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A Review of Studies on Stone Matrix Asphalt by using various Additives

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Abstract - *New technologies such as Stone Matrix Asphalt are now being adapted to provide long lasting roads and are having a capability of improvement in roads by using stabilizing additives such as Natural Fibre in a Stone Matrix Asphalt Mixture. To verify the performance of Stone Matrix Asphalt various Natural Fibre are selected. For this Marshall Characteristic, Volumetric properties and Drain Down Test evaluation are to be done. Here in this paper, various literature related to this have been presented. Methodology for performance evaluation for Marshall Stability Test and Volumetric properties is also being suggested. In this review paper the steps carried out for the study of Marshall Stability Test as regards to ASTM D 1559 guidelines, Drain Down Test study to be carried out using (AASHTO T305).*

Key Words: **Stone Matrix Asphalt1, Natural Fibre2, Marshall Characteristic3, Volumetric properties4 and Drain Down Test5.**

1. INTRODUCTION

Indian road infrastructure is quickly increasing. The lifespan of roads created with typical bituminous mixes is reduced as traffic and vehicle loads rise. There is a lot of research being done on this topic all throughout the country to solve the problems with pavements. For long lasting Indian roads the Stone Matrix Asphalt mix has been proven to be a good choice. But main problem in Stone Matrix Asphalt is drain down.

In this paper study has been done on various natural fibre, their effect on Stone Matrix Asphalt has been discuss in terms of Marshall Characteristic, Volumetric properties and Drain Down Test. Marshall Characteristic plays an vital role in determining Marshall Stability and Flow Value of the Stone Matrix Asphalt Sample. Volumetric property includes Bulk Specific Gravity, Air Voids, Voids in Mineral Aggregates and Voids filled with Bitumen. Drain Down Test determine the amount of bitumen Drain Down from mixture and also determine Optimum Fibre Content in Stone Matrix Asphalt Mix. Drain Down play an vital role in reducing the strength of pavement to solve this problem various research has been done and it is found out that using natural fibre in SMA mix drain down can be controlled which will increase the life of the SMA mix pavement. Natural fibre is present in nature in large quantity which can be bring in use.

2. Literature Review

Pragnya P. (2020)

This research highlights the significance of additives in SMA and provides an environmentally acceptable another option to synthetic fibres. After careful examination it has been shown that the use of well graded aggregates in bitumen pavement provides additional strength. In this study banana fiber and coconut fiber is used as additives. According to the Marshall test 0.3% of fibre can increase Marshall Features to a satisfactory level. Both banana fibre and coconut fibre may be found in abundance in trash, however the experiment results reveal that coconut fibre stabilised SMA has a greater specific gravity than banana fibre stabilised SMA. Even though it has been determined that whatever the fibre content maximum Marshall Quotient, Marshall charecteristics are found a 0.3% of fibre content and flow values are under control range.

Mustafa Musleh Razahi1, Avani C. (2020)

This article examines the use of Sisal and Coir fibres as stone matrix asphalt additives. Fibres and polymers are additives used to stabilise the SMA, which are represented by high coarse particles and high asphalt content. Coarse aggregates serve a critical function of providing stone to stone network and intermixing in the mixture which gives strength and a long lasting rich mortar. To avoid the SMA mix from draining stone matrix asphalt utilised fibres and polymer as an addition Natural fibres such as Sisal, coir, banana, hemp, and others are used in the transportation business. As the number of fibres in SMA mixes increases the stability decreases. The addition of sisal and coir fibres increases the strength and longevity of the mix while also preventing it from draining. All investigations revealed that the Marshall Stability test was used to evaluate the mix's stability, flow value, and volumetric characteristics, and that the Marshall Mix Design is used to determine the mix stability, flow value, and volumetric properties.. Some studies used another test by the name of Drain Down, it help in determined the amount of Drain Down from uncompacted Stone Matrix Asphalt (SMA).

N.L.N Kiran Kumar, A. Ravitheja (2019)

The goal of this study is to see how additives affect the properties of SMA mixes and to come up with an optimum surface course for pavements. Natural fibres such as coir,

sisal, and banana fibres were employed as additions in this study. To characterise the materials utilised in this study a preliminary examination is carried out. For improving SMA mixes and studying the engineering characteristics of stabilised mixtures, the Marshall Test are used.. The purpose of this research is to get a basic knowledge of behaviour of a Stone matrix asphalt mixture using natural fibres as additives in order to boost confidence in the material's field applicability.

K. Karunakar (2018)

In this article include study of carbon fibre and glass fibre in SMA. Carbon fibres will be added to the SMA mixes in addition to the glass in this investigation, and the characteristics of the mixtures will be find out. It was selected to use carbon fibres in the current research since they are readily available in India. Preparing asphalt concrete mixes with two types of fibres (carbon and glass) at dosages of 0.3%, 0.4%, and 0.5% by weight of total mix will be used to conduct detailed laboratory experiments. The mixture volumetric characteristics will be find out as well as marshal stability.

Siva Gowri Prasad S. (2018)

In this study coconut fibre, banana fibre are used to determine the Marshall property of mix, all these fibre play an important role in providing stability to bitumen binder in mix and prevent drainage during manufacturing, transit, and development. Based on laboratory experiments that looked at flow and stability the goal of this study is to investigate if coconut and banana fibre may be utilised as a stabilising element in a combination. Cement is utilised as mineral filler and VG30 grade of bitumen is used as a binder. A stone matrix asphalt mix with a nominal maximum aggregate size of 20mm,10mm is use fiber as additives improve stability and bulk specific gravity while lower flow value. At 0% drain down coconut and banana fibres exhibited optimum fibre levels of 0.3 and 0.4% respectively.

Prashanth M D, Divyesh (2018)

In this research Marshall properties are find out by conducting the test for Marshall stability, flow value, air voids, voids filled with mineral aggregates, and voids filled with bitumen with varying percentages of hospital waste plastic (6%, 8%, 10%, and 12%) by weight of mix, by using VG30 bitumen in a mix. The stability grows with a rise in hospital waste plastic up to a certain point then declines similarly the stability grows with an risein fibre content, then decline as more fibre content is added. The availability of hospital waste plastic as a stabilising factor in stone matrix asphalt is investigated in this study. SMA mix should have a bitumen concentration of 5.82%. In comparison to other proportions adding 8% plastic to the mix improves stability. This fraction has a higher level of stability than a controlled combination. When 0.3% areca nut fibre is added to the mix, it has a greater stability value (17.10) than the control mix (16.1).

Uma Maruthi Venkatesh V, Siva Gowri Prasad S. (2018)

The strength of a pavement wearing course constructed with SMA mix without and with various fibres is compared in this study. At a Fibre Content of 0.3%, the Optimum Fibre Length of 6 to 8mm was discovered. Without the stabilising component, the SMA mix with nominal maximum aggregate size performs better. When compared to other fibres coconut fibre has a high stability and bulk density. When compared to polymer fibres natural fibres perform better in preventing asphalt drain down. The addition of fibre to bituminous mixes alters their characteristics by improving their stability and flow value while reducing air spaces. By adding stabilising additives like fibres and polymers, the binder concentration may be decreased, preventing the asphalt from draining. However, waste plastics are utilised as an addition to have a effective influence on the Marshall characteristics of SMA mix. Coconut fibre performs better as a stabilising addition when compared to the other fibres. In most tests, the ideal coconut fibre length was determined to be 6 to 8mm, while the optimum fibre concentration was 0.3%. For increasing the stiffness of the mix and resistance to permanent deformation, the optimal quantity of waste PET content was found to be 6%. When compared to a normal SMA mix.

Rose Mary X. (2018)

SMA consist of high percent of coarse aggregate content. A thick asphalt coating holds them together with mineral filler, fibre as stabilisers. There is great contact between stones and better interlocking. SMA Mix has a significant draining problem. Cellulose fibres, mineral fibres, and polymers are employed as stabilising agents to prevent the mix from draining. SMA structural features allow it to maximise deformation resistance or rutting, as well as offer pavement durability and service life. The optimal bitumen content and optimum fibre content for the SMA Mix are determined using Marshall characteristic and volumetric properties. A variety of studies have been conducted to assess the performance characteristics of SMA mixes including various fibres as stabilisers. The fibres serve to improve aggregate to aggregate contact and enhance bonding. When fibres are introduced, the amount of binder that drains down is greatly reduced. Using a variety of locally accessible fibres, the SMA research may be expanded to a larger region. For future researchpineapple fibre, which is high in cellulose might be utilised as a stabilising component in SMA.

Shaik. Dilkusha, K.V. Manikanta (2018)

In bituminous pavements, the SMA mixture is utilised to reduce discomfort and improve durability. The influence of different natural fibres as stabilising additions on the

behaviour of SMA mixtures is proposed in this study. Natural fibres such as coir, sisal, and banana are used as stabilisers in the Marshall tests to measure the asphalt mix characteristics. By weight of the mix, the percentage of fibres added in this study is 0.1%, 0.2%, 0.3%, and 0.4%. The test findings show that for all fibre mixtures regardless of type the optimal fibre content is 0.3 percent by weight of mix. Coir fibre performs the best of all the fibres in terms of stability, while sisal and banana fibres have similar qualities.

Sambhav Jain, Harpreet S., Tanuj C. et al. (2017)

This article study the results of an experiment from stone matrix asphalt mix made by VG 30 bitumen and various fibres as additions including coconut fibre, glass fibre, and jute fibre. SMA mixtures made with various types of fibres. SMA mix design and drain down testing are all part of the investigation process. In comparison to all other fibres utilised Stone matrix asphalt with cellulose fibre having greater Marshall Stability and lower drain down value. The cellulose fibre drains the least, despite the fact that other types of additives drain within required limits. The results show that during field production, the drain down of a cellulose fibre based mix is minimum.

K. Shravan, K.B.R. Prasad R. (2017)

SMA is the combination of coarse aggregate, bitumen, mineral filler and fibre. Due to the presence of stone network structure and high bitumen binder content it is ideally suited for urban road and junctions where braking effects are greater. Coir fibres and cellulose fibres will be added to SMA mixtures in this investigation, and their characteristics will be assessed. coir fibreare readily available in India and are very inexpensive. Preparing asphalt concrete mixes with cellulose and coir fibre doses of 0.2%, 0.3% and 0.4% by total mix weight will be used to conduct detailed laboratory experiments. The mixture volumetric characteristics and Marshall stability is find out.

Umashankar D. (2017)

The development and usage of asphalt materials and mixes began in Europe and North America, and they are still widely used today. The SMA mix consist of higher volume of coarse aggregates, binder, and fibre added as stabilising elements. The goal of this study was to concentrate on the designing property of a combination of (SMA) fibres and no fibres. Banana fibre and jute fibre are two natural fibres that will be used in this project. Flow tests will be conducted to evaluate characteristics and stability, as well as the mechanical qualities of the mix with banana and jute fibres. The bitumen concentration varied as 4%, 4.5%, 5%, 5.5%, 6%, and 7% by the total weight of the mix, and the fibres utilised as 0.3 percent. As a filler, cement is utilised, and bitumen 60/70 penetration grade (VG 30) is used as a binder.

Naveen Kumar R, V Sunitha (2016)

The engineering characteristics of stone matrix asphalt mixes produced with standard bitumen VG-30 and a natural fibre specifically sisal fibre were investigated in this project. To find optimum bitumen content, several amounts of binders are employed to prepare mixtures with a chosen aggregate grade. The optimum binder content and optimum fibre content for stabalised stone matrix asphalt mixtures are evaluated by stability, flow value, density, and air voids. After that the drain down properties of modified and non modified SMA Mix were investigated. It has been discovered that adding 0.28 percent sisal fibre to SMA mixtures enhances the Marshall characteristics considerably.

Bindu C.S, Beena K.S. (2014)

The impact of additions such as coir fibre, sisal fibre, and banana fibres on drain down of stone matrix asphalt mix are study. SMA mixes are put through drain down sensitivity testing. The optimum fibre content was found at 0.3 % by weight of mix for above mention fibres. Fibres as stabilisers play a main role in decreasing the drain down of SMA mix because fibres have a tendency of absorbing. The inclusion of coir fibre beats every other fibre tested. In terms of stability, the results from sisal and banana fibre mixes were nearly identical. The SMA mixe drain down investigation indicated that all of the additives employed in this study stone matrix asphalt mixtures work as effective stabilisers. The addition stiffens the mastic, which reduces drainage in SMA mixes during storage, transportation, installation, and compaction at high temperatures. The control mixture suffers from substantial drain down due to the gap graded aggregate and high volume of bitumen binder content.

Rajendra S. (2012)

The main object is to study the behaviour of stone matrix asphalt mix using a natural waste fibre such as sugarcane fibre which is a waste product following sugarcane juice extraction. Various samples of SMA mixes with and without fibres as well as binder content were developed to achieve this. The optimal binder content was calculated using Marshall Properties. The Drain down characteristics are also calculated.

3. SUGGESTED METHODOLOGY

After going through various literature and their methodologies it is observed that for evaluating the performance characteristics of Stone Matrix Asphalt (SMA) by using various Natural Fibre content certain steps are to be followed. A plan for experimental research must be developed. As a preliminary inquiry, the purchase of different Stone Matrix Asphalt components and the assessment of their characteristics must be carried out. Marshall Stability Test experiments are recommended for SMA mix design with and without Natural Fibre additions.

To evaluate binder drain down, a drain down test on several SMA mixes is presented. For optimization, a comparative examination of several properties volumetric, mechanical, and drain down of numerous stabilized mixes with varied additive amounts and types must be performed. The optimal mix must be recommended from among the numerous SMA mixes with the highest additive concentration.

4. CONCLUSIONS

The study of various research paper on SMA which consists of use of various different natural fiber in SMA mixture there are various tests which has been done traditional and modified SMA mix such as Marshall Test and Drain down test. Marshall Test is done to obtain stability and flow value, Drain down test is done to obtain amount of bitumen binder drain off from the surface of aggregate. According to the literature several additives are used such as fibres, polymers have been utilized to improve the bituminous mixes. Stone Matrix Asphalt is traditionally made with synthetic fibres. They aren't made in India and must be imported at a hefty price. Synthetics have polluted the environment due to their widespread use. The utilization of bio-renewable resources and plant fibres has become necessary as a result of the ecological crisis. Materials consumed in the building and maintenance of roads are extremely rare and limited. India generates a large amount of naturally obtain fibres which can be use in bitumen road without compromising road strength, performance and increases the life time

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