International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 3 Issue 6, October 2019 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Experimental Study on Properties of SMA Mixed with Sisal Fiber and Partially Replaced Aggregate with Scrap Tyre

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How to cite this paper: Umashankar Yadav | Nitesh Kushwah "Experimental Study on Properties of SMA Mixed with Sisal Fiber and Partially Replaced Aggregate with Scrap Tyre" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-3 | Issue-6, October 2019, pp.1041-1044, URL: https://www.ijtsrd.com/papers/ijtsrd29313.pdf

IJTSRD29313

INTRODUCTION

Stone Matrix Asphalt (SMA) is a gap-graded mixture, have a better stone to stone contact which gives better strength to the mixture.

In this examination work total utilized according to the MORTH determination which was taken from an equivalent part. The examples are made with total with various degree, filler (concrete) and fastener (bitumen 60/70). Strands are utilized as stabilizer and are utilized to diminish the channel down and to expand the quality and dependability of the SMA Blend.

SCRAP TYRE RUBBER:

- Tyre may be divided into two types – car and truck tyres. Car tyres are different from truck tyres with regard to constituent materials (e.g. natural and synthetic rubber).

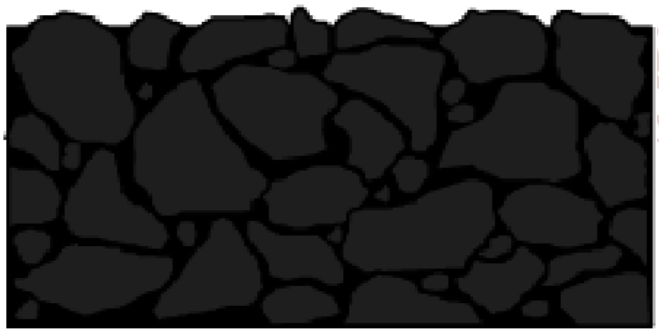

Fig.1.1 Gap Graded Mix Structure

LITERATURE REVIEW

1. **Shaik. Dilkusha al [2015]** Advancement of balanced out Stone Lattice Black-top (SMA) blends for improved asphalt execution has been the focal point of research all over India for as long as couple of decades. India, being a horticultural economy delivers genuinely gigantic amount of regular strands. This paper centers around the impact of added substances like coir, sisal, banana strands (normal filaments), on the compressive quality of SMA blends. A starter examination is directed to portray the materials. Compressive quality tests are led to contemplate the protection from squashing to withstand the worries because of traffic loads. Every balanced out blend demonstrate the most extreme estimation of compressive quality at 0.3% fiber content. SMA with coir fiber shows higher compressive quality demonstrating its higher smashing obstruction. The records of held quality for all blends fulfill the constraining estimation of 75%. In any case, for control blend, it is just about 60%, which substantiate the need of added substances in SMA blends.

2. **Naveen Kumar R et al [2016]** in the present examination, an endeavor has been made to contemplate the building properties of blends of stone lattice black-top made with customary bitumen 60/70 with a nonconventional characteristic fiber, in particular sisal fiber. The covers in various extents are utilized for readiness of blends with a chose total evaluating to discover OBC. The ideal folio substance is dictated by keeping the recommended air voids content in the blend. The fiber is added to OBC and two other bitumen focuses nearest to it. For this, different Marshall tests of SMA blends with and without filaments with changing fastener focus are readied. Marshall properties, for example, soundness, stream esteem, thickness, air voids are utilized to survey the ideal fastener substance and ideal fiber content for changed SMA blends. From there on, the channel down attributes for adjusted and unmodified SMA Blend have been examined. It is seen that lone 0.28% expansion of sisal fiber fundamentally improves the Marshall properties of SMA blends. Expansion of ostensible 0.28% fiber impressively improves the channel down qualities of the SMA blends with customary bitumen, which would some way or another have not had the option to meet the recommended criteria.

3. **Yadav et al [2017]** deals with the improvement of changed clasp definitions from plastomer and elastomer compose waste with an intend to constrain non-biodegradable the post client polymer waste and furthermore environmental hazard, to meet this objective ten exceptional models have been gotten from a couple of sorts of waste to cover particular arrangements of polymeric waste from the family unit, mechanical and likewise restorative waste. Changed spread definitions were from the start depicted by the

relevant checks (code of preparing) to deciding their suitability for above said application. The physical properties of changed spreads are inside beyond what many would consider possible. Marshall Adequacy, underhanded unbending nature and creep modulus lead have been evaluated and discussed in this assessment to exhibit their twofold favorable circumstances like waste minimization and propriety of such latches to be used for Durable Road.

4. **Abdulnaser Al-Sabaeei al [2018]** Compaction is one of the most significant parameters that influence the properties and execution of black-top blend. The point of this examination was to explore the impacts of TCR on the gyratory compaction of stone mastic black-top (SMA) blend. Tests for execution tests were readied utilizing Superpave blend plan technique. A 40 work TCR powder was differed from 0 to 2.5 % by weight of the all out blend with 0.5% augmentation. A few examinations including the volumetric properties of SMA, flexible modulus and Marshall Properties, steadiness and stream were tried for both control and rubber treated blends. The outcomes demonstrated that as the measure of TCR expanded the quantity of gyrations required expanded and the channel down of the cover diminished. The rubber treated examples indicated better dependability, strong modulus and channel down obstruction than the control tests.

5. **Shaik. Dilkusha al [2018]** Street system is critical to the financial improvement, social reconciliation and exchange of a nation. Insufficient transportation offices could affect financial and social advancement of a nation. In India, increment in the volume of traffic and huge stacking conditions requires a gigantic advancement for better, solid, and progressively viable streets that counteracts or decreases the trouble of bituminous black-top. In Indian roadways, the wearing coat is laid by thick reviewed bituminous blends; subsequently the significant misery is because of dampness actuated harms. The SMA blend is utilized to limit the upsets and give better strength in the bituminous asphalts.

6. **PHoang-Long Nguyen's al [2019]** The main objective of this study is to develop and compare hybrid Artificial Intelligence (AI) approaches, namely Adaptive Network-based Fuzzy Inference System (ANFIS) optimized by Genetic Algorithm (GAANFIS) and Particle Swarm Optimization (PSOANFIS) and Support Vector Machine (SVM) for predicting the Marshall Stability (MS) of Stone Matrix Asphalt (SMA) materials. Other important properties of the SMA, namely Marshall Flow (MF) and Marshall Quotient (MQ) were also predicted using the best model found. With that goal, the SMA samples were fabricated in a local laboratory and used to generate datasets for the modeling. The considered input parameters were coarse and fine aggregates, bitumen content and cellulose. The predicted targets were Marshall Parameters such as MS, MF and MQ.

7. **Shiva Kumar Govindaraju al [2019]** In this study, banana fiber (BF) and pelletized fiber (VP) are used as stabilizing additives to prepare SMA mixtures with conventional viscosity-graded (VG) 30 bitumen. Mixtures were prepared with different levels BF and VP content, and another mixture without any stabilizers was also prepared using polymer-modified bitumen (PMB). Superpave mix design, draindown, fatigue, rutting, workability, and moisture-induced damage properties were evaluated. Results indicated that addition of natural and pelletized fiber controls binder draindown and improves resistance to rutting, fatigue, and moisture-induced damage of SMA mixture. Further, polymer-modified SMA mixtures take less energy for densification compared to SMA mixtures with natural and pelletized fiber. Results also showed that even though polymer-modified SMA mixtures performed better, SMA mixtures with pelletized fiber provided comparable results.

Objectives

- Study of properties of SMA mix with Binder content was 4, 4.5, 5, 5.5, 6, 6.5 percentage by weight of aggregate.
- Sisal Fiber was 0.0%, 0.1%. 0.2%. 0.3% and 0.4% with 5% scrap tier waste by weight of aggregate.

Methodology Adopted

Research facility tests were directed on the regular bitumen (60/70) and changed bitumen tests. Singular properties (Infiltration, Softening Point, Flexibility, Flash and fire, and Specific Gravity) of the example were resolved. Utilizing the Marshal Blend outline portrayal of customary bituminous blend (60/70) for thick bituminous blend (DBC) were completed and examination was made for traditional bitumen blend properties with changed bitumen. Subsequent to deciding elements to be considered for demonstrating adjusted bitumen in bituminous blend, a point by point anticipates the exploratory program (test arrangement and arrangements of tests) was created. Following tests were conducted:

1. Penetration test
2. Ductility test
3. Softening point test
4. Specific gravity test
5. Flash and fire point test
6. Marshal stability test

Results

Marshall Test Values

For every sample Marshall Test data is recorded and tabulated in following table: Here stability number is in kN and flow is in mm.

Stability vs Sisal Fiber Content

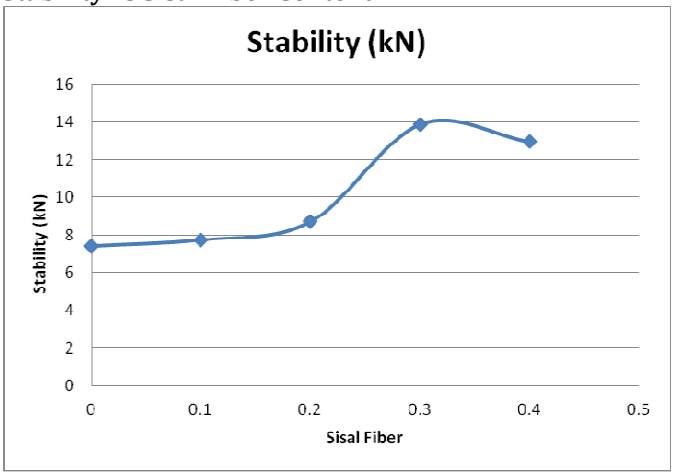

Fig1.2. Stability vs. Sisal Fiber Content

Flow value vs.

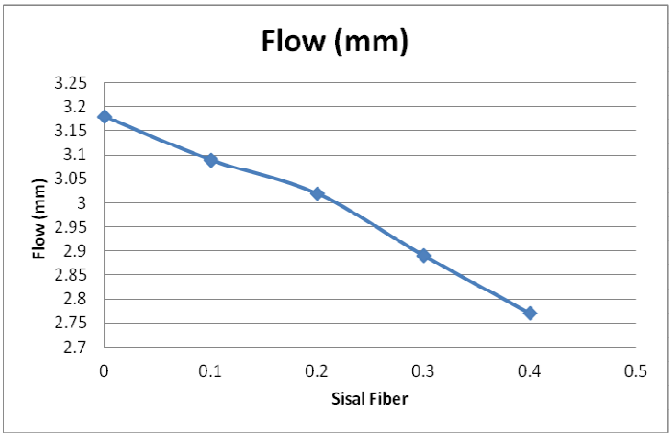

Fig1.3. Flow vs. Sisal Fiber Content

VMA vs. Sisal fiber content

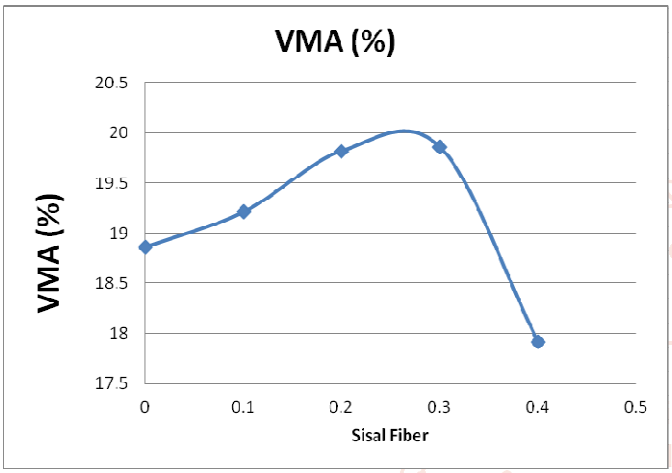

Fig1.4. VMA vs. Sisal Fiber Content

VFB vs. Sisal fiber content

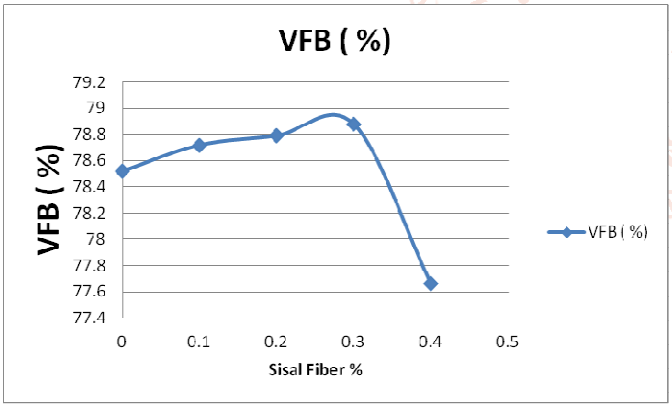

Fig1.5. VFB vs. Sisal Fiber Content

Graphs obtained

1. Stability vs. bitumen content

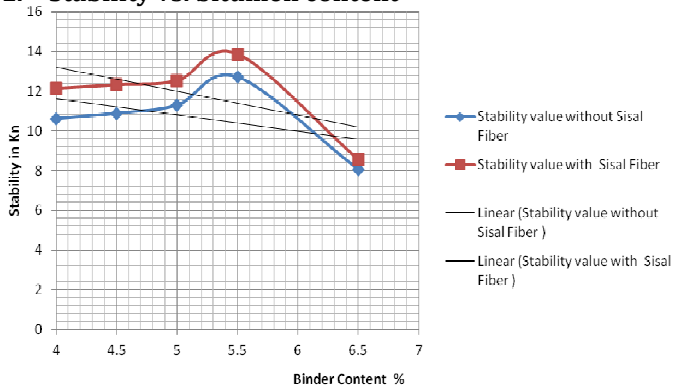

Fig1.6. Stability vs. Bitumen Content

2. Flow value vs. bitumen content

Values of flow values in mm and bitumen content in bitumen in %ge are plotted against bitumen in x-axis and Flow in y-axis.

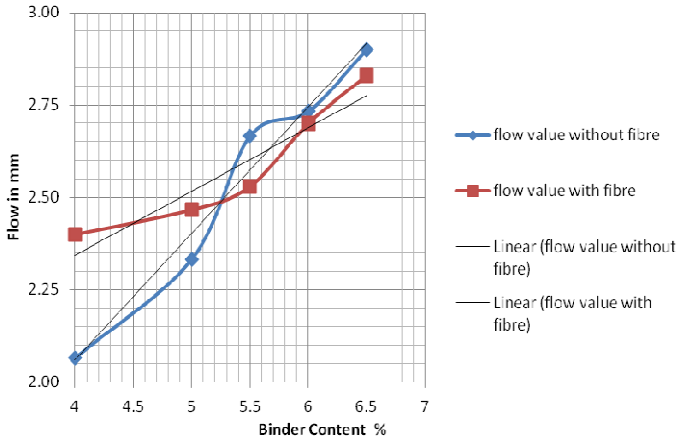

Fig.1.7. Flow vs. bitumen content

3. VMA vs. bitumen content

Values of VMA values in %ge and bitumen content in bitumen in %ge are plotted against bitumen in x-axis and VMA in y-axis.

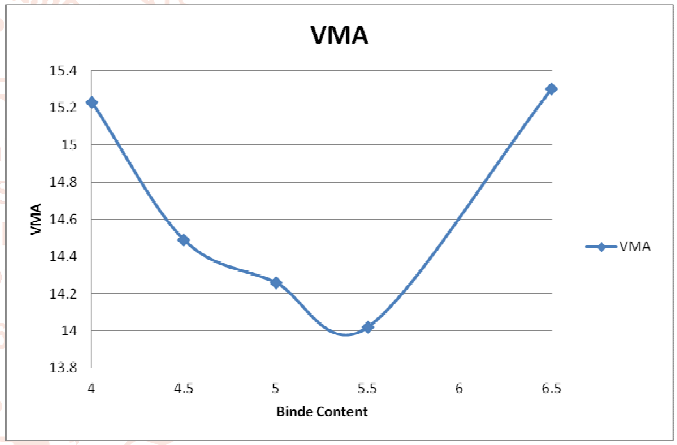

Fig.1.8 VMA vs. bitumen content

4. VFB vs. bitumen content

Values of VFB values in %ge and bitumen content in bitumen in %ge are plotted against bitumen in x-axis and VFB in y-axis.

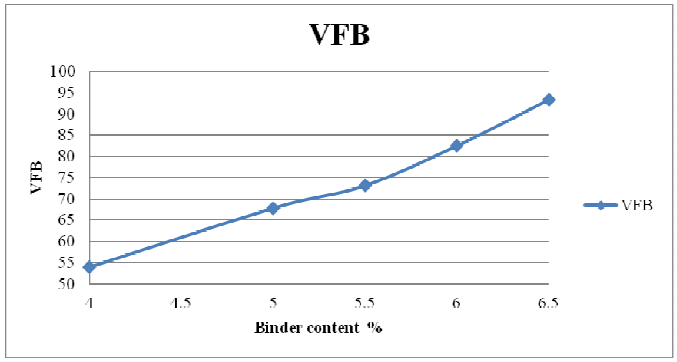

Fig.1.9 VFB vs. bitumen content

5. VA vs. bitumen content

Values of VA values in %ge and bitumen content in bitumen in %ge are plotted against bitumen in x-axis and VA in y-axis.

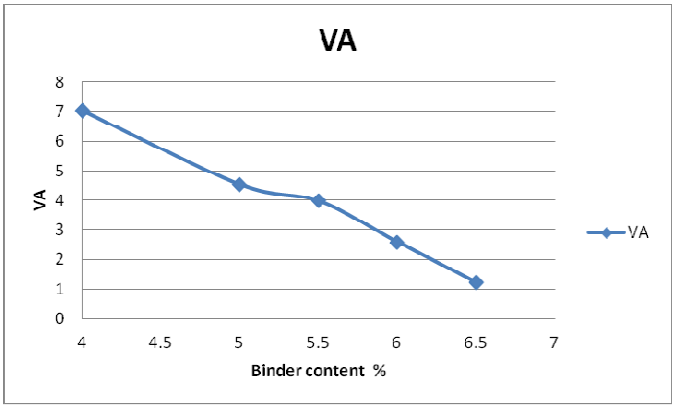

Fig.1.10 VA vs. bitumen content

DETERMINATION OF MIX DESIGN PARAMETER

From the curves, at 4 % air voids, the mix properties are as follows

SMA With Sisal Fiber content

Requirements of SMA according to IRC SP-79-2008 IS given in table 5.2

Table 5.10 IRC SP 79-2008 Specification mix design requirements of SMA & Mix properties at 4% air void

Property	Specification	Result obtained with 0.3% Sisal Fiber + 5% Scrap Tire
Minimum binder content by weight of mix, (%)	>6.5	5.5%
Stability (kN)	8 Minimum	13.86
Flow (mm)	2 – 4	2.89
VMA (%)	17 Minimum	18.86
VFA (%)	75 – 80	78.88
Binder Type	60/70 grade binders	60/70 and modified binders

Here OBC is 5.5% and OFC is 0.3% with 5% Scrap tire.

CONCLUSION

EFFECT OF SISAL FIBRE ON SMA WITH SCRAP TIRE

Here result of variation of Marshall Properties with different binder content where Sisal Fiber content is taken as 0.3% is explained below.

Marshall Stability

It can be observed that with increase binder content stability value increases up to certain binder content and there after it decreases. Similarly by addition of Sisal Fiber stability value also increases up to certain limits and further addition of Sisal Fiber stability value starts decreasing. May be this is due to excess amount of Sisal Fiber which is not able to mix in asphalt matrix properly.

SMA with Sisal Fiber content is 0.3% with 5% Scrap tire waste & OBC is 5.5% were found. Hence for SMA OBC is found as 5.5% and OFC is found as 0.3%. From above it is observed that by addition of 0.3% of Sisal Fiber not only stability value increases but also binder quantity also decrease as compare to mixes contain 0.3% Sisal Fiber. If binder content is more then it causes drain down of binder in mixes. Hence for SMA OFC is taken as 0.3%.

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