International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume: 3 | Issue: 4 | May-Jun 2019 Available Online: www.ijtsrd.com e-ISSN: 2456 - 6470

Tyre Rubber Modified Bitumen for Ashpalt Mixture

D. Vamsikrishna[1] K. V. Manikanta[2]

[1]M.Tech Scholar, [2]Assistant Professor

[1,2]Civil Engineering Department, VEC, Kavali, Nellore, Andhra Pradesh, India

***How to cite this paper**:* D. Vamsikrishna | K. V. Manikanta "Tyre Rubber Modified Bitumen for Ashpalt Mixture" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-3 | Issue-4, June 2019, pp.1613-1617, URL: https://www.ijtsrd.com/papers/ijtsrd25125.pdf

IJTSRD25125

Copyright © 2019 by author(s) and International Journal of Trend in Scientific Research and Development Journal. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0) (http://creativecommons.org/licenses/by/4.0)

ABSTRACT

Every nation depends upon exports and imports of goods and services. These goods and services are majorly done by the road ways. The idea of utilizing of Crumb rubber and glass fiber to enhance the properties and pavement performance of the selected asphalt mixtures. Crumb rubber and glass fiber with an additive dosage rate of 0.1% of binder content and 0.5% of aggregate content and increasing the stability and workability of bituminous mix. In order to improve the stability (i.e. bonding between aggregates and pavement) and pavement performance of asphalt mixtures, two varieties of admixtures (Crumb rubber and glass fiber) were selected and then combined. A series of tests about pavement performance of base asphalt mixtures and asphalt mixtures with admixture of Crumb rubber or glass fiber were conducted. 0, 0.1%, 0.2%, 0.3% , 0.4 and 0.5% Crumb rubber were added into base asphalt mixtures according to quality to evaluate the pavement performance and 0.5%,1.0%,1.5%,2.0%. and were added into base asphalt mixtures. The performance of asphalt mixtures modified with the optimum content of Crumb rubber and glass fiber were tested to evaluate the improvement of stability at high temperature and enhance the materials strength and fatigue characteristics of above mixtures. These results show that the stability and strength and pavement performance of asphalt mixtures improve obviously. The problem of improving the asphalt mixtures performance with a single admixture is solved, in addition to also improving other pavement performance.

Keywords: *Bitumen, Crumb rubber, Glass fiber, Pavement performance, Marshall Stability, Flow*

1. INTRODUCTION

1.1 General

Bitumen is a sticky and highly viscous liquid. It may be found in natural deposits or may be a refined product, Bitumen is a thermoplastic material and its stiffness is dependent on temperature. The temperature vs stiffness relationship of bitumen is dependent on the source of crude oil and the method of refining. It is assessed that the present world utilization of bitumen is roughly 150 million-tones every year. Around 80% of all the bitumen created is utilized as the cover as a part of black-top for streets. It is additionally utilized as a part of other cleared regions, for example, airplane terminal runways, auto parks and footways. Ordinarily, the creation of black-top includes blending sand, rock and smashed rock with bitumen, which goes about as the coupling operators. Different materials, for example, polymers or fibers may be added to the bitumen to modify its properties as indicated by the application for which the black-top is eventually proposed. 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 present research work tries to identify some of the issues involved in this art of bituminous mix design and the direction of current research. Asphalt concretes are widely used in pavements. Permanent deformation happens when pavement does not have sufficient stability, improper compaction and insufficient pavement strength. From practical experiences it is proved that the modification of asphalt binder with polymer additives, offers several benefits. To enhance various engineering properties of asphalt many modifiers such as styrene based polymers, polyethylene based polymers, polychloroprene, various oils have been used in asphalt.

The massive development of highways everywhere through the world was going ahead at present century. A good roadway infrastructure is the foundation of a solid stable financial. So the main aim of the project is to increase the life period and stability of the flexible pavement. As we know that the life period of the rigid pavement is more than flexible pavement But the cost of the rigid pavement is high and the cost of the flexible pavement is low and the strength of the flexible pavement is low .So to increase the strength and the reduce the maintenance we are using Crumb rubber and glass fiber. Glass fiber that is used in the study was the recycled from waste glass as we know all over India some million tons of glass is disposed outside every year in the form of bottles and jars. one answer for a part of the waste transfer issue is to reuse and utilize these material in the managing the developing issue of transfer of this material is an issue that requires coordination and duty by all gatherings development of highways however such an utilization ought not trade off the quality and execution of the roadway framework not bring about a domain issue.

1.2 Objectives:
The main objective of this study is to evaluate the performance characteristics of the bituminous concrete mix using of Crumb rubber and Glass fiber of different percentages of 0.1%, 0.2%, 0.3%, 0.4%, 0.5% by weight of bitumen and 0.5%, 1.0%,1.5%,2.0% and by weight of aggregates.

1. To know the stability and flow values for nominal mix and modified mixes with different proportions by conducting of Marshall Stability test.
2. To improve the bulk density of the mix.
3. To decrease the air voids percent in specimens of the mix.
4. To improve the percentage of VFB.

2. MATERIALS USED AND PROPERTIES:
2.1 Materials used
A. Aggregates

1. Coarse aggregates
2. Fine aggregates
3. Filler material

B. Bitumen

1. Bitumen VG-30
2. 3.1.3 Admixtures
3. Crumb rubber
4. Glass fiber

2.2 Properties of materials:
C. Coarse aggregates

1. Specific gravity - 3.0
2. Aggregate impact value - 19.01%
3. Aggregate crushing test value - 25.62%
4. Los angeles abrasion test value - 36.86%
5. Water absorption test value - 0.6%

D. Bitumen

1. Specific gravity - 0.99
2. Penetration test value - 61.76
3. Ductility test value - 76.47 cm
4. Softening point value - 62.45^{0}C
5. Flash - 210^{0}C
6. Fire point test value - 225^{0}C

3. METHODOLOGY
3.1 MARSHALL STABILITY TEST
The Marshall Stability and flow test values are helpful to the prediction of pavement performance measure for Marshall Mix design method. The Marshall Stability test of specimen measures the maximum load at a loading rate of 50.8mm/ minute.

PROCEDURE

In the Marshall Test method, all compacted samples are prepared for each additives content. All the compacted specimens are subjected to the following tests.

➢ **Marshall stability test**

The Marshall Mix design method was developed by Bruce Marshall Mississippi state highway department and it is applicable to hot mix design of bitumen and maximum size of aggregate used for this test is 2.5cm. In India, bituminous concrete mix is commonly designed by Marshall Method. It is extensively used in pavement performance works. The stability of a specimen is defined as a maximum load is carried by a compacted specimen at a standard temperature of 60^{0}C . The flow is measured as deformation in units of 0.25mm between no load and maximum load carried by a specimen at stability test.

Take 1300gms of aggregates and filler material is heated to a temperature of 175-190^{0}C. Bitumen is heated to a temperature of 120-125^{0}C with percentage of bitumen (say 4.0 to 6% by weight of mineral aggregates). The selected heated aggregates and bitumen are thoroughly mixed at a temperature of 150-160^{0}C. Later, the mix is placed in a preheated mould and compacted by a rammer with 75 blows on either side at temperature of 135-150^{0}C. The weight of aggregates and bitumen taken for the preparation of the specimen may be suitably altered to obtain a compacted thickness of 63.5+/- mm. The prepared mould is loaded in the Marshall Stability test. The sample is taken out of the mould after few minutes using sample extractor.

3.1.1 Sample preparation:
Take 1300gms of aggregates and filler material is heated to a temperature of 175-190^{0}C. Bitumen is heated to a temperature of 120-125^{0}C with percentage of bitumen (say 4.0 to 6% by weight of mineral aggregates). The selected heated aggregates and bitumen are thoroughly mixed at a temperature of 150-160^{0}C. Later, the mix is placed in a preheated mould and compacted by a rammer with 75 blows on either side at temperature of 135-150^{0}C. The weight of aggregates and bitumen taken for the preparation of the specimen may be suitably altered to obtain a compacted thickness of 63.5+/- mm. The prepared mould is loaded in the Marshall Stability test. The sample is taken out of the mould after few minutes using sample extractor.

3.1.2 CALCULATION OF OPTIMUM BINDER CONTENT:

Table: 1 shows the results of different bitumen percentages

% of bitumen	Wt of bitumen (gm)	Height (Cm)	Wt of specimen		G_m	G_t	V_v	V_b	VMA	VFB	Proving ring reading	Stability value	Flow value
			In air (W_a)	In water (W_w)									
4.5	58.5	5.7	1341	800	2.48	2.68	7.37	10.78	18.15	59.385	110	596.42	5.75
	58.5	5.8	1345	800	2.47	2.68	7.78	10.73	18.51	57.98	110	571.36	5.92
	58.5	5.7	1345	800	2.47	2.68	7.78	10.73	18.51	57.98	105	569.31	6.1
Avg					**2.47**	**2.68**	**7.644**	**10.750**	**18.395**	**58.449**		**579.03**	**5.92**
5.0	65	5.9	1355	810	2.49	2.655	6.340	11.959	18.299	65.352	230	1142.274	5.52
	65	5.9	1346	800	2.47	2.655	7.133	11.858	18.990	62.440	210	1042.946	5.7
	65	6.0	1353	810	2.49	2.655	6.134	11.985	18.119	66.146	230	1142.274	6.2
Avg					**2.48**	**2.655**	**6.536**	**11.934**	**18.470**	**64.613**		**1109.165**	**5.81**
5.5	71.5	5.8	1359	820	2.52	2.634	4.261	13.277	17.539	75.703	255	1324.528	4.0
	71.5	5.8	1359	820	2.52	2.634	4.261	13.277	17.539	75.703	255	1324.528	3.6
	71.5	5.8	1358	820	2.52	2.634	4.154	13.29	17.446	76.190	240	1246.615	3.65
Avg					**2.52**	**2.634**	**4.226**	**13.282**	**17.508**	**75.865**		**1298.557**	**3.75**
6.0	78	6.0	1362	830	2.56	2.613	2.026	14.638	16.664	87.841	220	1092.61	6.41
	78	5.9	1359	830	2.57	2.613	1.688	14.688	16.376	89.694	205	1018.114	6.2
	78	5.9	1359	830	2.57	2.613	1.688	14.688	16.376	89.694	205	1018.114	5.75
Avg					**2.57**	**2.613**	**1.801**	**14.672**	**16.472**	**89.069**		**1042.946**	**6.12**

4. EXPERIMENTAL RESULTS

Table 2 shows the average results of crumb rubber in bitumen

% Of Crumb Rubber In Bitumen	G_m	G_t	V_v	V_b	Vma	Vfb	Stability Value	Flow Value
0.1	2.48	2.63	5.50	13.10	18.61	70.45	1126.05	5.03
0.2	2.52	2.63	4.28	13.27	17.56	75.66	1233.33	5.60
0.3	2.55	2.63	3.39	13.40	16.78	79.81	1255.71	4.67
0.4	2.50	2.63	4.72	13.21	17.93	73.85	1299.21	3.82
0.5	2.49	2.63	5.31	13.13	18.33	71.19	1228.69	6.06

Table 3 shows the average results of 0.3% crumb rubber in bitumen and selected percentage of glass fiber in aggregates

% Of Crumb Rubber In Bitumen	% Of Glass Fiber In Aggregates	Gm	Gt	V_v	V_b	VMA	VFB	STABILITY VALUE	FLOW VALUE
0.3	0.5	2.49	2.63	5.41	13.12	18.53	70.82	1125.71	5.18
0.3	1.0	2.51	2.63	3.89	13.25	17.67	75.07	1233.32	4.64
0.3	1.5	2.53	2.63	3.57	13.37	16.94	78.91	1473.36	4.65
0.3	2.0	2.54	2.63	3.39	13.39	16.78	79.81	1240.52	6.19

Table 4 shows the average results of 0.4% of crumb rubber in bitumen and selected different percentages of glass fibers in aggregates

% OF CRUMB RUBBER IN BITUMEN	% OF GLASS FIBER IN AGGREGATES	G_m	G_t	V_v	V_b	VMA	VFB	STABILITY VALUE	FLOW VALUE
0.4	0.5	2.49	2.63	5.49	13.10	18.60	70.64	1274.71	5.41
0.4	1.0	2.51	2.63	4.47	13.25	17.72	74.91	1489.92	4.50
0.4	1.5	2.53	2.63	4.10	13.30	17.40	76.45	1774.68	3.92
0.4	2.0	2.54	2.63	3.51	13.38	16.91	79.17	1233.32	5.12

5. RESULTS AND DISCUSSIONS
5.1. Marshall Stability Results:
Increase in stability values as the and fiber content increases in the mix up to optimum zycotherm and fiber content in the mix and later decrease in stability values as the Crumb rubber and fiber content increase in the mix. But we can not say in the same manner in case of flow values.

5.2 Flow value results:
The increase of Crumb rubber and fiber content in the mix does not necessarily increase the flow values. The increase of the Crumb rubber and fiber content in mix decreases the stability value and the more fiber and Crumb rubber add the lower is the stability, but this is not the case for the flow value.

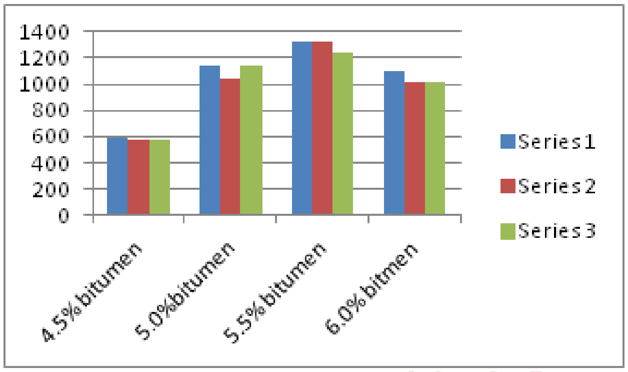

Figure1. Stability values for different mix proportions of bitumen (for OBC)

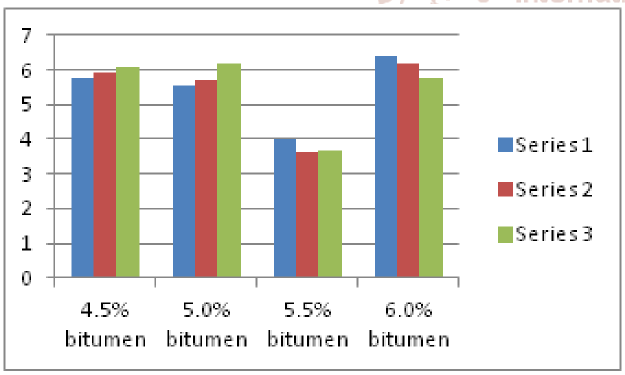

Figure2. Flow values for different mix proportions of bitumen (for OBC)

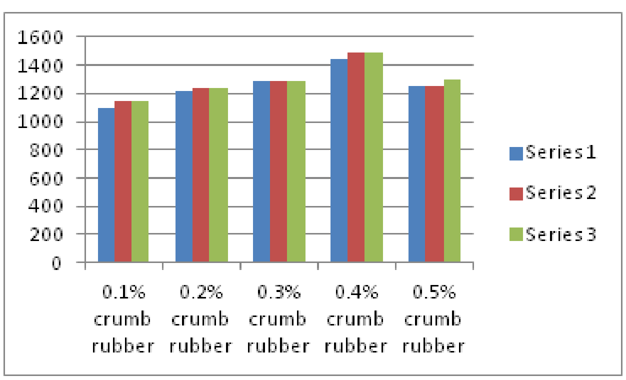

Figure:3 stability values of different percentages of crumb rubber in binder

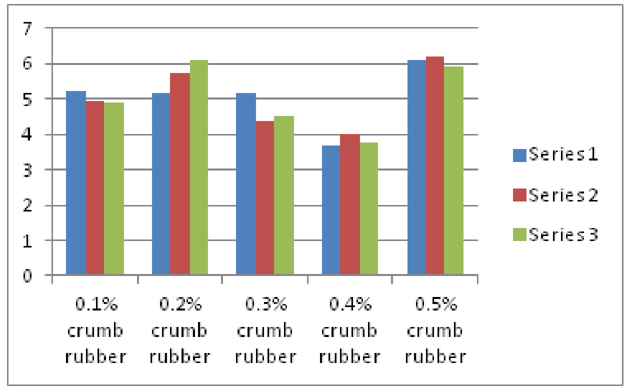

Figure: 4 flow values for different percentages of crumb rubber in binder

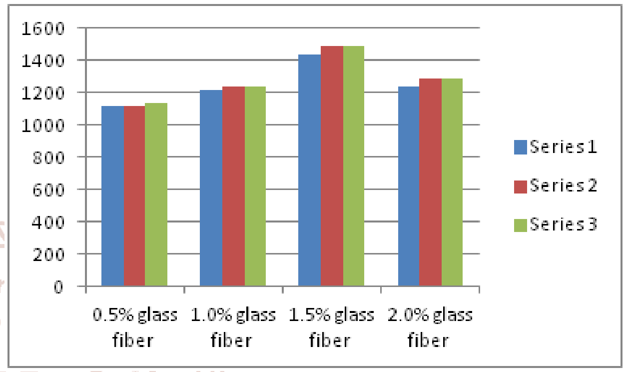

Figure: 5 stability values for 0.3% of crumb rubber in binder

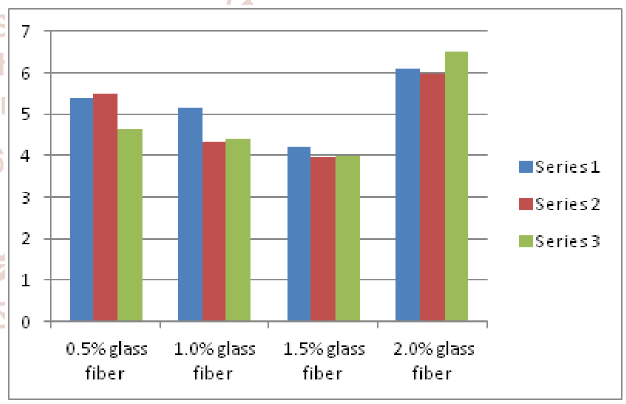

Figure: 6 flow values for 0.3% crumb rubber in binder

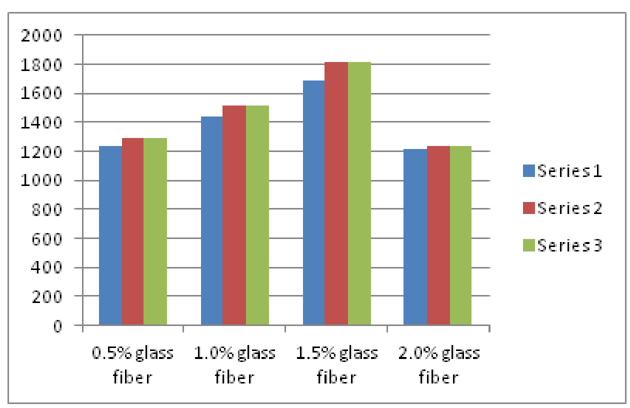

Figure: 7 stability values for 0.4% crumb rubber in binder

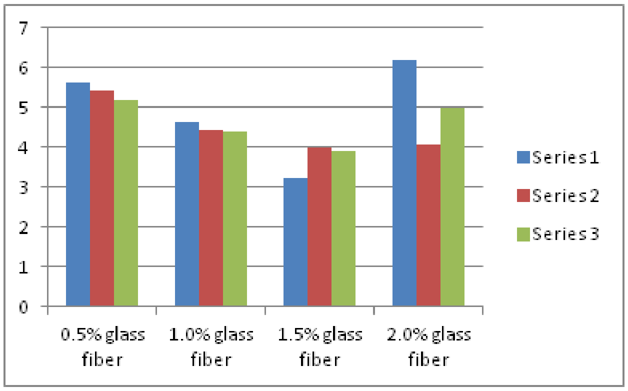

Figure: 8 flow values for crumb rubber in binder

6. CONCLUSIONS

1. This thesis is intended to develop the relationship between the normal asphalt mix and the asphalt mix which developed by the concept of crumb rubber used as admixture in binder.
2. The Marshall stability values which obtained by adding the admixtures were increased, when compared with the Marshall stability values of normal asphalt concrete mix.
3. The whole experimental study was carried under OBC 5.5%, since the Marshall stability and Flow value for the mix was considerably nominal when compared with 4.5%, 5.0% and 6.0% of bitumen contents in the mixes.
4. The study was carried under various percentages of Crumb rubber and glass fiber which are tabulated and shown in the above chapters. Due to the addition of admixtures like Crumb rubber and Glass fiber to the normal asphalt concrete mix, the Marshall values were increased from 1298.55 kg.
5. The value of optimum parentage of admixture is 0.4% of Crumb rubber and 1.5% of Glass fiber, at which the stability and flow values are 1841.35 kg.
6. Therefore from the above values it is clear that the load carrying capacity values of pavement will get increase. Not only the increment in load values and the overall performance of the pavement but also the maintenance cost of the pavement will get reduce even though the initial cost is somewhat high.

7. REFERENCES

[1] Bindu, C.S. Beena, K.S. (2010). "Waste plastics as stabilizing additive in Stone Matrix Asphalt", International Journal of Engineering and Technology, Vol.2(6), 379-387

[2] IRC SP-53:2010, "Guidelines on use of modified bitumen in road construction"

[3] IRC SP: 53-2002, 2004, 2010 "Guidelines on use of Polymer and Crumb Rubber Modified binders

[4] Ministry of Road Transport and High Ways, Manual for construction and supervision of Bituminous works, New Delhi, November 2001.

[5] Ministry of Road Transport and Highways Specification (2010)

[6] R. Vasudevan, S. K. Nigam, R. Velkennedy, A. Ramalinga Chandra Sekar and B. Sundarakannan, Utilization of Waste Polymers for Flexible Pavement and Easy Disposal of Waste Polymers, Proceedings of the International Conference on Sustainable Solid Waste Management, 5-7, Chennai, India, September (2007) pp. 105-111