

# Performance Evaluation of Wooden Charcoal as Filler in Stone Matrix Asphalt

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**Abstract** - SMA is gap graded mixture consisting of 70% to 80% coarse aggregate of total mass, 6% to 7% of binder, 8 to 12% of filler, and about 0.3 to 0.5% of fiber or stabilizer or additives. It provides a durable surfacing material, deformation resistant, suitable for heavy traffic loads. SMA is used as a durable asphalt surfacing option for residential streets. SMA forms an interlocks between aggregate to a stone skeleton which can sustain permanent deformation. The stone skeleton fully filled with bitumen and filler along with fiber so that it can bind them properly so as to prevent drainage of binder and not to cause any problem while transportation and while placing. The main objective of the study is to check the suitability of wooden charcoal as filler in SMA and then compare its properties obtained with different types of filler used and then study its effect on different properties of SMA. Study of different Marshall Properties using different fillers (Stone dust, Portland cement, Fly ash etc.) and then comparing the results with wooden charcoal as filler. To find out optimum binder content using Marshall Method.

**Key Words:** Stone matrix asphalt, marshal stability, cellulose fibres, wooden charcoal, OFC (optimum fibre content), OBC (optimum bitumen content).

## 1. INTRODUCTION

SMA was first carried out in Germany in year -1960 by Zichner of Straubag -Bau central laboratory, As SMA showed outstanding rut-resistance and resistance to structural deformation caused by heavy traffic at high temperatures, it has been used successfully by many countries as a highly rut-resistant bituminous course, both for binder and wearing courses, for heavy traffic roads. Bitumen mixed with coarse and fine aggregates are widely used all over the world for construction & maintenance of bituminous pavements. The close and well-uniform or dense graded aggregate mixed with normal bitumen generally perform very well in heavily traffic roads therefore they are very common in paving industries. Basically to form dense graded aggregate, it is very difficult to put together aggregates of different size which are found in sites. In such a situation, bituminous mix known as stone matrix asphalt consisting of gap graded aggregates can be used.

## 1. Advantages of matrix Asphalt over Other Conventional Mixes (BC/SDDBC)

- (i) Better Rut Resisting Capacity caused by heavy traffic loading.
- (ii) It Provide better resistance to Skid of vehicle and also resists permanent deformation at high temperature.
- (iii) The surface texture Properties is approximate similar to Open graded premix concrete (OGPC) the noise produces between the surface and tires of the roads reduces.
- (iv) SMA has greater Strength, higher longevity, and reduced moisture permeability over other usual mixes.

## 1.2 Difference between SMA and BC mix.

PROPERTIES	SMA MIX	BC MIX
<b>Definition</b>	SMA Is a gap graded mix consisting of very high percentage of coarse aggregate firmly bonded together by strong asphalt matrix.	BC consists of well graded coarse and fine aggregate, filler and bitumen.
<b>Mass of coarse aggregate content(%)</b>	70-80	50-60
<b>Mass of fine aggregate content(%)</b>	20-30	40-50
<b>Mass of filler content (%)</b>	<5	>5
<b>Binder type</b>	60/70,PMB 40	60/70,80/100 or other modified binder
<b>Minimum binder content by weight of the mix (%)</b>	3.5-4	5-6
<b>Thickness(mm)</b>	25-75	30-60

## 2. Fillers

Basically Fillers are fine particles which when passed through 2.36 mm sieve and retained in 0.075 mm sieve. Generally the fillers we used are waste materials that are produced from industries or from any natural products to decrease the cost and increase its workability and strength. As fillers are used to reduce the voids gaps so that the compaction between coarse and fine aggregate increases to provide better stability of the pavement.

The fillers that are used in experimental process are as follows:

**Stone dust:** Stone is the cheapest material basically obtained by crushing the stones such that the size of the particles are retained in 0.075mm sieve.

**Portland Cement:** Cement is also used as a filler due to its lump property due to which it can bind the particles properly.

**Fly Ash:** Fly Ash are the industrial waste materials produced from the (thermal power plant) industries which can be used as a replacement for fillers and the cost of fly ash is very low. The fly ash is used in the project work.

**Wooden Charcoal:** Concrete pavements suffer from discernment that they contribute a considerable amount of carbon dioxide (CO<sub>2</sub>) to the environment due to the use of wooden charcoal it binds the aggregates together.

### CELLULOSE FIBER:

Cellulose fibers are obtained from the bark, wood or leaves of plants or from a plant-based material. Besides cellulose, these fibers are compound of hemicelluloses and lignin and different percentages of these components are introducing different mechanical properties.

The main applications of cellulose fibers are in textile industry, as chemical filter and fiber-reinforcement composite due to their similar properties to engineered fibers being another option for bio composites and polymer composites. Cellulose fiber is used as a stabilizer in the present study. It is mixed with SMA so that it can bind the bitumen with the coarse aggregate and fine aggregate properly. It also provides good strength to the sample. It is generally spread on the sample when heat is applied to it. The amount of fiber that is used during experiment is about 0.3% to 0.5% of the total weight.

## 3. CONCLUSION

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

results with wooden charcoal as filler. To find out optimum binder content using Marshall Method.

## 4. Literature review.

**Brown and Mallick (1994)** studied the properties of SMA related to mix design by using Marshall Mix design method. A compactive effort of 50 blows of the mechanical fixed base Marshall Hammer was given to the mix for preparing the mix and proper compaction. They showed an increase in the density of the mix prepared, if higher compactive effort was used, but this may result in crushing of the coarse aggregate due to which stone to stone contact may be lost. Hence they recommended that SMA mixtures to be designed with 50 blows rather than blows as high as 75 and they suggested that drain-down of binder in the mix gets significantly affected by the types of fillers used. Presence of higher percentage of filler in the mix lowers the drain-down of the binder.

**Mogawer and Stuart (1996)** studied the effect of mineral fillers on properties of SMA mixtures. They chose eight mineral fillers on the basis of their performance, gradation etc. They evaluated the properties of SMA mixtures in terms of drain down of the mastic, rutting, low temperature cracking, workability, and moisture susceptibility

**Brown and Haddock (1997)** has remarked that, due to the fact that the strength of SMA relies mostly on the stone-on-stone aggregate skeleton, steps should be taken as to design the mix and place it with a strong coarse aggregate skeleton that would provide the desired strength and stability to the mix.

**Punith V.S., Sridhar R., Bose Sunil, Kumar K.K., Veera ragavan A (2004)**

using 50 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 stabilizer showing better rut resistance, resistance to moisture damage, rutting, creep, aging and better drain-down properties as well.

## 5. REFERENCES

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