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Effect of Using Various Types of Fillers in Bituminous Mixes: A Review

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Abstract: ***All over the world most commonly used pavement in flexible pavement is bituminous pavement. It consists of mixture of bitumen and aggregates. These materials when mixed are laid in layers and compacted. Due to increase in traffic loads and increase in traffic volume present life of pavement should be sufficiently long. Considering this a lot of work has been conducted in the past in order to improve the various parameters of pavement. The present study deals with reviewing of the works carried out earlier in the past with regard to addition of fillers in mixes. After going through number of researches it was seen that fillers play vital role and improve various properties of mix. One of the main advantages was seen of solving the problem of waste disposal. Higher filler concentration results in stronger pavement. However excessive addition of filler weakens the mixture.***
Keywords: ***Flexible pavement, bituminous mix, Marshall Test, Plastic waste, Stability, Air voids, unit weight, voids in Mineral aggregates, polyethylene.***

I. INTRODUCTION

Because of the limitation and lack of available natural resources there has been a significant increase in the demand for using recycled materials.

Thus, for the construction of road a number of industrial and domestic waste products are being used. Roads in which bitumen is used as a binder are generally termed as bituminous roads. It is a mixture of aggregates and bitumen. Filler is generally added in it to fill the voids. Fillers modify the properties, improve the performance and thus increase the durability of pavement. Among all the sectors of construction, it is found that waste materials can only be used effectively in road construction provided the laboratory and field performances show satisfactory results. Using waste materials as fillers reduces environmental risk as they get utilized instead of stockpiling.

II. MATERIALS

Aggregate and bitumen are the basic ingredients of bituminous mixes. Further on the basis of size of particles aggregates are further divided into coarse aggregates, fine aggregates and filler fractions. Materials used in bituminous pavements are discussed below:-

A. Coarse Aggregate

Impact value, abrasion value and crushing strength of coarse aggregates should be good enough to withstand the design loads within the design life span. All the stresses coming on the wheels are beard by coarse aggregates. Wear due to abrasion is also to be resisted by coarse aggregates. That portion of the mixture which is retained on 2.36 mm (No. 08) sieve according to the Asphalt Institute is termed as Coarse aggregates.

B. Fine Aggregate

In coarse aggregates between the particles voids remain, those voids need to be filled. Those voids which remain there are filled by fine aggregates. So to fill the voids of coarse aggregates is the main function of Fine aggregates. Crushed stone or natural sand generally is termed as fine aggregates.

C. Filler

After the voids are filled in coarse aggregates by fine aggregates, some of the voids still remain unfilled. Function of the fillers is to fill up the voids. Fillers used may be brick dust, stone dust, concrete dust, limestone dust, fly ash or pond ash.

D. Bitumen

Bitumen is used as a water repellant material.

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III. REVIEWS FROM THE PAST STUDIES

In 2008 for the purpose of modification in bituminous concrete waste plastic material was used. In order to find the optimum binder content Marshall Method was used. Different samples were prepared for varying bitumen content and varying weight of aggregates. Bitumen content was varied from 5 to 6.5 percent by weight of aggregate with increment of 0.5%. Waste plastic was varied from 6% to 18% by weight of bitumen with increment of 4%. It was observed that the Marshall Stability value increased. For the mix with 10%, 14%, 18% waste it increased by 18%, 25% and 45%. [1] In 2002 for the purpose of modification in bituminous concrete processed plastic bags were used. For both ordinary and modified bitumen properties were observed. Both the properties were compared with each other. It was observed that as the proportion of plastic waste increased, penetration value and ductility of modified bitumen decreased. Further it was observed that addition of plastic bags improved the life of pavement. Life of pavement with modified bitumen increased in comparison with ordinary bitumen. [2] In 1952 fly ash was used as filler. It was observed that on adding filler various properties in terms of mixing, placing and composition improved. Further resistance to water damage also improved. [3] In 1974 effect of class C fly ash used as filler on asphalt mixture properties was studied. In this study it was concluded that on addition of fly ash stability and flow increased. But it was also observed that it resulted in low air voids. Further in this study it was conclude that stability can be further increased if fly ash is immersed in water. [4] In 2016 performance of hot mix asphalt concrete when missed with waste material was studied. Materials used in the study were carbonized wood saw dust and PET. On all the samples Marshall Test was carried out. The study revealed that wood saw dust can be used as filler and gave satisfactory results. The study also revealed that PET when used show increase in the Marshall Properties trend. [5] In 1984 rise husk ash was used as filler in bituminous mixes. With varying percentage of rusk husk and bitumen various samples were prepared and studied for Marshall Properties. Out of the various samples, sample with 4% of rice husk ash and 6.5% of 80/100 grade bitumen was considered as optimum. The study further revealed that rice husk ash can be successfully used as filler. [6] In 2015 fly-ash was used as filler to determine Marshall Properties of samples containing varying percentage of bitumen content. The study revealed that Maximum stability and unit weight was observed when fly ash was used as filler. The study further revealed that using high calcium fly ash is good solution for disposal of waste products. [7] In 2015 stone dust and fly ash were used as fillers and compare with each other. It was observed that Marshall Stability was higher for the sample containing stone dust as filler. Further with the increase in the percentage of bitumen content flow value also increased. In case of fly ash it was observed that with increase in percentage of bitumen content volume of voids decreased. [8] In 2015 sewage sludge ash was used as mineral filler in bituminous mixes. The study showed that buy using 2-3% SSA waste satisfactory results are obtained. It was further concluded that using SSA maintains adequate level of cohesion and adhesion in mixture. Further using SSA does not increase the permanent deformation in bituminous pavements. [9] In 2011 waste polymer was used as filler in bitumen. Evaluation of various properties was done and compared with the standard bitumen. It was concluded that using polypropylene as filler was not suitable and the properties of bitumen are not improved. It was further observed that various difficulties were observed mixing resulting in poor cohesion. [10] In 2002 polyethylene obtained from LDPE carry bags was used in asphalt cement. Various tests were conducted on these samples containing varying percentage of PE. It was conclude that incorporation of PE resulted in Increase in moisture susceptibility. [11] In 2008 plastic was used as filler in bituminous mixes. In this study results showed that plastic increases the melting point of bitumen and makes the road flexible during winters. The study revealed that using plastic in high temperature areas increases the life of road by about 70%. Further it also showed that problem of big potholes in rainy areas can be solved to a huge extent. [12]

IV. CONCLUSION

After going through number of researches I conclude that using fillers in bituminous mixes not only helps in improving various properties of bitumen but also helps in usage of waste materials. Further I conclude that fillers can be used effectively only upto some limit. Using of fillers upto 7.5% is seen to give satisfactory results. Using fillers beyond 7.5% decreases the stability of the mix. I also conclude that by addition of the fillers Marshall Stability value is increased by about 25%. Using SSA as filler gives better results that for the mixes with other fillers. Further I also conclude that using fillers like polyethylene improves the moisture susceptibility of mix. I further conclude that fillers should be used on daily basis in bituminous mixes so as to solve the big problem of waste disposal.

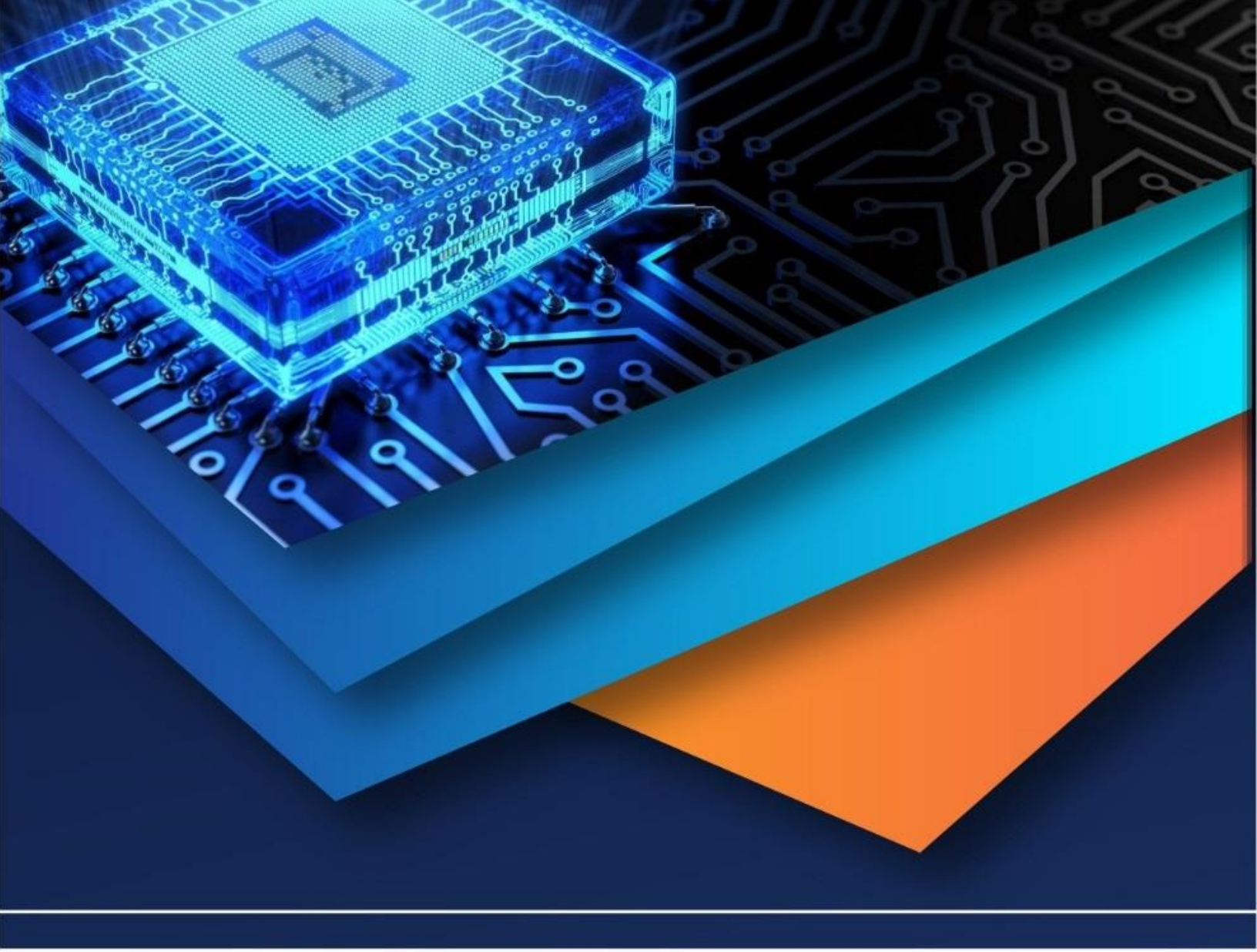
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