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Experimental Study on Bitumen Content and Pavement Design

Kishor S. Tupe¹, Prathamesh P. Puri², Kuldip J. Jagdale³, Ashutosh A. Kadam⁴,
Dnyaneshwar M. Jade⁵

U. G Student, Department of Civil Engineering, Sinhgad Academy of Engineering, Pune, India^{1,2,3,4}

Assistant Professor, Department of Civil Engineering, Sinhgad Academy of Engineering, Pune, India⁵

ABSTRACT: Bitumen is one of the binder materials used in the construction of roads and pavement and has increased prices and costs to achieve it. As a result of increasing economic and traffic load, road bitumen structures designed should have the durability and capability services play a key role in the communication network, the most important. The objective of this study is to reduce the quantity of bitumen used and coconut charcoal shells with SMA. Therefore, many efforts have been undertaken to improve the quality of the existing bitumen. In this study, bitumen grade is done with the addition of various charcoal shell powder percent content. The percentage of coconut shell charcoal used is 3.1%, 3.3%, 3.5%, 3.7%, and 3.9% by weight of material. Overall analysis will show, that the addition of coconut shell charcoal in the mixture can enhance the capability of the mixture to pave flexibly.

KEYWORDS: SMA Mix, Coconut shell charcoal, Filler, Binder, Marshall Stability.

I. INTRODUCTION

Generally, aggregates mixed with bitumen are widely used all over the world for the construction & maintenance of flexible pavements. The close and well-uniform, or dense graded aggregates mixed with normal bitumen generally perform very well in heavily trafficked roads therefore they are very common in paving industries. To form dense graded aggregate, it is very difficult to arrange aggregates of different sizes which are found in sites. In such a situation, a bituminous mix known as **Stone Matrix Asphalt** (SMA) consisting of gap-graded aggregates can be used.

As the Coarse aggregate content is high in SMA Mix, it forms a skeleton-type structure which provides good resistance for rutting. Brown & Manglorkar (1993) reported that traffic loads for SMA are mainly carried by the coarse aggregate instead of the fine aggregate asphalt mortar. The higher content of the binder makes the mix durable. The fibers or stabilizer holds the binder in the mix even at a high temperature; this helps prevent factors like drainage during operations such as production, transportation, and laying.

SMA is more cost-efficient than dense-graded mixes for roads with high volumes. Brown (1992) observed several influencing factors for the performance of SMA mixes, such as Changes in binder source & grade.

- Type of aggregate
- Environmental condition
- Production & construction

Therefore, SMA is defined as a gap-graded Hot Mix Asphalt designed to maximize deformation (rutting) resistance & durability by using a stone-on-stone contact structure. As aggregates are all in contact, rut resistance depends on aggregates property rather than asphalt binder property. Since the aggregate does not deform much as asphalt binders, the stone-on-stone contact significantly reduces the rutting underloading

II. AIM & OBJECTIVE

The main aim is, "To find out optimum binder Content using Marshall Stability Method."

Objective is,

1. The main objective is to check the suitability of Coconut shell charcoal as filler in SMA Mix and then compare its properties obtained with different types of fillers and then study its effect on different properties of SMA Mix.
2. Study different Marshall Properties using different fillers (Stone dust, Portland cement, Fly ash, etc.) and then compare the results with Coconut shell charcoal as filler.



III. AREA OF STUDY

To achieve the above aim and objective, the scope of work generated as follows:

- The global warming the temperature is going on increasing and because of this increase in temperature, it adversely affects the road pavement.
- Because of the increase in temperature, the stability of bituminous road pavement decreases, and resultantly failure occurs in the pavement.
- To avoid this failure and increase the stability we can add the fillers to the bituminous mix.
- Coconut shell charcoal is economical and easily available.

To accomplish this particular work, define is explained in the detailed methodology.

IV. METHODOLOGY

The Aggregate used in the study is crusher Aggregate from Quarry and VG30 60/70 grade of Bitumen is used as a binder. First, Laboratory testing has been carried out to find the physical properties of Aggregate by conducting tests like Grain size analysis, Aggregate Impact Value, Abrasion Test, Crushing value test, Water absorption, Specific Gravity, etc.

Similarly, The Bitumen test for VG30 has been done including a Penetration test at 25 °C, Softening Point test, a Ductility test at 27 °C, Viscosity at 150 °C, and Specific Gravity, etc which satisfied the requirement of IS:73-2006.

Secondly, will prepare samples for the Marshall mix design and determine the Optimum binder content for VG30. After determining the OBC prepare sample at different % of filler. And based on this the Optimum Charcoal charcoal shell content has been determined.

V. LITERATURE REVIEW

Behnood, M. Ameri (2012) and others[1] conducted an Experimental investigation of stone matrix asphalt mixtures containing steel slag. According to the results obtained from Marshall Stability, it was found that mixtures with steel slag have shown encouraging results in comparison with those containing stone. Also, replacing the coarse portion of stone aggregate with steel slag leads to some better results in comparison with mixtures that contain steel slag as the fineportion

V.S., Sridhar R., Bose Sunil, Kumar K.K., Veera Raghavan A (2004) [2] Adopted Marshall mix design at 60°c using 75 blows of compaction per side and did a comparative study of SMA with asphalt concrete mix utilizing reclaimed polythene in the form of LDPE carry bags as stabilizing agent (3 mm size and 0.4%). The test results indicated that the mix properties of both SMA and AC mixture are getting enhanced by the addition of reclaimed polythene as a stabilizer showing better rut resistance, resistance to moisture damage, rutting, creep, aging, and better drain-down properties aswell.

Brown and Haddock (1997 [3]) have remarked that because the strength of SMA relies mostly on the stone-on-stone aggregate skeleton, steps should be taken to design the mix and place it with a strong coarse aggregate skeleton that would provide the desired strength and stability to themix.

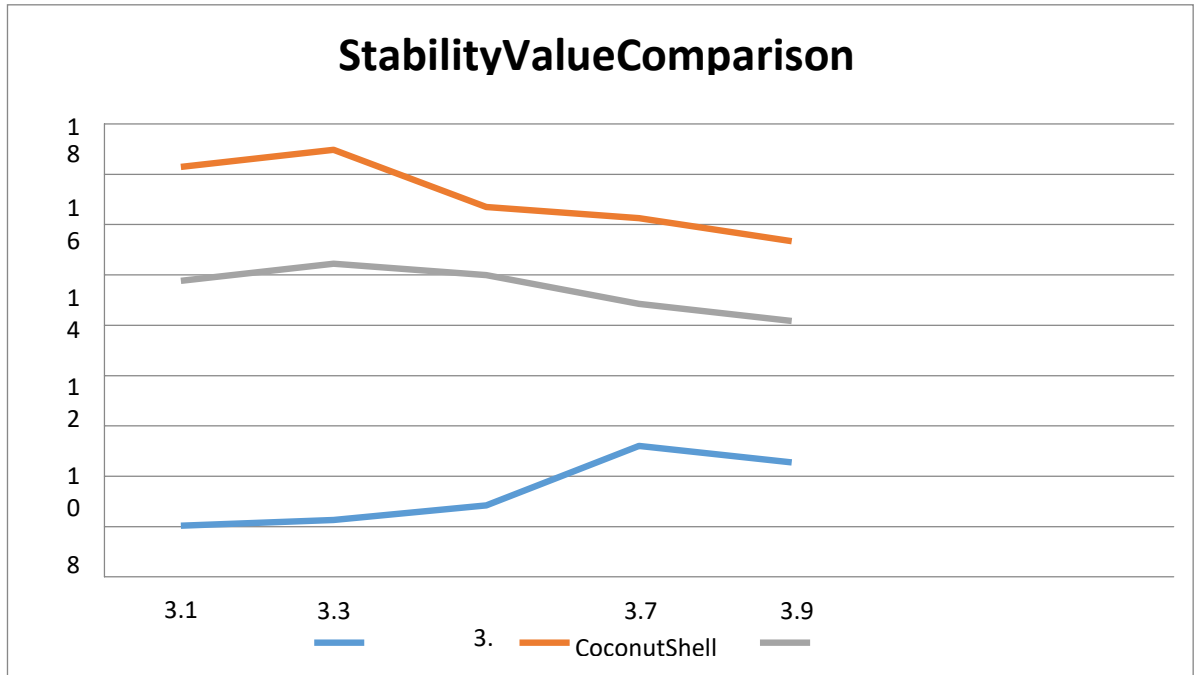
Punith V.S., Sridhar R., Bose Sunil, Kumar K.K., Veera Raghavan A(2004)[4] Adoptedthe Marshallmixdesignat60°cusing75blows of compaction per side and did a comparative study of SMA with asphalt concrete mix utilizing reclaimed polythene in the form of LDPE carry bags as stabilizing agent (3 mm size and 0.4%). The test results indicated that themix properties of both SMA and AC mixture are getting enhanced by the addition of reclaimed polythene as a stabilizer showing better rut resistance, resistance to moisture damage, rutting, creep, and aging, and better drain-down properties aswell.



VI. RESULT

STABILITY VALUE COMPARISON USING DIFFERENT FILLERS:

STABILITY VALUE COMPARISON GRAPH WITH DIFFERENT BITUMEN CONTENT



	Bitumen content (%)	dust as filler	ent As a Filler	Coconutshell coal as filler
STABILITY(KN)	3.1%	2.03	11.76	16.29
	3.3%	2.26	12.44	16.97
	3.5%	2.83	11.99	14.70
	3.7%	5.20	10.85	14.25
	3.9%	4.54	10.17	13.34



- The maximum Stability Value obtained is 16.97 KN by using Coconut Shell Charcoal as Filler at an Optimum binder of 3.3% seconded by Cement as filler with a stability value of 12.44 KN.
- Using Coconut Shell charcoal as filler, an average Stability is obtained which is 15.11 KN.
- As the difference in Stability value is less which is 14.94% therefore Coconut shell charcoal can be used as a substitute as filler.

Therefore it is proved that with an increase in bitumen content, the Stability Value also increases but up to a certain point i.e. 3.3% of bitumen content. After that, the stability Value decreases due to excess use of bitumen which decreases the strength of the Mix.

VI. CONCLUSION

Based on the information collected on this project, the following conclusions can be drawn:

- The maximum stability obtained is 5.20 KN in the case of Stone dust used as filler and the stability value obtained for coconut shell charcoal is 16.97 KN.
- As the Stability value is more than 16 KN in the case of coconut shell charcoal as filler, it can be used as filler in the SMA mix for pavement of roads.
- Flow increases with an increase in bitumen content in the case of all fillers used in the sample.
- Air voids decrease with an increase in bitumen content for all the fillers used in the sample.

From the experiment, it can be concluded that coconut shell charcoal can be used as a substitute for filler as it satisfies all the criteria to be used as a filler

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