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EXPERIMENTAL STUDY ON BITUMINOUS CONCRETE MIX BY USING FIBER GLASS REINFORCED PLASTIC AND SURKHI

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Abstract: Road and transportation are pivotal to the nation's growth of industrialization, infrastructure and massive production. Mostly National high ways, State high ways, Express ways and Air run ways (In terms of flexible pavements) are constructed by Petroleum derived products such as Asphalt/ Bitumen. As flexible pavement is majorly used in India, it is important that steps have to be taken to increase the life of the bituminous pavements. Pavements are always prone to distress such as cracking, potholes, permanent deformations and surface wear due to repeated traffic loads. Modification of bitumen mix is one of the approaches to improve the pavement performance. This paper explores the optimum use of fibre glass reinforced plastic (FGRP) as a partial replacement of fine aggregate, surkhi (as mineral filler) used to improvise the engineering properties of bituminous paving mixes.

1.Introduction

Throughout the growth of human society, transport plays a major role. This will cause industrialization, infrastructure and significant output growth for the country. Roadway is the country's central segment of a strong and stable economy. Transportation has quick, high traffic activity and significant load, globalized traffic movement due to rapid population growth. We know the maximum road transport network made of flexible pavements constructed by goods extracted from petroleum such as asphalt / bitumen. This project is accompanied by Surkhi powder as a filler material which has a particle size of less than 75 microns in a mixture. This will fill the vacuums in coarse aggregates which are used to increase the density, stability and strength of a traditional tar mixture. By partially replacing the aggregate with FGRP, we can increase mechanical strength and resistance to wheel load damage. The use of modified bitumen with additives such as surkhi powder and FGRP decreases the different forms of distress.

2.Literature Review

Sumi S and N Unnikrishnan have concluded that the importance of natural fibres, as well as the application of natural fibers in engineering projects ranges from light weight composites to ground engineering applications, has resulted in the development of a broad range of modification techniques to carry them up to and even higher.

Saswat Biswa priya Dashet.al, investigated that increases the content of fiber The length of the fibers decreases upto a value of a certain amount, air freeze and value indicating the flow, while in the case of a prescribed mixture by increasing the marshall quotient increases. That later is a strong indicator of the routing

power of bitumen/ asphalt pavement mixes types. The IST test shows that the ITS sample increases by adding emulsion coated fibres and carbon ash to allow DBM the samples withstand heat cracking. It was an excellent engineering product. The utility of the emulsion coated fiber or carbon ash / both in DBM blends, improves moisture and resistance to TSR damage and sustained stability is also observed. This research considers the

effects of certain emulsion forms, such as RA and MS emulsion, to be regarded only as the coating medium on sisal fibre, and subsequent tests should be carried out for future studies. Emulsions are regarded as a coating medium on sisal fibre.

D.B. Eme et.al, The goal of their work was to define the suitability of an asphalt cement concrete mix with the use of plastic pellets as a partial substitute for the aggregate. The purpose of their paper was to classify the suitability of the asphalted cement mix. I have found from their analysis that the use of plastic pellets in asphalted concrete as part replacement for groove aggregates is most effective at 2 to 4 percent.

3.Details of the Study:

3.1 Aggregates

In bituminous mix, aggregates play a key role. The overall combination by consideration of the weight of the blend was applied to limit of average load bearing and the strength features added to the blend. The characteristics like physical and quality related properties of these aggregates are therefore significant for paving. In bituminous mixes, three kinds of mineral aggregates are used and are indicated below.

3.2 HOT MIX ASPHALT

Grade of viscosity 30 bitumen (VG-30) was used in this study under the property of binding.

The

bitumen should not be very sensitive to temperatures because the mix is too soft during

the warmest weather and too brittle during cold weather which can lead to cracking. Bitumen

viscosity should be sufficient when combined and compacted. VG-30 BITUMEN: VG-30 is used primarily to

Properties of Aggregates	Standard specification	Test Result			
		Aggregate coarser size	Aggregate finer size	FGRP	Surkhi
Impact value of aggregate, %	IS:2386 part-IV	14	-	-	-
Crushing value of aggregate	IS:2386 part-IV	13.5	-	-	-
Abrasion value of aggregate, %	IS:2386 part-IV	18	-	-	-
Soundness test (five cycle in sodium sulphate), %	IS:2386 part-V	3	2.5	-	8.2
Flakiness index, %	IS:2386 part-I	11.9	-	-	-
Elongation index, %	IS:2386 part-I	12.5	-	-	-
Water absorption, %	IS:2386 part-III	**1.8%**	1.5%	-	0.4 %
Specific gravity	IS:2386 part-III	2.74	2.57	0.90	2
Apparent specific gravity	IS:2386 part-III	2.52	2.65	1.86	2.1

create heavy Bitumen extra flooring which has to withstand large traffic loads. It can be used for 60/70 degrees of penetration.

Table 2: PROPERTIES OF HOT MIX ASPHALT

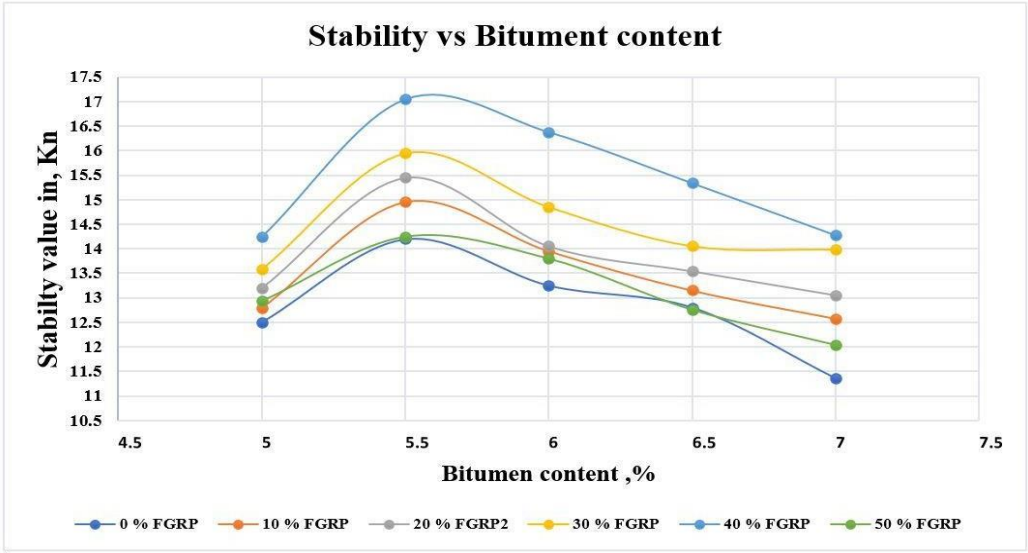
Physical Properties	IS Code	Test Result
Penetration at 25°C/100gm/5s, 0.01mm	IS:1203-1978	46
Softening Point, °C	IS:1205-1978	46.5
Specific gravity, at 27°C	IS:1203-1978	1.01
Absolute viscosity, Brookfield at 160°C, Centi Poise	ASTM D 4402	200
Flash point	IS : 1209-1978	160 °C

3.3 Marshall Test

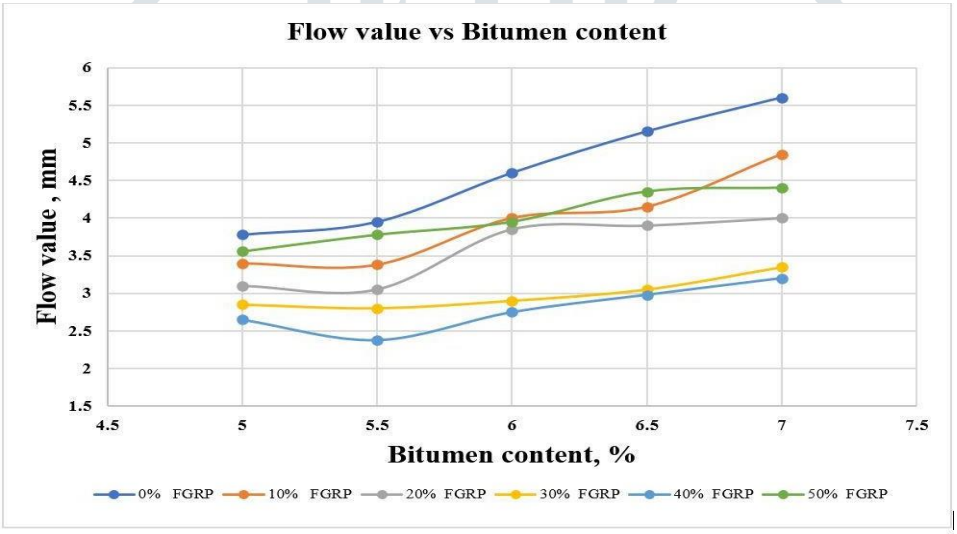
The Marshall Stability and Flow Test provides the performance prediction for the design method of the Marshall Mix. The test stability component tests full load with a load rate of 50,8 mm / minute assisted by the experimental test specimen and 42 temperatures at 60 cm.

Table 3: Marshall test results

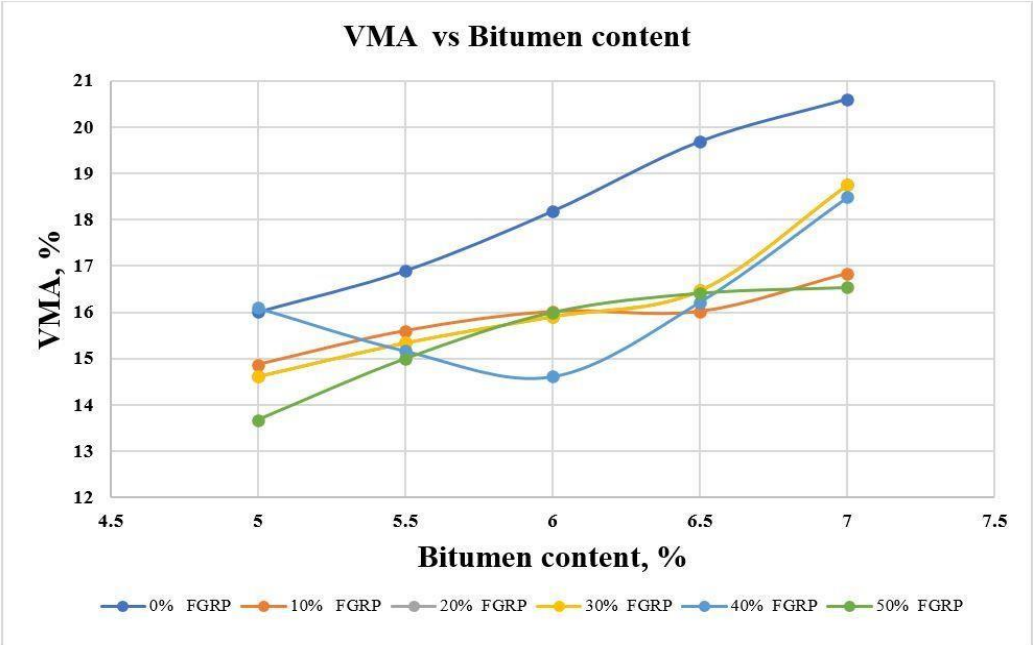
Marshall properties analysis									
FGRP CONTENT	**Bitumen content**	**Gt**	**Gm**	**Va (%)**	**Vb (%)**	**VMA (%)**	**VFB (%)**	**Flow value , mm**	**Stability ,Kn**
0% FGRP	5	2.31	2.20	4.39	11.61	16.00	72.52	3.78	12.5
	5.5	2.29	2.17	5.11	12.58	17.69	71.10	3.95	14.2
	6	2.27	2.17	4.45	13.73	18.18	75.52	4.6	13.25
	6.5	2.26	2.14	4.99	14.68	19.68	74.60	5.15	12.8
	7	2.24	2.13	4.86	15.73	20.60	76.37	5.6	11.35
10% FGRP	5	2.28	2.19	4.18	10.68	14.86	71.85	3.4	12.8
	5.5	2.27	2.18	3.94	11.65	15.59	74.68	3.38	14.95
	6	2.25	2.18	3.37	12.64	16.01	78.95	4	13.95
	6.5	2.26	2.18	3.37	12.64	16.01	78.95	4.15	13.15
	7	2.23	2.18	2.23	14.60	16.83	86.75	4.85	12.58
20% FGRP	5	2.26	2.17	3.98	10.57	14.55	72.65	3.1	13.2
	5.5	2.25	2.18	3.41	11.57	14.97	77.26	3.05	15.45
	6	2.24	2.17	2.84	12.56	15.39	81.57	3.85	14.05
	6.5	2.22	2.17	2.27	13.54	15.81	85.62	3.9	13.54
	7	2.21	2.17	1.72	14.51	16.22	89.42	4	13.05
30% FGRP	5	2.23	2.14	4.20	10.40	14.61	71.21	2.85	13.58
	5.5	2.22	2.13	3.99	11.34	15.33	73.98	2.75	15.95
	6	2.21	2.13	3.61	12.29	15.90	77.30	2.9	14.85
	6.5	2.19	2.13	3.24	13.23	16.46	80.34	3.05	14.05
	7	2.18	2.07	4.88	13.85	18.74	73.93	3.35	13.98
40% FGRP	5	2.20	2.08	5.25	10.15	15.40	65.88	2.65	14.25
	5.5	2.19	2.10	3.88	11.20	15.08	74.27	2.38	17.05
	6	2.18	2.13	2.31	12.29	14.61	84.15	2.75	16.38
	6.5	2.16	2.09	3.15	13.06	16.22	80.57	2.98	15.34
	7	2.15	2.05	4.78	13.69	18.48	74.08	3.2	14.28
50% FGRP	5	2.17	2.06	3.47	10.20	13.67	74.62	3.56	12.93
	5.5	2.16	2.07	3.94	11.05	14.99	73.70	3.78	14.25
	6	2.15	2.06	4.08	11.91	15.99	74.48	3.95	13.8
	6.5	2.14	2.06	3.56	12.84	16.41	78.26	4.35	12.75
	7	2.13	2.07	2.72	13.81	16.53	83.53	4.4	12.03



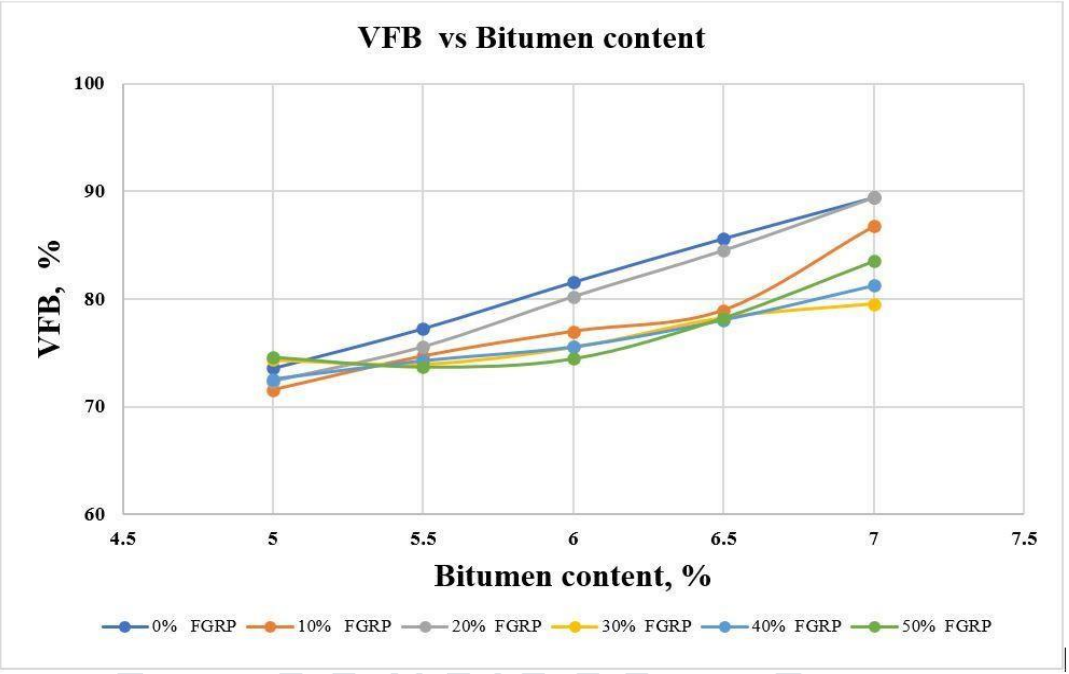
Graph 1. Variation of Stability value with bitumen content at different % of FGRP content



Graph 2. Variation of flow with bitumen content at Different % of FGRP content



Graph 3. Variation of VMA value with bitumen content at different % of FGRP content



Graph 6. Variation of VFB value with bitumen content at different % of FGRP content

4.Conclusions

Based on the experimental studies conducted in the present work, the following conclusions are drawn.

1. The optimum sample binder content produced using FGRP was found to be 5.7 percent in the stability diagrams.
2. The stability versus bitumen graph reveals that the marshal stability value rises to 40 percent with partial substitution of the fine aggregate by FGRP When 40 percent of the FGRP by weight of the fine unit with 5.5% bitumen material; a maximum stability value of 17.05 kN was achieved.
3. It has been found that with 40 percent FGRP mix fewer flow values were available than with the conventional mix. It has also been found that the flow value increased to 58.82% after 40% FGF (i.e. 2,38 mm) of 10% FGRP (i.e. 3.78) with a mixture increase.
4. Increasing the bitumen content reduces the VA of the Marshall sample as bitumen replaces the air vacuums in the mix and the VFB increases as the bitumen content increases.

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