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# Experimental Study on Bitumen with Recycled Material as Fillers

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ABSTRACT

Bituminous pavements have been the most commonly used pavement in highway construction across the world. Going in detail in every individual material used in the pavement, filler material plays a crucial role in clearing the voids which are the main reason for pavement failure. The material that passes through 0.075mm sieve is considered as the filler material. Filler material can be of any type but the material which is economical, helps in maintaining the strength and doesn't affect the durability of the pavement in medium is used. In this study, coconut shell charcoal is selected as filler material and the properties are figured out. Firstly, bitumen optimum content is found by casting the specimens with different bitumen contents i.e., from 4 to 6% by weight. Coconut shell charcoal is further crushed and 0.075mm passing material is collected. This filler material is added from 4 to 10% by keeping the bitumen content as constant. The load values, flow, stability is noted down. The results are tabulated and the observations are made by comparing the results from previous journal papers.

**Key Words:** Bitumen, Coconut Shell Charcoal

INTRODUCTION

Bituminous roads are defined as the roads in the construction of which bitumen is used as binder. It consists of an intimate mixture of aggregates, mineral filler and bitumen. The quality and durability of bituminous road is influenced by the type and amount of filler material is used. The filler tends to stiffen the asphaltic cement by getting finely dispersed in z it. Various materials such as cement, lime, granite powder, stone dust and fine sand are normally used as filler in bituminous mixes. Cement, lime and granite powder are expensive and used for other purposes more effectively. Fine sand, ash, waste concrete dust and brick dust finer than 0.075 mm sieve size appear to be suitable as filler material. The use of waste powder as filler in asphalt mixture has been the focus of several research efforts over the past few years.

Coconut shell charcoal has no scrap value and it is almost available for free. It was proved that these types of recycled filler could be used in asphalt mixture and gave improved performance. So, if this waste is proceeded for being used as a filler, it would be better in all constraints for the pavement.

There exist many mix proportions in daily practices. But well grade has been selected for this project, in which all grades of aggregates are present i.e., from 25 mm to 0.075mm.

## i. LITERATURE REVIEW

2.1. Cohesive zone model to predict fracture in bituminous materials and asphaltic pavements [Yongk –Ra 2011]

Cohesive zone (CZ) modelling has been receiving increasing attention from the asphaltic materials and pavement mechanics community as a mechanistic approach to model crack initiation and propagation in materials and structures. The CZ model provides a powerful and efficient tool that can be easily implemented in existing computational methods for brittle, quasi-brittle and ductile failure as well as interfacial fracture, all of which are frequently observed in asphaltic materials. Accordingly, this paper introduces the CZ modelling approach in the form of a state-of-the-art review addressing the concept of CZ modelling, CZ constitutive relations, their implementation into computational methods and up-to-date applications of CZ modelling to bituminous mixtures and pavement structures. This paper also includes a brief discussion on the current challenges that researchers face and the future directions to the modelling of fracture in bituminous materials and pavements. CZ modelling is not a topic that can be possibly

discussed in a single article; therefore, it should be clearly noted that this review primarily attempts to deliver some of the core aspects of CZ modelling in the area of bituminous composites.

## METHODOLOGY

### ii. RESULTS

After performing the various standard tests on the modified bitumen sample. The results obtained as shown below says that the bitumen is up to the mark and clearly indicates that it is VG30 grade bitumen.

| S.NO | PROPERTY | VALUES |
|---|---|---|
| 1. | Penetration | 6 mm |
| 2. | Ductility | 76 cm |
| 3. | Elastic recovery | 10 mm |
| 4. | Flash &fire point | Min 220$^0$C, 260$^0$C |
| 5. | Softening point | 47$^0$C |
| 6. | Specific gravity | 0.99 |

Table 4.1 Property values of bitumen

The actual gradation is from 26 mm to 0.075mm, but to use 26mm sieve size aggregate specifications varies. So, the gradation starts from 20mm aggregate and the material from

0.075mm is considered as filler material. So, in order to change the material, gradation below

0.075 is taken off. That is added filler.

- Total weight of the aggregate = 1200gm.
- Calibration factor = 0.033KN.
- Bulk Volume = Wt. of specimen in air – Wt. of specimen in water.

Bulk density = Wt. in air / Bulk Volume.

As well grade mix in used, where there exist all the gradations from 20mm to 0.150mm, the filler material used is low. High strength obtained at 5.5% bitumen content. As filler content increases the stability value decreases.

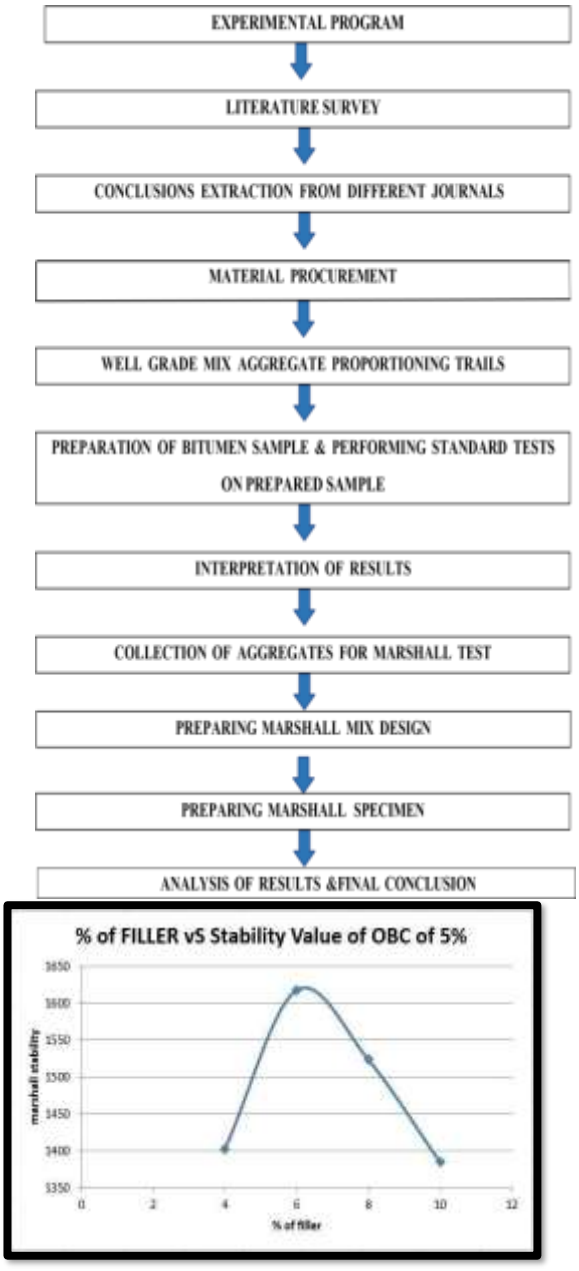


Fig 4.1. Filler % vs Stability value graph for OBC 5%

The graph shows that, increase in filler content from 4% increase in stability value is observed.It is observed that 6% of filler content has high strength for optimum bitumen content of 5%.

Further increase in filler content decreases the strength gradually.

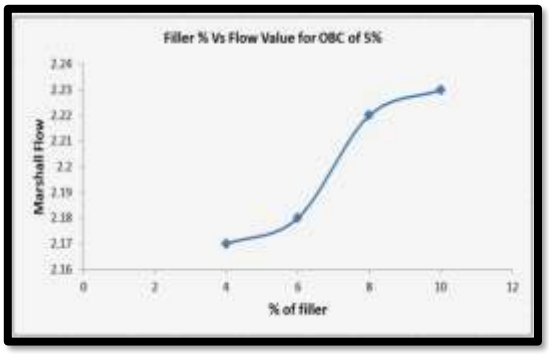


Fig 4.2. Filler % vs Flow value graph for OBC 5%

The graph shows that, increase in filler content from 4% increases in flow value and goes on increases as the filler content increases, so it is observed that the filler percent is directly proportional to flow value. It is observed the maximum flow value is obtained at 10% of filler used (i.e., 2.23).


Fig 4.3. Filler % vs Stability value graph for OBC 5.5%

The graph shows that, increase in filler content from 4% increase in stability value is observed. It is observed that 6% of filler

content has high strength for optimum bitumen content of 5.5%.

Further increase in filler content decreases the strength gradually.

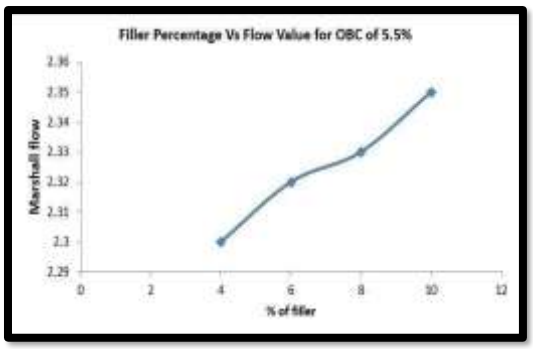


Fig 4.4. Filler % vs Flow value graph for OBC 5.5%

The graph shows that, increase in filler content from 4% increases in flow value and goes on increases as the filler content increases, so it is observed that the filler percent is directly proportional to flow value. It is observed the maximum flow value is obtained at 10% of filler used (i.e., 2.35).

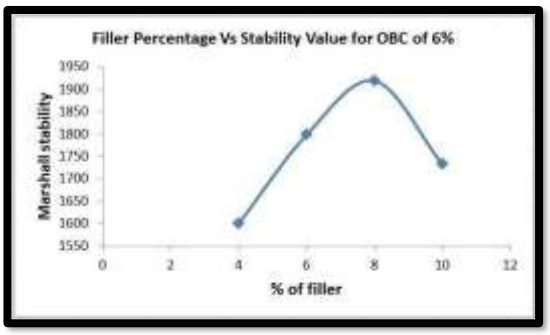


Fig 4.5. Filler % vs Stability value graph for OBC 6%

The graph shows that, increase in filler content from 4% increase in stability value is observed. It is observed that 8% of filler

content has high strength for optimum bitumen content of 6%.

Further increase in filler content decreases the strength gradually.

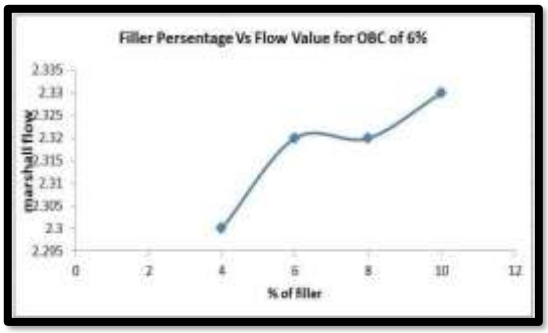


Fig 4.6. Filler % vs Flow value graph for OBC 6%

## iii. CONCLUSIONS

1 By analysing the above results, it is observed that the optimum content of bitumen is 5.5% of total weight.

By using coconut shell charcoal as filler material, at 6% of filler content the strength is higher.

2 As the mixed used is well grade mix, the filler material consumed for obtaining higher strength is 6%. If the mix type changes filler material content may vary from 4 to 10%.

3 In referred journals it is mentioned that than ceramic and stone dust, brick dust as filler material performs good in resisting against moisture attack and occupying the voids. But individually each has better properties in serving as filler.

4 Coconut shell charcoal, it has high carbon content and density, low ash content and uniform pore distribution.

5 So, with some modification in design mixes, can result in utilization of coconut shell charcoal as fillers in bituminous pavement, thus save considerable investment in construction and partially solving the disposal of wastes.

6 Observing the strength results, and comparing all the factors like economy, rheological properties and availability coconut shell charcoal is considerably very good when compared to other filler materials.

7 Well grade mix has other benefits like the void ratio when compared to other mixes is very low as it has all gradation from 26 mm to 0.150. This helps in preventing from excessive settlement and pavement cracking. Sustainable pavement construction: The study showcases the potential for sustainable pavement construction by utilizing recycled materials as fillers in bitumen.

8 Cost-effectiveness: The use of recycled materials as fillers reduces the cost of pavement construction, making it a cost- effective solution.

9 Improved stability: Recycled material as filler enhances the stability of bitumen mixtures, leading to better pavement performance.

10 Enhanced durability: The addition of recycled material as filler improves the durability of bitumen mixtures, increasing the lifespan of pavements.

Better performance: The study demonstrates that recycled material as filler can improve the overall performance of bitumen mixtures

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