Effect on Cement and Coir Fiber In The Property of Bituminous Concrete on Stone Mix Asphalt

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Abstract- *Bitumen as binding material has been used widely in the world wide for pavement construction from many years, because of their excellent binding characteristics and water proofing property. In bituminous mix design the strength of the mix design depends upon the gradation of aggregate also or can say all the constituents material that are used in the mix design. In the present era coarse aggregate, fine aggregate, mineral filler or natural filler are used as bituminous constituents to improve the strength characteristics of the bitumen mix. As the filler material there are several waste material like slag, fly ash, stone dust, cement and different fibers as sisal fiber, coir fiber, jute etc are being used widely.*

In the Stone Mix Asphalt (SMA) mixture is a gap graded mix in which coarse aggregate content, Asphaltic content and some additives like fibers as stabilizers are used. In SMA stone on stone make a contact in the presence of high filler content it acts as a stiff material and is best suitable for high traffic volume specially in urban road pattern where braking effects are more. In the present study coir fiber and cement are used to the mix and its property is investigated

Keywords- Bituminous Concrete Mix, Marshall Stability Test, Drain down test Optimum Bitumen Content, Optimum Fibre Content

I. INTRODUCTION

Construction of highway involves huge outlay of investment. A methodical engineering design can be save the considerable investment amount. It also provides the reliable performance of the in-service highway and can be achieved. There are two things that are of major considerations in flexible pavement engineering–pavement design and the mix design. This study is related to the mix design considerations. Mix design gives a balance between mutually irrelevant parameters. Bitumen mix design is a critically make among the proportions of various aggregate sizes and bitumen content. For the given aggregate gradation and bitumen content, the optimum bitumen content is calculated by satisfying a number of mix design parameters.

A good bituminous mix design is expected to give 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 Highway engineer tries to achieve these requirements through a number of tests of mix with different proportion of bitumen and aggregate gradation and finalizes with the best one.

1.2 OBJECTIVE OF THE STUDY:

- Utilize the waste material as coir fiber which is easily available in local areas to improve the property of mix.
- This experimental study has been done to enable the use of cement and coir fiber to ensuring the adequate performance result in fatigue and creep value.
- In this study the possible effect of coir fiber are taken in to the consideration.
- To determine the drain-down test while using the coir fiber with cement.

II. REVIEW OF LITERATURE:

Ravi Shankar et al. (2009) he used stone dust as well as cement as the filler material for SMA mixes. They used a filler content of 10% by dividing it into 8% stone dust and 2% cement and for their studies used conventional 80/100 penetration bitumen in their performance study of SMA mixtures using waste plastics as modifier.

T. Subramani , (2012) used coir fiber as the stabilizing agent in SMA mix and found that fibre reinforcement in bituminous mixes will lead to an economic mix with lower binder content. And There was a significant increase in the Marshall stability value on addition of coir fibre. This addition of coir fubre results in an increase in stability by nearly 13% that will help achieve stronger pavement sections.

Kabir et al. (2011) carried out a study to investigate the effects of natural fibre surface on composite properties are discussed. Several fiber surface modification methods are reported and their effects on composite properties are analyzed. These properties constitute the prime area of research in developing green fiber polymer composite technologies

III. MATERIAL USED AND THEIR PROPERTY

In this research study of SMA cement, coir fiber is used with natural and mineral aggregate. Following are the details of material-

(a) Coarse Aggregate- the aggregate with size less than 20 mm and more than 4.74 mm are consider as coarse aggregate. The Sp. Gravity of coarse aggregate is 2.8
(b) Fine Aggregate the aggregate with size less than 4.7mm and more than 0.075 mm are consider as fine aggregate. The Sp. Gravity of coarse aggregate is 2.68.
(c) Cement- use ordinary Portland cement as a filler with specific gravity of 3.15.
(d) Coir fiber- it is a fruit fibre generally found from the coconut fruit. It is waste material and easily available in local areas.
(e) Bitumen- the main material of flexible pavement. In this study VG-30 grade bitumen are utilized.

IV. HOT MIX ASPHALT (HMA)

This is a well graded aggregate asphalt mix used in flexible pavement not only India but all the word. Semi dense graded bitumen mix, dense graded bitumen mix and Stone mastic asphalt are the common part of HMA.

Stone mastic Asphalt- this is abbreviated form of SMA. This is well graded aggregate mix. In SMA mix design bitumen concrete the part of coarse aggregate is more as 70-80%. For the maximum use of coarse aggregate there is more air space are available, for filling this space finer particle and fillers are used. In the SMA mix design 70%-80% coarse aggregate 7-15% fine aggregate and 4-6% fillers are utilized. SMA is very useful for the country like India where heavy traffic load are available maximum time. It has a strong capacity to resist the rutting resistance. With the use of filler it is more workable as well as durable and has high shear strength.

V. METHODOLOGY USED

In the research work, beyond the convention test on bitumen and aggregate Marshall test and Draindown test are taken into consideration.

Marshall test:

- The proportioned coarse aggregate, fine aggregate, quarry dust and filler material was weighed and heated together in a pan at temperature of 175 degree Celsius.
- The required quantity of first trial percentage of bitumen is heated to a temperature of 145 degree Celsius and is added to the heated aggregate.
- The above mix is thoroughly mixed at the desired temperature of 160 degree Celsius.
- The mix is placed in a cylindrical mould of 10.16 cm dia and 6.35 cm height and compacted by a hammer with 75 blows on either side at a temperature of 160 degree Celsius.
- Three specimens are prepared for each trial bitumen contents.
- Compacted specimens are cooled to room temperature in the moulds for 24 hour and then removed from the moulds using a specimen extractor.

The diameter and mean height of the specimen are measured and then they are weighed in air and also suspended in water. Then determine the bulk gravity of the test specimen

Figure5.1 Marshall Stability Test in Progress

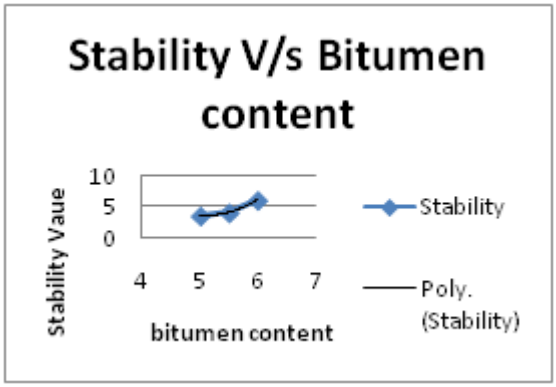
Table 5.1 Test on Bituminous Mix- Marshall Stability Test

S.no	Bitumen % by weight of aggregate	Dry Weight	Wet weight	Gm
1	5	1255	760	2.53
2	5	1296	771	2.46
3	5	1253	759	2.54
Avg				**2.51**
1	5.5	1161	726	2.67
2	5.5	1234	733	2.46
3	5.5	1239	723	2.41
Avg				**2.51**
1	6	1241	746	2.51
2	6	1249	787	2.49
3	6	1249	740	2.45
Avg				**2.48**

Stability test with cement used.

Table 5.2 Stability And Flow Value Of Mix

S. n.	Bitumen content	Stability value	Correction factor	Corr. stability value	Avg stability value	Flow Value	Avg Flow Value	Vv
1	5	26.23	1.00	26.13	27.28	4.52	3.46	4.5
2		18.5	0.97	27.47		2.21		
3		19.9	1.01	28.23		3.65		
1	5.5	29.72	0.96	28.61	29.83	5.02	3.97	5.7
2		30.33	1.00	30.38		3.20		
3		30.9	0.99	30.49		3.70		
1	6	21.7	1.03	22.33	21.77	5.65	5.99	6.5
2		21.99	1.00	21.98		5.70		
3		21.25	0.99	21.01		6.64		



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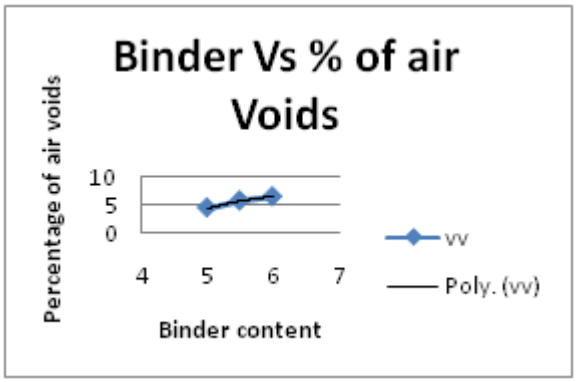

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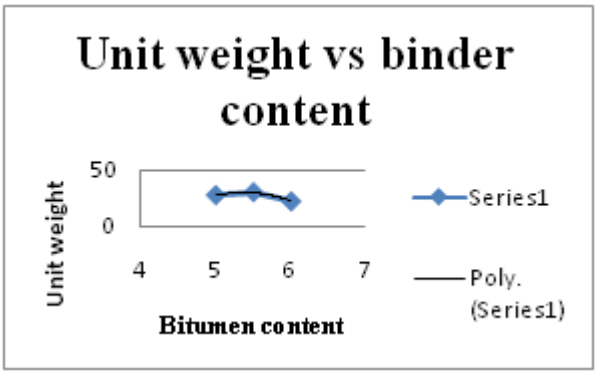


(c)

Figure 5.2
(a) graph Stability V/s Bitumen content
(b) Stability V/s Bitumen content
(c) Stability V/s Bitumen content

SELECTION OF OPTIMUM BITUMEN CONTENT

The optimum bitumen content for the mix design is found by taking the average value of the following three bitumen contents found from the graph:

- Binder content for maximum unit weight = 5.33%
- Binder content for maximum stability = 5.41%
- Binder content corresponding to 4.5% voids = 5%

The Optimum Bitumen Content = 5.25%

EFFECT OF COIR IN MARSHAL STABILITY TEST

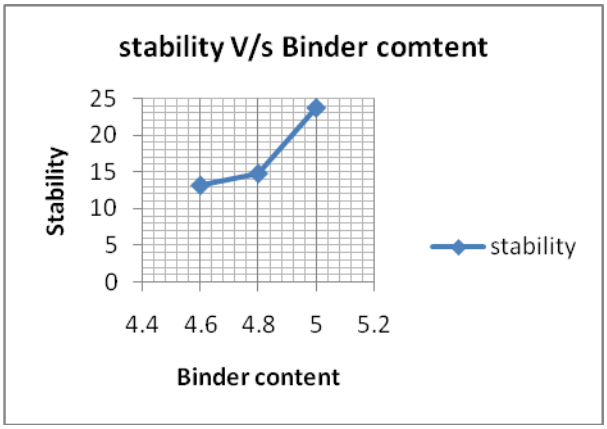
Table 5.3 Bulk gravity of specimen after adding coir fibre

Coir%	Binder %	Dry wt w1	wet wt w2	Gm	unit wt
0.3	4.95	1231	730	2.45	
		1247	743	2.46	
		1260	740	2.42	
				2.44	**2447.95**
0.5	4.75	1257	750	2.47	
		1281	756	2.43	
		1283	754	2.42	
				2.44	**2442.55**
0.7	4.55	1287	753	2.40	
		1266	736	2.38	
		1257	732	2.39	
				2.39	**2392.55**

Fig 5.3 Specimen to be tested after adding coir fibre

Table 5.4: Stability And Flow Value of Mix

Specimen No:	Bitumen Content	Stability value	Correction factor	Corrected Stability	Average Stability Value	Flow Value	Average Flow Value
1	5.0	14.7	**1.03**	15.1520		5.35	
2		16.50	**0.97**	27.5854	23.6422	6.30	5.17
3		13.3	**1.01**	28.1890		3.87	
4	4.8	22.90	**0.99**	22.7497		2.06	
5		11.10	**0.99**	11.0112	14.7846	5.75	4.37
6		10.70	**0.99**	10.5930		5.29	
7	4.6	13.30	**0.99**	13.1504		3.53	
8		11.80	**0.97**	11.4755	13.2008	6.90	5.69
9		15.40	**0.97**	14.9765		6.64	



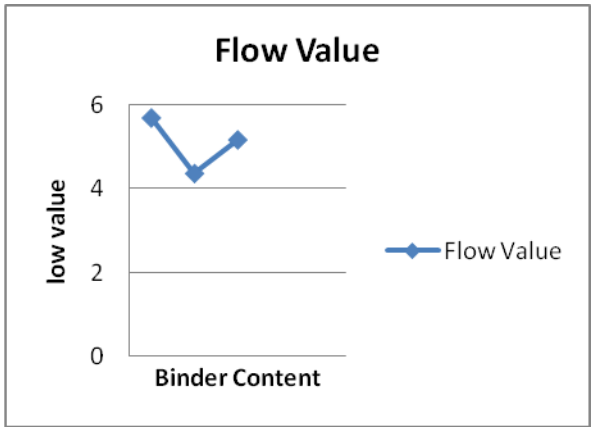


Figure Graph Stability V/s Binder And Flow Value after adding fiber

From The graph and table it is observe that 5% of bitumen and 0.3% of fiber content gives the better Marshall Stability Value and the flow has been decreased. From The study and investigation it is indicated that the mixture have higher stability.

DRAINDOWN CHARACTERISTICS

SMA mixes are very good in binder, which provides durability to the mix. A major problem that has been seen with SMA mixes is that drain-down of the binder from the mix when heating resulting in bleeding and formation of fat spots. Therefore the to check the drain-down characteristics of the SMA mixes the mix prepared at their OBC and OFC were verified using the MORTH (2001) specifications as described in chapter 4. Here the results of the drain-down tests are discussed.

Given below table shows the results of the drain-down tests carried out on mixes without fiber and with three different percentage of binder and estimated by using Equation. This is observed from the results that for SMA mixes with 60/70 bitumen the drain-down is 0.005%.

When SMA mixes sample with coconut fiber were prepared at their OBC and OFC are subjected to MORTH drainage test it was observed that there is no drain-down of binder for any of the mixes. Therefore addition of the fiber improved the drain-down characteristics of SMA mixtures.

VI. CONCLUSION

It is observed that with the increase in binder content, the Marshall Stability value decreases. It also depends on the fiber content in the mix i.e. an increase in fiber content increases the stability value as long as its amount is .3% but

with further increase in fiber content i.e. .5%, its value decreases.

- The flow value increases with increase in binder content and when fiber is added to the mix the flow value decreases and after .5% fiber content, it increases. A higher fiber concentration in the mix increases its flow value.
- The unit weight increases with the increase in binder content up-to a certain binder content and thereafter decreases. The unit weight also depends on the fiber content of the mix. When fiber was added to the mix, its unit weight decreases compared to the mix with no fiber.

Coconut fiber is a low cost and abundantly available natural fiber. It has been used in the bituminous mixes. The OBC are found to reduce considerably by addition of fibers, which is an important advantage from economy and quality point of view

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