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Laboratory Evaluation of Usage of Crumb Rubber in Bituminous Mix

Ayush[1], Gourav Kumar [2], Sumith Kumar[3], Bushan Kumar[4], Raveesh J[5]
[1,2,3,4]UG student, [5]Assistant professor

Abstract: ***In today's era, solid waste management is the thrust area. Out of this various waste materials, plastic waste, tyre waste and municipal solid waste are of great concern. On the other side, the road traffic is increasing. The traffic intensity is also increasing. The load bearing capacities of the road are to be increased. Our present work is helping to take care of both these aspects. Plastic waste, consisting of carry bags, cups, thermocoles, etc. can be used as a coating over aggregate and this coated stone can be used for road construction. Secondly the waste tires are powdered and the powder is blended with bitumen and this blend is used along with plastic coated aggregate. In this study an attempt is made to use the crumb rubber material in bituminous mix and compared the Marshall properties with conventional mix HMA for bituminous (BC) Grade-2***
Keywords: VG grade, HMA, crumb rubber, BC grade

I. INTRODUCTION

Construction of highway involves huge outlay of investment. A precise engineering design may save considerable investment as well a reliable performance of the in-service highway can be achieved. Two things are of major considerations in flexible pavement engineering–pavement design and the mix design. The present study is related to the mix design considerations.

A good design of bituminous mix is expected to result in a mix which is adequately (i) strong (ii) durable (iii) resistive to fatigue and permanent deformation (iv) environment friendly (v) economical and so on. A mix designer tries to achieve these requirements through a number of tests on the mix with varied proportions and finalizes with the best one. The most dominant mode of the transport in India is the Road Transport, carrying close to 90% of the passenger traffic & 70% of the freight transport. In India, flexible pavement type of construction is preferred over the rigid pavement type of construction due to its various advantages such as low initial cost, maintenance cost, etc. Therefore, among the surfaced roads, maximum is the contribution of the bituminous pavements. In spite of the prominence of the surface transport, most of the roads are poorly managed and badly maintained. Bitumen is used as binder & water proofing material for construction of roads, pavements & air field surfacing for several years .The demand of bitumen has increased tremendously because of rapid urbanization in recent years. The objective can be achieved by enhancing the durability of existing road surfacing which will result in reducing maintenance & resurfacing operations. Hence, the modification of bitumen to meet the required performance standards of the pavement appears to be logical & economical approach. Bituminous pavement fails to give the expected service life under adverse climate, environmental& traffic conditions. The use of crumb-rubber in bitumen modification helps in achieving better performance of wearing courses.

II. LITERATURE REVIEW

Mahrez (1999) investigated the properties of rubberized bitumen prepared by physical blending of bitumen 80 / 100 penetration grade with different crumb rubber content and various aging phases. The results of penetration values decreased over the aging as well as before aging by increasing the rubber content in the mix. Also, the modified binders have lower penetration values than unmodified binders.

Becker et al, (2001) claimed that blend properties will be influenced by the amount of crumb rubber added to the bitumen. Higher amounts indicated significant changes in the blend properties. As rubber content generally increases, it leads to increased viscosity, increased resilience, increased softening point and decreases penetration at 25°C.

Mahrez and Rehan (2003) claimed that there is a consistent relationship between viscosity and softening point at different aging phases of rubberized bitumen binder.

Lee et al. (2008), claimed that the higher crumb rubber content produced increased viscosity at 135°C and improved the rutting properties. It was also observed that the increased crumb rubber amount (fine crumb rubber) produced rubberized bitumen with higher viscosity and lower resilience.

hen et al. (2009), the particle size effects of CRM on high temperature properties of rubberized bitumen binders was an influential factor on visco- elastic properties. The coarser rubber produced a modified binder with high shear modulus and an increased content of the crumb rubber decreased the creep stiffness which in turn showed significant thermal cracking resistance.

III.OBJECTIVES AND METHODOLOGY

A. Objectives

The main objective is to study the effect of using additive in modified and plain binder for HMA and WMA. The present study includes

1) The physical properties of bitumen by conducting basic tests
2) The physical properties of aggregates by conducting basic tests to meet specifications
3) The physical properties of bitumen by conducting basic tests with added crumb rubber
4) Preparation of marshall moulds.
5) To find marshal properties with and without crumb rubber (5%, 10%, 15%)

B. Materials Requirements

In this study, the design of bituminous concrete mix is carried out as per the MORTH specifications. The materials selected for the preparation of bituminous mixes in the present investigation are:

1) Aggregates
2) VG-10 plain bitumen
3) Crunb rubber
4) *Aggregates:* For this study aggregates are selected in near yelahanka quarry from Bangalore
5) *Bitumen:* -bitumen were used in this work. Based on the viscosity grade VG-30

C. Methodology

The following methodologies adopted in this study are

1) Basic tests on aggregate and different grades of bitumen.
2) Marshall Stability test for normal mould
3) marshall stability mould for crumb rubber added mould

TABLES

Table 1. Basic properties on aggregate Table 2. Basic properties on bitumen

Tests on aggregates	Results	MORTH Specifications as per IS code 2386	Remarks
Aggregate impact value	25%	30% max	satisfactory
Aggregate crushing value	22%	30% max	satisfactory
Aggregate abrasion value	24%	30% max	satisfactory
Specific gravity	2.68	>2.60	satisfactory

Table 3. Marshall properties on Bitumen mix

sl no	bitumen content %	Unit Weight	Stability (Kg)	Flow (mm)	Air Voids %	VMA %	VFB %
1	4	2.34	1219.18	2.59	6.36	17.06	62.74
2	4.5	2.36	1290.53	3.15	5.52	16.84	67.21
3	5	2.38	1370.41	3.57	4.47	16.74	73.31
4	5.5	2.41	1450.58	4.16	3.87	17.89	78.38
5	6	2.34	993.6	5.21	3.95	18.86	79.03

Table 4. Marshall propeties on crumb rubber modified Bitumen mix

Sr. No.	Crumb Rubber %	Unit Weight	Stability (Kg)	Flow (mm)	Air Voids %	VMA %	VFB %
1	5	2.29	1435.87	4.87	3.45	16.29	78.52
2	10	2.27	1524.29	4.35	3.927	16.96	76.24
3	15	2.31	1597.5	4.59	4.213	16.45	75.21
4	20	2.21	1395.82	4.21	4.398	16.284	74.92

Gradation as per JMF

In this present study three different sizes of aggregates (20 mm down, 12.5 mm down, 4.75 mm down) were considered. For this study BC-2 were adopted.
Blending of aggregates proportions are

1) 27% for 20 mm down size
2) 23% for 12.5 mm down size
3) 50% for 4.75 mm down size aggregates

D. Specimen Preparation

1) *Number of Specimen*: at least three specimens are prepared for each combination of aggregates and bitumen content.
2) Preparation of aggregate
3) Sieve analysis of aggregates
4) Preparation of compaction and mixing temperature
5) Preparation of mould and hammer
6) Compaction of the Specimen: These study 75 blows were applied on each side.

7) Basic parameters of Marshall Test: Mould is put out on Marshall Apparatus and Marshall Stability as well as Marshall Flow is measured by proving ring and flow dial gauge respectively. After that calculate the other factors like unit weight, VMA (%), VFB (%), etc.

Optimum Binder Content based on Marshall Stability, unit weight and air voids is 5.5%

FIGURES

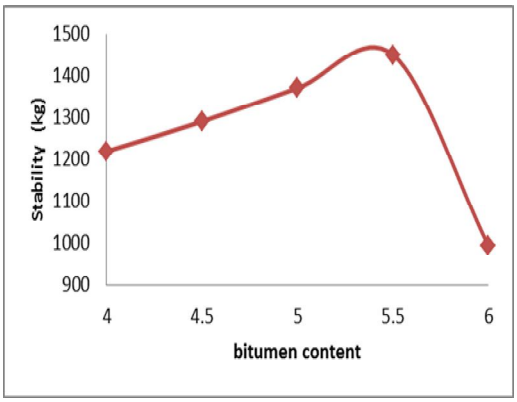


Fig 1: Marshall Stability results for HMA

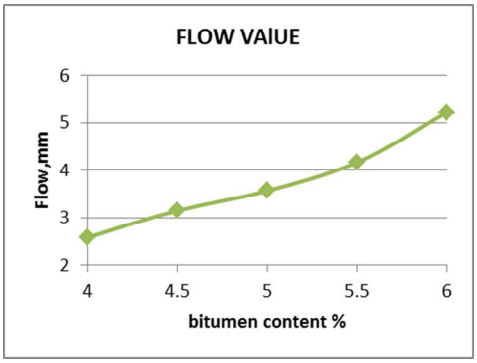


Fig 2 : Marshall flow value results for HMA

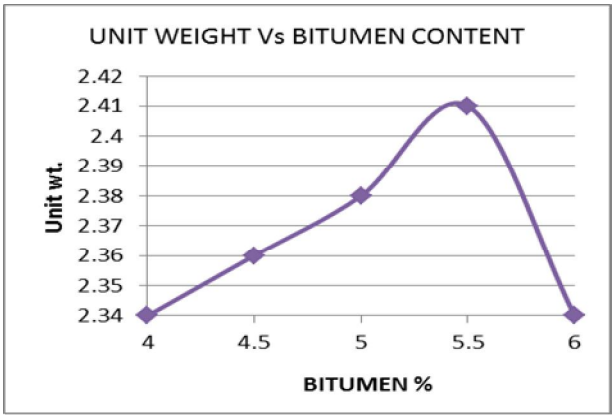


Fig 3: Marshall Unit weight value results for HMA

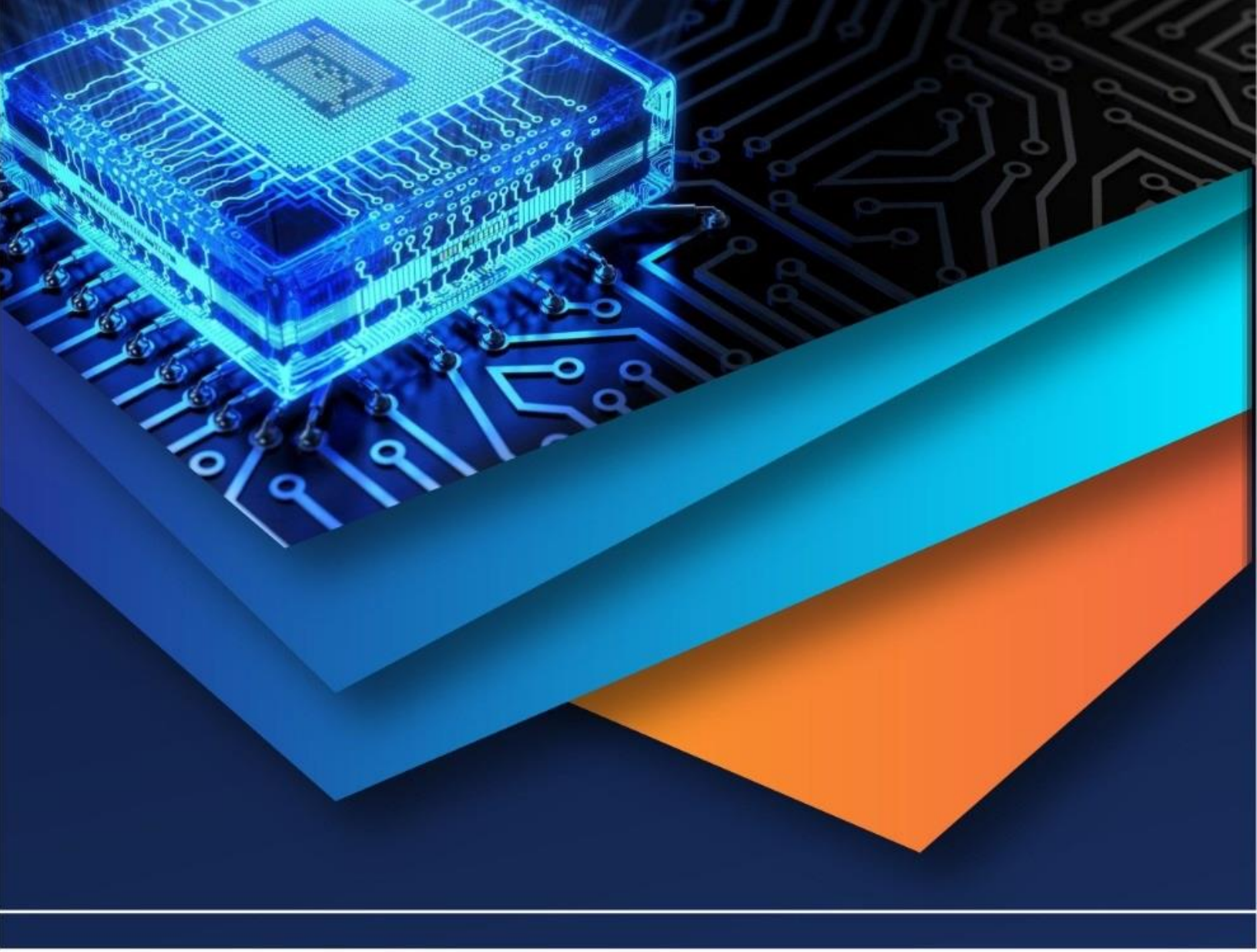
IV. CONCLUSIONS

Based on the results and discussion of experimental investigation carried out on mixes.

Following conclusion is drawn. Crumb rubber gives the satisfactory results by using it in 15% of proportion to replace the bitumen for various tests of bitumen & bitumen mix. Crumb rubber gives the Marshall Stability value of 1597.5 kg by using 15% of crumb rubber powder with bitumen mix, which is 1.2 times greater than the Marshall Stability value of conventional bitumen mix. This will help to dispose the waste tire rubber in a proper way and solve the problem of environmental concerns up to a certain extent.

REFERENCES

[1] Khanna S.K. and Justo C.E.G. (2001), "Highway Engineering", Nem Chand and Bros, Roorkee, pp315-321
[2] IS: 1203 (1978), "Methods for Testing Tar and Bituminous Materials: Determination of Penetration", Bureau of Indian Standards, New Delhi
[3] IS: 1205 (1978), "Methods for Testing Tar and Bituminous Materials: Determination of Softening Point", Bureau of Indian Standards, New Delhi



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