SUITABILITY OF WOODEN CHARCOAL AS FILLER IN STONE MIX ASPHALT

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Abstract - *SMA is defined as gap-graded Hot Mix Asphalt designed to maximize deformation (rutting) durability & resistance by using stone-to-stone contact structure. As all aggregate in contact, rut resistance depending upon the aggregates property rather than property of asphalt binder. The aggregate not much deform as asphalt binders, the stone-to-stone contact significantly reduces the rutting and settlement under loading. But in this research Project work, the mix that is used is STONE MIX ASPHALT (SMA) to improve the quality and longevity of the roads. It consists of gap-graded mix comprising of aggregate continuously graded from maximum size, typically less than 19 mm, through the fine filler that is smaller than 0.075 mm. The STONE MIX ASPHALT design aims to determine the proportion of bitumen, filler, fine aggregates, and coarse aggregates to produce a mix which is workable, strong, durable and economical.*

Mineral filler play an important role in determining the properties of SMA mixes in terms of air voids (VA) and for determining optimum binder content in the mix for which different fillers are used.

Key Words*: *STONE MIX ASPHALT (SMA), WOODEN CHARCOAL, TOPCELL FIBRES, OPTIMUM BITUMEN CONTENT, STABILITY, FLOW VALUE.

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.

2. FILLERS

Basically Filler are fine particles which when passed through 2.36 mm sieve and retained in 0.075 mm sieve. Generally the filler 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 filler are used to reduces 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 are the cheapest material basically obtained by crushing the stones such that the size of the particles is retained in 0.075mm sieve.

Portland cement: Cement also used as 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 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_2) 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.

2. EXPERIMENTAL RESULTS:

(A) AVERAGE STABILITY VALUE USING DIFFERENT FILLERS

	BITUMEN CONTENT (%)	STONE DUST AS FILLER	FLY ASH AS FILLER	WOODEN CHARCOAL AS FILLER
STABILITY	4%	7.3	7.82	7.8
	5%	8.35	8.02	8.2

(KN)	5.5%	9.1	8.91	8.4
	6%	8.05	8.06	7.45
	7%	7.9	7.88	6.7

The stability of the specimen is derived by the load taken by it and then multiplying with the correlation ratio which is obtained from thickness/height or volume of the sample. Theoretically with increase in Bitumen content, the stability also increases up to a certain point and then gradually decreases.

This is due to with increase in bitumen content, the bond between the aggregate and the bitumen increases but with further increase, the strength between them decreases as the contact point between the aggregates become immobilize. Due to which mix become weak against plastic deformation. Simultaneously the stability Values also decreases.

(B) AVERAGE FLOW VALUE USING DIFFERENT FILLERS

	BITUMEN CONTENT (%)	STONE DUST AS FILLER	FLY ASH AS FILLER	WOODEN CHARCOAL AS FILLER
FLOW VALUE (MM)	4%	3.0	2.3	2.75
	5%	3.25	2.5	3.15
	5.5%	3.6	2.8	3.7
	6%	4.3	3.2	4.15
	7%	4.45	3.7	4.55

Flow Value is defined as deformation caused when maximum load is applied where usually failure occurs. The flow value increases with increase in bitumen content. But the flow is gradually slow where stabilizers are not used. The flow increases very slowly initially but with increase in bitumen content, the flow value increases theoretically.

(C) AIR VOIDS USING DIFFERENT FILLERS

	BITUMEN CONTENT (%)	STONE DUST AS FILLER	FLY ASH AS FILLER	WOODEN CHARCOAL AS FILLER
AIR VOIDS	4%	10.9	10.37	10.2
	5%	9.44	9.56	9.64
	5.5%	8.63	9.12	8.92
	6%	7.62	8.46	8.36
	7%	7.47	8.11	7.88

3. CONCLUSIONS

- The maximum stability obtained is 9.1 KN in case of Stone dust used as filler and the stability value obtained for wooden charcoal is 8.4 KN.
- As the Stability value is more than 8 KN in case of wooden charcoal as filler, it can be used as filler in SMA Mix for pavement of roads.
- Flow increases with increase in bitumen content in case of all fillers used in the sample.
- Air voids decreases with increase in bitumen content for all the fillers used in the sample.
- From the experiment, it can be concluded that wooden charcoal can be used as a substitute for filler as it satisfies all the criteria to be used as filler.

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