends on Ambient temperature at site

IV. TESTS ON MATERIALS

Table 2: International Testing Standards and Requirement

Material Work	Test	Field/Laboratory	Test Procedure
Aggregate	Gradation	Laboratory	IS 383-1970
	Sand equivalent	Laboratory	IS 2386-1963

			IS 2720(Part 33)
Bitumen emulsion	Water content	Laboratory	IS 8887-1995
	Particle change	Laboratory	IS 8887-1995
	Penetration of the residue	Laboratory	IS 1203-1978
Manufactured Mix	Rate of application	Field	IRC SP-81-2008
	Residual bitumen extraction	Laboratory	IS 73-1992
	Extracted aggregate gradation	Laboratory	IS 73-1992
	Wet Track Abrasion Test	Field/Laboratory*	IRC SP-81-2008
Finished surface	Surface Texture	Laboratory	ASTME 965
	Skid resistance Coefficient	Laboratory	ASTME 303

V. CONCLUSION

Based on the above study following conclusions can be made

- 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.
- Micro-surfacing mixtures were further strengthened against rutting using different type of SBS Polymer. In overall, a significant improvement of around 45% in rutting resistance of micro-surfacing mixtures was achieved using low penetration bitumen emulsion modified with SBS polymer and stabilized using Bio Stab MY, in comparison to the mixes prepare with the conventional SBR latex modified bitumen emulsions.
- Such a significant improvement in rutting resistance of micro-surfacing mixes was achieved using lower level of bitumen residue, in the mixes prepared with low penetration bitumen emulsion stabilized with Bio Stab MY. This further indicates the potential of the hard bitumen emulsions to form a cold mix with the same bitumen proportions than the conventional HMA with 5% bitumen content.

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