*Impact Factor (SJIF): 5.301*

**International Journal of Advance Research in Engineering, Science & Technology**

*e-ISSN: 2393-9877, p-ISSN: 2394-2444*

***Volume 5, Issue 4, April-2018***

# AN EXPERIMENTAL USE OF SISAL FIBER IN HOT MIXED PAVEMENT

***Chahil Joshi*[1], Vrundani Vaidya[2]**

[1]*M.E. student, Transportation engineering, Hasmukh goswami college of engineering*

[2]*H.O.D, Transportation engineering, Hasmukh goswami college of engineering*

ABSTRACT - *The increase in traffic growth and maintenance expenditures demands the urgent need for building better, long-lasting, and more efficient roads preventing or minimizing bituminous pavement distresses. The Sisal fiber mixtures provide a durable surface course. In order to improve the performance for a pavement surface, the fiber additives in flexible pavement mixture were compared. Furthermore, certain groups of comparative experiments were conducted by adding the different length and different quantity of the sisal fiber toward the flexible pavement mixture by conducting various test and showing that the sisal fiber is good additive to improve performance for pavement surface. The best length and the best quantity of the sisal fiber in the flexible pavement mixture were determined and its application is very limited mainly due to the lack of proper specifications.*

**Keywords:** *Sisal fiber, additives, stability and strenfth characterstic.*

## I. INTRODUCTION

Sisal Fiber is one of the most widely used natural fiber and is very easily cultivated. It is obtain from sisal plant. The plant, known formally as Agave sisalana. These plants produce rosettes of sword-shaped leaves which start out toothed, and gradually lose their teeth with maturity. Each leaf contains a number of long, straight fibers which can be removed in a process known as decortication. During decortication, the leaves are beaten to remove the pulp and plant material, leaving the tough fibers behind. The fibers can be spun into thread for twine and textile production, or pulped to make paper products. Sisal fiber is fully biodegradable, green composites were fabricated with soy protein resin modified with gelatin. Sisal fiber, modified soy protein resins, and composites were characterized for their mechanical and thermal properties. It is highly renewable resource of energy. Sisal fibre is exceptionally durable and a low maintenance with minimal wear and tear. Its fibre is too tough for textiles and fabrics. It is not suitable for a smooth wall finish and also not recommended for wet areas.The fine texture of Sisal takes dyes easily and offers the largest range of dyed colours of all natural fibres. Zero pesticides or chemical fertilisers used in sisal agriculture. It is a stiff fiber traditionally used in making twine, rope and also dartboards Sisal fiber is manufactured from the vascular tissue from the sisal plant (Agavesisalana). It is used in automotive friction parts (brakes, clutches), where it imparts green strength to performs, and for enhancing texture in coatings application.

## II. LITERATURE REVIEW

The application of fibres in dense graded bituminous mixtures, their reinforcing effects and the improved performance of pavements.This section deals with the review of previous works done in SMA with different synthetic fibres, waste fibres and some natural fibres like jute fibre and oil palm fibre. Fibre can stabilize bitumen to prevent binder leakage especially for the open-graded-friction courses (OGFC) and stone matrix asphalt (SMA) mixtures during the material transportation and paving (Hassan et al., 2005; Serfass and Samanos, 1996; Peltonen, 1991). Fibre changes the viscoelasticity of mixture (Huang and White, 2001) improves dynamic modulus (Wu et al., 2008), moisture susceptibility (Putman and Amirkhanian, 2004), creep compliance and rutting resistance (McDaniel, 2001; Chen et al., 2004). It reduces the reflective cracking of bituminous mixtures and pavements (Tapkin, 2008; Maurer and Malasheskie, 1989). Muniandy and Huat (2006) reported that the cellulose oil palm fibre improve the diametric fatigue performance of SMA design mix. The fatigue life increased to a maximum at a fibre content of about 0.6% and the tensile stress and stiffness also showed a similar trend in performance. The initial strains of the mix were lowest at a fibre content of 0.6%.

## III. Materials

Aggregates form the major constituent of road construction materials. Since they have to bear the brunt of traffic, they should be strong enough to resist the degradation and should have enough structural stability which is offered by the mechanical interlock of aggregate in the layer. IS 2386-1963 gives the methods of tests for aggregates in road construction. Aggregate of sizes 20mm, 10mm and stone. The values obtained for various properties of aggregate. The role of mineral filler is essentially to stiffen the rich binder. It is designed to fill the voids and form stiff mastic with bitumen binder and stabilizing additive. It increases the cohesion of the mix resulting in a significant increase in shear resistance. A higher percentage of filler may stiffen the mixture excessively, making it difficult to compact and may be resulting in a crack susceptible mixture, (Brown et al., 1997). In general, amount of material passing through the 0.075 mm sieve is 8-12 % of the total amount of aggregate in the mix. Commonly used mineral fillers are fly ash, hydrated lime, finely ground limestone dust and ordinary Portland cement (OPC). OPC from a local market which makes a better bond with aggregate, bitumen and additive has been used in this study. India has a vast resource for different natural fibres viz., jute, sisal, banana, coir fibre etc. and can be advantageously used for many construction activities. Presently, the production of natural fibres in India is more than 400 million tonnes (Saxena and Ashokan, 2011). The inclusion of fibres during the mixing process as a stabilizing agent has several advantages including increased binder content, film thickness and the mix stability. This will result in better interlock between the aggregates and thereby improving the strength and reducing the possibility of drain down during transport andpaving. Bitumen acts as the binder in mix. Different grade of bitumen are used in different mixes like hot-mix or gap-graded mix or dense-graded mix. Bitumen of 60/70 penetration grade obtained were used.

## IV. Test Results

The tensile characteristics of bituminous mixtures are evaluated by loading the Marshall specimen along a diametric plane with a compressive load at a constant rate acting parallel to and along the vertical diametrical plane of the specimen through two opposite loading strips. This loading configuration develops a relatively uniform tensile stress perpendicular to the direction of the applied load and along the vertical diametrical plane, ultimately causing the specimen tested to fail by splitting along the vertical diameter. A 13 mm (1/2″) wide strip loading is used for 101 mm diameter specimen to provide a uniform loading with which produces a nearly uniform stress distribution. The static indirect tensile strength of a specimen is determined using the procedure outlined in ASTM D 6931. A loading rate of 51mm/minute is adopted. Tensile failure occurs in the sample rather than the compressive failure. Plywood strips are used so that the load is applied uniformly along the length of the cylinder. The values of indirect tensile strength may be used to evaluate the relative quality of bituminous mixtures in conjunction with laboratory mix design, testing and for estimating the resistance to cracking. The results can also be used to determine the resistance to field pavement moisture when results are obtained on both waterconditioned and unconditioned specimens.

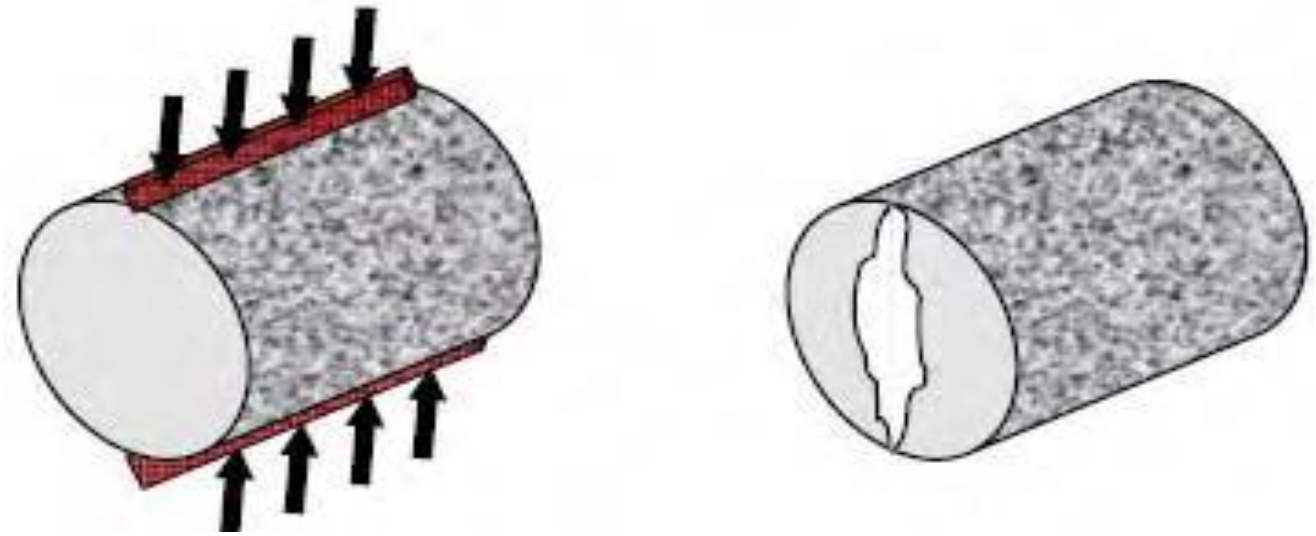

**Fig 1** schematic diagram of indirect tensile strength

| Additive | % | ITS,Unconditioned (Mpa) | ITS,Coditioned (Mpa) | %TSR (Mpa) |
|---|---|---|---|---|
| Nil | 0 | 0.8143 | 0.4253 | 52.23 |
| Sisal Fiber | 0.1 | 0.8313 | 0.6915 | 83.18 |
| | 0.2 | 1.0619 | 1.0114 | 95.23 |
| | **0.3** | **1.1057** | **1.0766** | **97.37** |
| | 0.4 | 1.0538 | 1.0153 | 96.35 |

**Table 1** Indirect tensile strength result

## V. Conclusion

Based on the indirect tensile strength test,

1) The mixtures containing additives have higher values of indirect tensile strength at failure under static loading as compared to the control mix
2) The effect of additive in increasing the indirect tensile strength value of mix is more influential in the conditioned state due to the improved adhesion property
3) Presence of additives strengthen the bonding between the aggregates provided by the binder and thereby enhancing the stone to stone contact which will result in increasing the resistance to crushing. This gives rise to a stiffer and tougher mix with considerable improvement in compressive strength.
4) All the fibre stabilized mixtures has the maximum tensile strength at 0.3% fibre content.

The values of retained stability, tensile strength ratio and index of retained strength for the control mixture is less than the required minimum values of 70% (LS 283), 70% (AASHTO T 283) and 75% ( ASTM D 1075) respectively. When additives are added, these values are enhanced to above 90%.

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