MICROSURFACING – AN ECO-EFFICIENT TOOL FOR ROAD SAFETY AND PAVEMENT MAINTENANCE

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Abstract

With the development of infrastructure, in rapidly developing modern era, frequent maintenance of existing infrastructure, especially roads is of prime importance. Microsurfacing is a preventive maintenance technique (preventative maintenance strategy aims at producing the most cost-effective improvements in pavement quality and life) involving three to six millimeter sized bitumen aggregate treated with a special emulsion. The layer is neatly laid down on road section requiring maintenance. This paper aims at focusing on the contributions made by researchers on Microsurfacing as a tool for pavement maintenance and repair. Although the technique is finding its place in Indian sub-continents little late, but nevertheless it is universally considered as an inevitable tool as far as preventive pavement maintenance is concerned and should be used to extend life of the underlying pavement.

Keywords: *Microsurfacing, Skid Resistance, Surface Texture, roughness, Pavement maintenance*

1.0 Introduction

Microsurfacing is a mixture of polymerized bitumen emulsion, specially graded fine aggregates, cement, water and necessary additives, mixed homogeneously on site in a special Microsurfacing machine, uniformly spread immediately over a properly prepared surface evenly by means of a spreader box attached behind the machine. It is an environment friendly cold mix application treatment applied over an existing pavement surface which is structurally sound, but the surface shows signs of premature ageing, aggregate loss, cracking, high degree of polishing etc. Microsurfacing helps in preservation of pavement strength and can be used both for preventive and periodic renewal treatment. Factors that reportedly limit the application of microsurfacing consist of established limitations and debated limitations that may act more as suggested guidelines for use. Microsurfacing is shown to be most effective under certain conditions [1]. Microsurfacing treatments can be expected to last at least seven years when placed on medium to high volume roads [2]. Microsurfacing is very successful on both low and high volume roadways and is recommended for night applications on heavy-traffic streets [3].

2.0 Literature Review

One of the early studies done on microsurfacing in the United States foreshadowed the favorable conclusions of further research by recommending that microsurfacing be approved for routine use in restoring flexible pavements to fill surface ruts and cracks, seal the surface and restore skid resistance [5]. Hicks et al. documented that microsurfacing as an appropriate maintenance strategy for more types of pavement distress than any other commonly used strategy, as well as having a longer life expectancy than all but thin HMA overlays which cost 30% more. Temple et al. observed the median Pavement Condition Index (PCI) of microsurface sections is approximately 85 after 60 months of service with significantly fewer cracks detected after treatment. Microsurfacing leads to reduction in initial rut after treatment [7]. The friction numbers

(FN) for smooth tire are in the low teens to low thirties on 50% of the microsurface section. Microsurfacing can be a highly cost-effective safety treatment for both intersections and road segments that warrant skid resistance improvement because of a high frequency of wet road accidents and low friction numbers [4]. Correlation is developed between International roughness index values to the amount of material placed in the surface preparation course [2]. Microsurfacing provide a tighter surface texture (improving noise) and require less weight of aggregate per square area to provide adequate coverage (reducing cost) [6].

3.0 Environmental Impact of Microsurfacing

Microsurfacing is an environmental friendly technique which is used for the preventive maintenance of road. As environmental footprint according Mr. Takamura energy used is almost zero because it cold mix asphalt as presented in table 1. Numbers of accidents also get reduced due to increases in skid resistance after microsurfacing. A comparison between hot mix asphalt and cold mix asphalt is described in figure 1.

Table 1: comparisons between hot mix asphalt and cold mix asphalt

CHARACTERISTICS	HOT ASPHALT	MICROSURFACING	SAVINGS
Materials (tons/ lane km)	46.875	6.09	87
Fuel consumption (kg/ton)	8	1	88
Fuel consumption (kg/lane km)	3,750	400	89
CO2 emission (Kg/lane km)	1,078	13.40	99
NO2 emission (Kg/lane km)	5.1	1.3	75
Accidents (estimated ratio)	1.0	0.5	50
Health risk (estimated ratio)	1.0	0.2	80

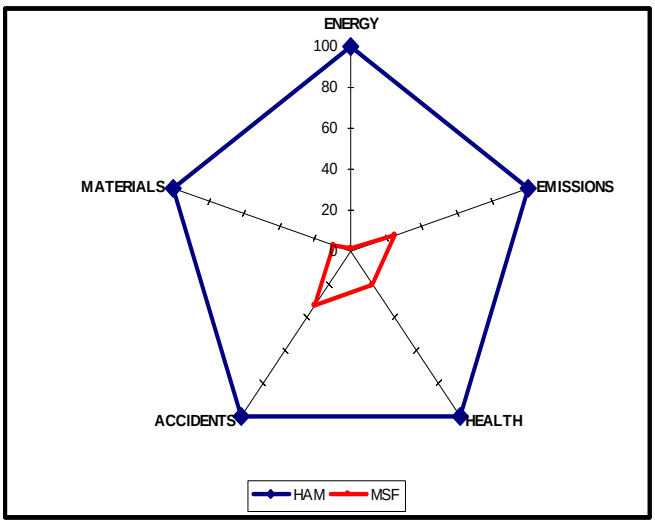

Figure 1: Footprint according to Mr.Takamura(Courtesy: ELSAMAX)

4.0 A Case Study of Ahmedabad - Vadodara Expressway

Microsurfacing, preventive maintenance techniques is first time used in Ahmedabad-Vadodara expressway. The Ahmedabad Vadodara Expressway also known as National Expressway 1 is a major artery of public transport connecting the cities of Ahmedabad and Vadodara in the state of Gujarat, India. This 95 Km long expressway has 2 lanes each side and

one service lane. It is a part of the Golden Quadrilateral Project by National Highway Authority of India (NHAI). Two-wheeler vehicles are forbidden on the road due to safety concerns. Microsurfacing (Type II) used as a preventive maintenance solution on Ahmedabad – Vadodara Expressway. In this expressway, a study of microsurfacing is done in a section between CH. 17.00 to CH. 22.

Pavement Performance evaluation is done to determine potential of microsurfacing as a preventive maintenance. For the measurement of performance of microsurfacing as preventive maintenance tool following performance measure are taken in to consideration:

- Skid resistance
- Roughness
- Surface Texture

Skid resistance is the force developed when a tire that is prevented from rotating slides along the pavement surface (Highway Research Board, 1972). Skid resistance is an important pavement evaluation parameter because inadequate skid resistance will lead to higher incidences of skid related accidents. Skid resistance depends on pavement surface texture. Skid resistance changes over time. Typically it increases in the first two years following construction as the roadway is worn away by traffic and rough aggregate surfaces become exposed, and then decreases over the remaining pavement life as aggregates become more polished. Skid Resistance measurement on Ahmedabad – Vadodara Expressway is done using Portable Pendulum Skid tester (ASTM-E-303-93-2003). Skid resistance is measured before laying microsurfacing and after 6 months of laying microsurfacing on highway between sections of CH. 17.00 to CH. 22. Figure 2 shows Results obtained from Portable Pendulum Skid tester before and after lying of microsurfacing.

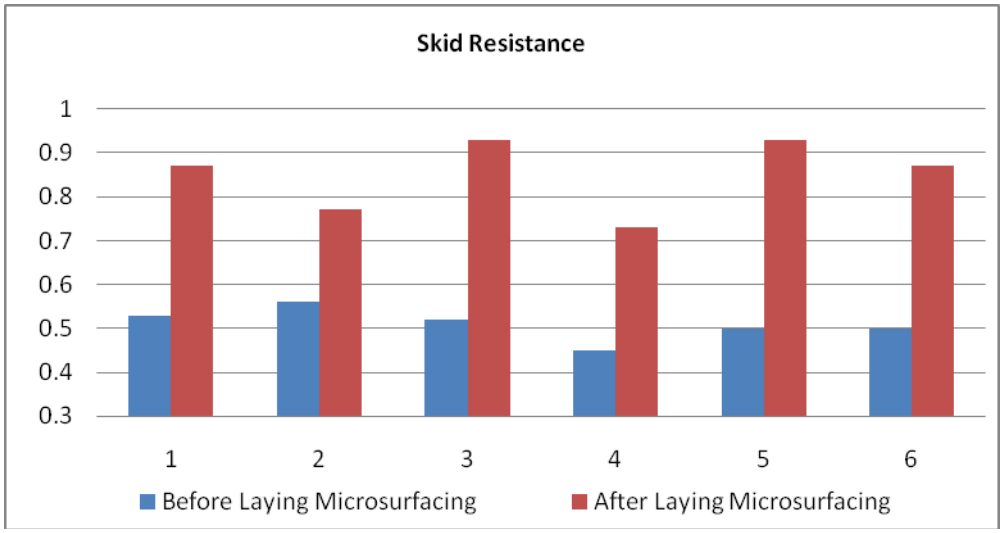

Figure 2: Graphical Results of Improved skid resistance

Pavement roughness is generally defined as an expression of irregularities in the pavement surface that adversely affect the ride quality of a vehicle (and thus the user). Roughness is an important pavement characteristic because it affects not only ride quality but also vehicle delay costs, fuel consumption and maintenance costs. Roughness measurement on Ahmedabad – Vadodara Expressway is done using fifth wheel bump integrator (developed by CRRI) and is reported as Unevenness Index (UI) in mm/km. Figure 3 shows Unevenness index before and after lying of microsurfacing.

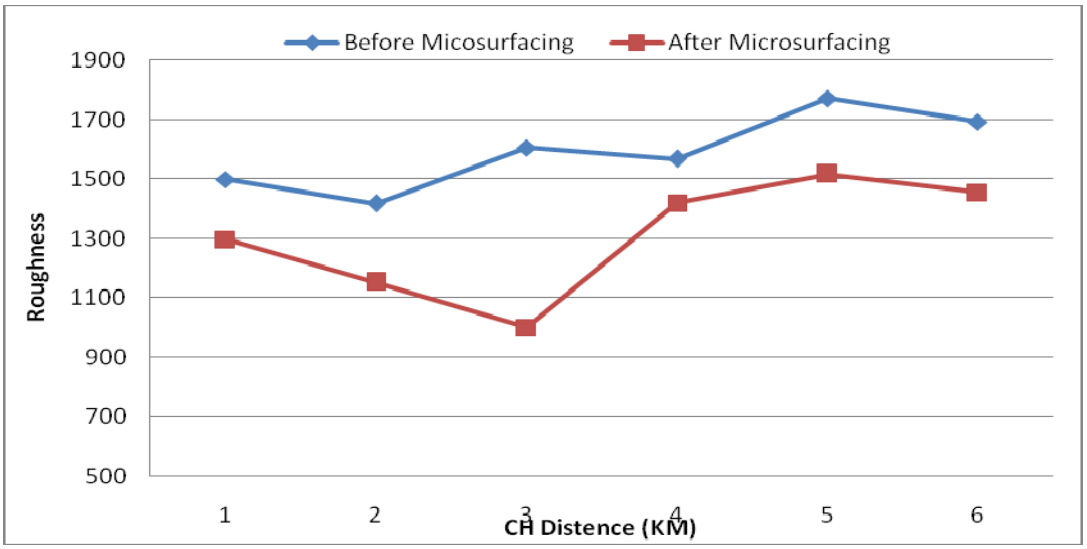

Figure 3: Graphical Results of Roughness

Texture depth test procedure covers the determination of the average texture depth of a paved surface using sand to give the volume of voids. The method is suitable for the measurement of surfaces with average texture depths greater than 0.45 mm (less than 350mm sand circle diameter). Figure4 Results of surface texture before and after lying of microsurfacing.

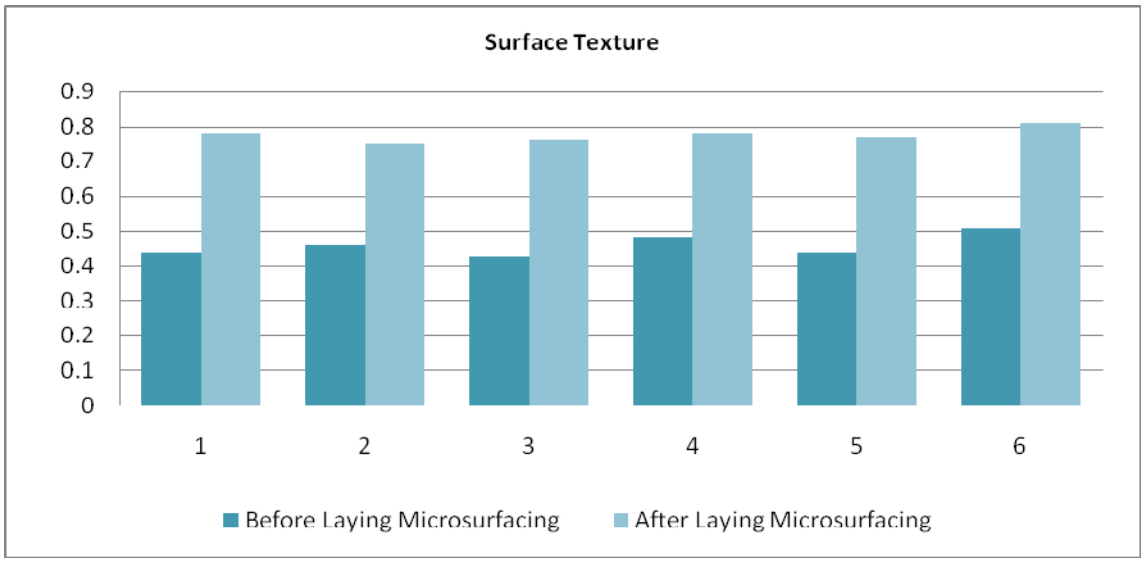

Figure 4: Graphical Results of Improved Surface Texture

In this study roughness is determined by Bump Indicator and skid resistance is measured. The roughness before lying of microsurfacing is 1461(mm/Km) to1772 (mm/Km) and roughness after microsurfacing is 1000 to 1517.The skid resistance is also improved from 0.2 to 0.6. Which shows that microsurfacing improve riding quality. The skid resistance is also improved by using microsurfacing.

5.0 Conclusion

Microsurfacing technology, which is applied to Ahmadabad-Vadodara expressway for the first time in Gujarat, shows outstanding results. Based on these results following conclusions are drawn :

a) Carbon Footprint of Microsurfacing shows that this technology is environmental friendly and economical technology.

b) Post results on Microsurfacing technology at expressway the shows that this method is not only an economical solution for preventive maintenance but also it's also provide safety and riding quality by improving skid resistance and reducing roughness respectively.

c) The roughness before lying of microsurfacing is 1461(mm/Km) to1772 (mm/Km) and roughness after microsurfacing is 1000 to 1517.

d) The skid resistance is also improved from 0.2 to 0.6 and surface Textures improved from 0.4 to 0.8. Which shows that microsurfacing contributes in Road Safety by reducing accidents.

References

[1] L. Samuel, G. Lamptey, and S. H. Kong, "Effectiveness of microsurfacing treatments," Journal of transportation engineering, vol. 133 (5), pp. 298-307, 2007.
[2] E. N. Johnson, T. J. Wood, and R. C. Olson, "Flexible slurry-microsurfacing system for overlay preparation: Construction and seasonal monitoring at minnesota road research project," Transportation Research Record: Journal of the Transportation Research Board, vol. 1989 (1), pp. 321-326, 2007.
[3] K. L. Smith, and D. G. Peshkin, "Pavement Preservation on High-Traffic-Volume Roadways." Transportation Research Record: Journal of the Transportation Research Board, vol. 2235 (1), pp. 54-65, 2011.
[4] L. Craig, and B. Persaud, "Safety effects of targeted program to improve skid resistance." Transportation Research Record: Journal of the Transportation Research Board, vol. 2068 (1), pp. 135-140, 2008.
[5] C. M, Pederson, W. J. Schuller, and C. D. Hixon, "Microsurfacing with natural latex modified asphalt emulsion: a field evaluation," Transportation Research Record, pp. 108- 112, 1988.
[6] R. G. Hicks, K. Dunn, and J. Moulthrop, "Framework for selecting effective preventative maintenance treatments for flexible pavements," Transportation Research Record, vol. 1597, pp. 1- 10, 1997.
[7] T. William, "Performance of Louisiana's chip seal and microsurfacing program," Transportation Research Record: Journal of the Transportation Research Board, vol. 1795 (1), pp. 3-16, 2002.