Research Paper Engineering

Physical Property Comparison of CRMB with Conventional Bitumen Used in Bituminous Concrete

* Nishant Vora ** Rutvij Desai *** Prof.M.H.Lunagaria

* M.E,Civil(Transportaion),L.D.Collage of Engineering, Ahmedabad

** M.E,Civil(Transportaion),L.D.Collage of Engineering, Ahmedabad

*** Associate Professor,Civil Engineering Department,Government Engineering Collage, Dhahod

ABSTRACT

In this research paper conducted this study which was carried out to physical property comparison of Crumb Rubber Modified Bitumen (CRMB-60) and conventional bitumen (60/70 percentage grade). Study included the assessment of the test sections based upon the pavement property data like (Marshall Stability, Flow, Marshall Density, Air Voids, Per. Voids in Mineral Agg. (VMA), Per. Voids filled with Bitumen(VFB). Based on the observation s made from the various experimental investigations conducted the different conclusions had been drawn. Use of Crumb Rubber Modified Bitumen in bitumen concrete layers demonstrated better engineering properties of mixes such as Marshall Stability. Performance trends indicated higher life of 40mm Bituminous Concrete (BC) surface with the use of CRMB compared to 60/70 paving grade bitumen.

Keywords : Air Voids, Ambient grinding, Shredding, Marshall Density, Per. Voids filled with Bitumen (VFB).

1. INTRODUCTION

Human being has always remained with a curious nature of invention. Since human being is surrounding by three basis mediums. Such as land, water and air. The modes of transportation are also connected with these three mediums for the movements. Land has given scope for the development for the road and rail transport. Water & Air have developed waterways and airways, respectively. Among all of these transport modes only road transport gives maximum service.

The increased road traffic during the last two decades along with inadequate maintenance inputs caused an accelerated deterioration of road structures. To counter this mechanism, several types of measures are found effective. These include super pave and the use of modified bitumen in structural layers.

Flexible pavements with bituminous surfacing are widely used in India. The high traffic intensity in terms of commercial vehicles, overloading of trucks and significant variations in daily and seasonal temperature of the pavement have been responsible for early development of distress like rutting, cracking, bleeding, shoving and potholing of bituminous surfacing. A factor which causes concern in India is very high and very low pavement temperature conditions in some parts of the country.

1.1 HISTORY OF CRUMB RUBBER

Rubber from discarded tyres has been used in various highways applications for over 50 years. Crumb rubber modified Asphalt (CRMA) was first applied to a section of pavements in 1964 in Phoenix, Arizona.The binder consisted of asphalt to which small particles of vulcanized rubber ground from waste tyres were added, after this section performed satisfactorily for three year, additional sections of CRMA asphalt mix were placed in 1967.

1.2 COMMON PROBLEMS IN SURFACING

In bituminous pavements common problems are high susceptibility to temperature variation, tendency to crack, lesser effective service life etc.The problem in the city section is due to heavy intensity of traffic, overloaded trucks and lack of efficient maintenance system. Rutting caused by permanent deformation within the asphalted layer. Bleeding at high temperature and lack of adhesion in the presence of ground water are also common.

The most common binder used for road surfacing is bitumen obtained from petroleum sources; bituminous road construction in future will face a setback due to the scarcity of materials. The various performance reports indicate that useful life of bituminous overlays has declined from average value of 2-4 years in recent years. The economic loss caused due to obstruction and frequent repairs is very high.

1.3 PERFORMANCE OF CRUMB RUBBER

Increased elasticity and resilience at high temperatures. Improved resistance to surface initiated and fatigue/reflection cracking due to higher binder contents and elasticity. Savings in energy and natural resources by using waste products.

1.4 CRUMB RUBBER MODIFIER (CRM)

Scrap tyre rubber that is reduced in size for use as modifier in asphalt paving materials is called Crumb Rubber Modifier. Different types of Crumb Rubber Modifier are:

1. Ground crumb rubber modifier – irregularly shaped, torn scrap rubber particles with a large surface area, generally produced by a cracker-mill.
2. High natural rubber (Hi Nat) – scrap rubber product that includes 40-48 percent natural rubber and a minimum of 50 percent rubber hydrocarbon according to requirements. Sources of high natural rubber include scrap tire rubber from some types of heavy truck tires, but are not limited to scrap tires.
3. Tread peel – pieces of scrap tire tread rubber that are also a by-product of tire re-treading operations that contain little if any tire cord.

0.5 CRM PREPARATION METHOD

1. Ambient grinding - method of processing where scrap tire rubber is ground or processed at or above ordinary room temperature. Ambient processing is typically required to provide irregularly shaped, torn particles with relatively large surface areas to promote interaction with the asphalt.
2. Cryogenic grinding – process that uses liquid nitrogen to freeze the scrap tire rubber until it becomes brittle and then uses a hammer mill to shatter the frozen rubber into smooth particles with relatively small surface area. This method is used to reduce particle size prior to grinding at ambient temperatures.
3. Shredding – process that reduces scrap tires to pieces 6 in.^{2} (0.023 m2) and smaller prior to ambient grinding.

Overall, a typical scrap tire contains (by weight):
70 percent recoverable rubber
15 percent steel
3 percent fiber
12 percent extraneous material (e.g. inert fillers)

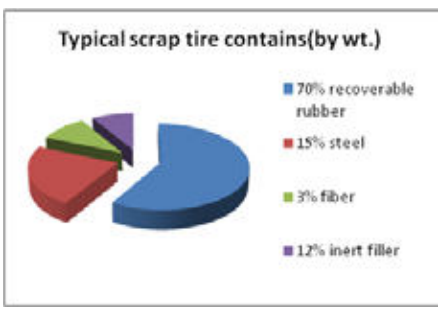

Figure 1.1 Chart of typical scrap tire contains.

2. OBJECTIVE OF STUDY

1. To know the Change in property of Bitumen mixes prepared by using crumb rubber modified bitumen & conventional bitumen.
2. Physical Property variation due to adding of Crumb Rubber in to plain Bitumen.

3. LAB STUDY

For the comparisons of various properties of material which were used in execution in the selected stretch was required. The data related to the various properties of the aggregates, bitumen and CRMB has been collected from the office of the project director of NHAI, Palanpur.The mix design used in the execution works for the bituminous concrete work carried out by using of CRMB-60 and conventional bitumen also been collected.

To know the various test procedures the sampling of the aggregates (chitrasani village), CRMB (hincol), bitumen (IOCL) has been collected from different sources.

3.1 COMPARISION OF VARIOUS PROPERTIES OF THE MATERIALS USED IN THE SELECTED STRETCHES

TABLE – 3.1 Comparison of test results of aggregate

Aggregate	Name of Test	Testing Result	REMARKS
(Chitrasani Quarry)	Aggregate Impact value	12.22 %	
	Combined EI & FI	26.1 %	
	Water Absorption	0.40 %	19mm
	Specific Gravity		
	19 mm	2.872	
	12.5mm	2.841	
	Dust	2.796	

TABLE – 3.2 Comparison of test results of conventional bitumen vs. CRMB

Name of tests	Conventional bitumen	CRMB
Penetration	63.83 mm	43.7 mm
Softening Point	48.3 ^{0}C	60.1 ^{0}C
Striping	97 %	99 %
Specific gravity	1.008	1.028

TABLE – 3.3 Comparison of job mix formula and mix results

Name of Test	Testing Result	
Blanding %	19mm–38%, 12.5mm- 15%, S/D- 44 %, Fines – 3 %.	
Bitumen % By mix	5.0 %	
	CRMB	Bitumen
Marshall Stability	1528 Kgs.	1195 Kgs.
Flow	3.2 mm	2.9 mm
Marshall Density	2.49 gm/cc	2.43 gm/cc
Air Voids	4.25 %	4.2 %
Per. Voids in Mineral Agg.(VMA)	15.5 %	16.2 %
Per. Voids filled with Bitumen(VFB)	71 %	72.15 %

4. CONCLUSION

Based on the observation s made from the various experimental investigations conducted the following conclusions had been drawn.

1. Use of Crumb Rubber Modified Bitumen in bitumen concrete layers demonstrated better engineering properties of mixes such as higher value of Marshall Stability.
2. Performance trends indicated higher life of 40mm Bituminous Concrete (BC) surface with the use of CRMB compared to 60/70 paving grade bitumen.
3. Lower pavement maintenance costs due to improved pavement durability and Performance.

REFERENCES

1. Pavement engineering and materials area “CENTRAL ROAD RESEARCH INSTITUTE NEW DELHI” Dec.2002. | 2. IRC SP 53 – 2010 “Guidelines on Use of Polymer & Rubber Modified Bitumen in Road construction” New Delhi. | 3. Asphalt Usage Rubber Guide Prepared by “State of California Department of Transportation Material engineering testing services”. | 4. “Modified Bitumen & Flexible Pavements” by Tina Overseas LTD. | 5. .Project director office NHAI | 6. “An Introduction to Implementation of Different Types of Crumb Rubber Modified Asphalt Mixtures” The James B. Henry Center for Executive Development, Lansing on 27 February 2012. |