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Utilization of Coconut Fibers in Road Construction

SARITHA V*,AKASH P NAIR#, ANCHANA SANTHOSH#, ATHUL HARI#, ROSHIN MATHEW#

** Assistant Professor, Department Of Civil Engineering, St. Thomas College Of Engineering & Technology Chengannur*

#Students, Department Of Civil Engineering, St. Thomas College Of Engineering & Technology Chengannur

Abstract: *Synthetic fiber are available in India only at very high cost and are used in construction of stone Matrix Asphalt (SMA). It is therefore necessary to find economical alternative to high cost materials. Hence a low cost natural fiber namely coir fiber is used as addictive in road construction. Coconut fiber are new waste material used in highway industry . Studies shows that coconut fiber increase the stability and resilient modulus. The main objective of this project is to study the effect of coir fiber on Marshall properties like stability of SMA mix. Marshall test will be carried out to determine the optimum bitumen content and optimum fiber content.*

Keywords: *Stone Matrix Asphalt, SyntheticFibersMarshall Properties, Coir fiber, Optimum bitumen content, Optimum Fiber content.*

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I. INTRODUCTION

Aggregates bound with bitumen are conventionally used all over the world in construction and maintenance of flexible pavements. The close, well, uniform,or dense graded aggregates bound with normal bitumen normally perform well in heavily trafficked roads if designed and executed properly and hence very common in paving industry. The cost of Materials used for pavement construction is increasing day by day. Hence it is necessary to use sustainable & low cost materials. Fibers are additives used in mixes to improve the binding & reduce the drain downof mortar. Most commonly used fibers for construction of stone matrix asphalt include Synthetic fibers which are very expensive.

Coconut Fiberare new waste materials used in highway industry. Natural fibers are biodegradable & an economical alternative to synthetic fibers. Coconut fiber which is abundantly & cheaply available in Kerala is used an additive for the SMA mix.The SMA mixtures have a rough macro texture, forming small path between the coarse aggregate, which useful for efficient surface drainage . The higher binder content is required to make the mix durable. The fibers or modifier are required to hold the binder in the mixture at high temperature; prevent drainage during production, transportation and laying.

II. LITERATURE REVIEW

George Mohan [2016] conducted a study on 'Effect of Marble Waste and Coir Fiber Content on the Indirect Tensile Strength of Bituminous Concrete Mixtures'. Marble dust and coir fiber were used and Marshall stability test Was conducted to determine the optimum bitumen content for neat bituminous concrete mixes. The indirect tensile strength was found to Increase by addition of marble dust up to 8%, and on further addition, theStrength decreases. Upto 0.5% the strength goes on increasing and then Decreases.

Bindu C [2015] conducted a study on' Shear Strength Characteristics of Coir Fiber Stabilized Stone Matrix Asphalt Mixtures'. The triaxial shearStrength test was conducted on SMA mixes to study the effect of additive, Coir fiber on the strength properties by varying the percentages of fiber. SMA without fiber was taken as the control mixture. At fiber content of 0.3%, higher values of cohesion and shear strength were observed. It is Observed that the shape change of the stress-strain curves is more gradual forStabilized mixtures with increase in fiber content and brittle type failure does Not seem to occur as in the case of control mixture.

Gray and Ohashi (1983) : conducted a series of direct shear tests on dry sand reinforced with different synthetic, natural and metallic fiber to Evaluate the effects of parameters such as fiber orientation, fiber content, Fiber area ratios, and fiber stiffness on contribution to shear strength.Based On the test results they concluded that an increase in shear strength is directly Proportional to the fiber area ratios and shear strength envelopes for fiber-Reinforced sand clearly shows the existence of a threshold confining stress below which the fiber tries to slip or pull out. Various types of randomly Distributed elements such as polymeric mesh elements, synthetic fiber.

III. TEST RESULT OF SOIL

Test Conducted	Values Obtained
Moisture Content	Sample 1 : 56.23% Sample 2 : 57.48%
Specific Gravity	1.189
Sand Replacement	Bulk density: 0.67g/cc Dry density : 1.04g/cc
Core Cutter	Bulk density : 1.678g/cc Dry density : 1.443g/cc
Standard Proctor Test	Max. Dry density : 1.97g/cc Optimum moisture : 18.3% Void ratio : 0.167 Porosity : 14.34%
Direct Shear Test	Sample 1, Cohesion: 0.05Kg/cm2 Angle of internal friction : 44° Sample 2, Cohesion : 0.13Kg/cm2 Angle of internal friction : 50°
California Bearing Ratio (Soaked)	2.5mm penetration : 3.98% 5mm penetration : 5.88%
California Bearing Ratio (Unsoaked)	2.5mm penetration : 3.72% 5mm penetration : 5.88%
Particle Size Distribution	Effective Size : 0.33 Uniformity Coefficient Cu : 8.78 Coefficient of Curvature Cc : 0.261

IV. TEST RESULT OF AGGREGATE

Test Conducted	Result Obtained
Los Angeles Abrasion	18%
Impact Value Test	40%
Aggregate Crushing Value	31.86%
Specific Gravity & Water Absorption	Specific gravity : 2.5 Water absorption : 10% Apparent Specific gravity : 3.33
Flakiness Index	23.92%
Elongation Index	19.73%

V. TEST RESULT OF BITUMEN

Test Conducted	Result Obtained
Ductility	78 cm
Penetration	58 cm
Viscosity	Absolute viscosity,Min:2400Poise Absolute viscosity, Max : 3600 Poise Kinematic viscosity : 350 centistoke Viscosity ratio : 4
Softening Point	47°c

VI. TEST ON MIXES

Marshall Stability Test

Marshall Mix design is a standard laboratory method, which is Adopted in India for determining and reporting the strength and flow characteristics of bituminous paving mixes. In the absence of modern Equipment, this method was used to study various Marshall Characteristics such as Marshall Stability, flow value, unit weight, air Voids etc., which helps in determining the Optimum Binder Content (OBC) and Optimum Fiber Content (OFC) of the SMA mixes.

Optimum Fiber Content

From the result obtained from the experiment we concluded that by Adding 1% of fibers, the stability is higher as compared to the Optimum Fibre Content.

Binder Content

By taking from various reference and Literature review we kept the Bitumen Content as 5% of the total aggregate.

Percentage Of Coir Fibres	Stability Value (KN)
0.0	9.39
0.5	16.8
1.0	17.23
2.0	12.98
2.5	6.42

Fig : Result Showing Marshall Stability Test

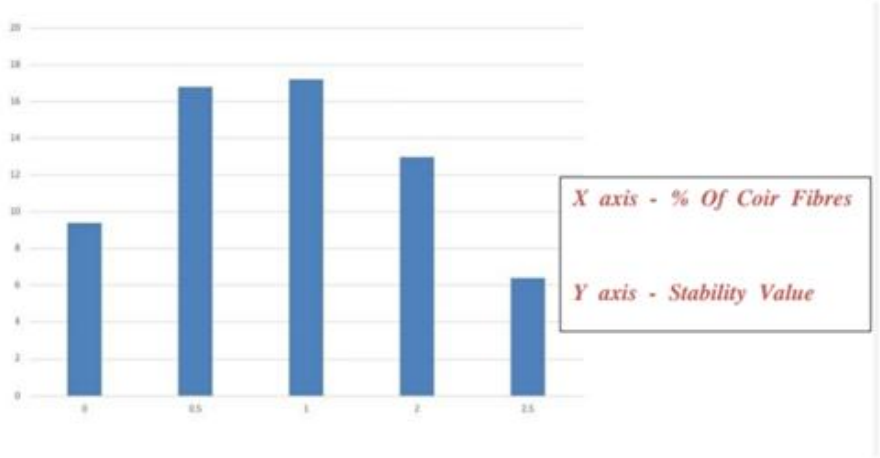

Fig : Graph of Marshall Stability Test

Indirect Tensile Strength Test

This test has been carried out both under static and dynamic (repeated) conditions. The static test has been carried out as per ASTM (2007) and is used to determine the tensile strength of SMA mixes . The same has also been used to evaluate the effect of moisture on bituminous mixtures.

Temperature (° c)	Indirect Tensile Strength (Kpa)
5	3490
10	1975
15	1640

Fig : Result Obtained from ITS Test (Without Fibers)

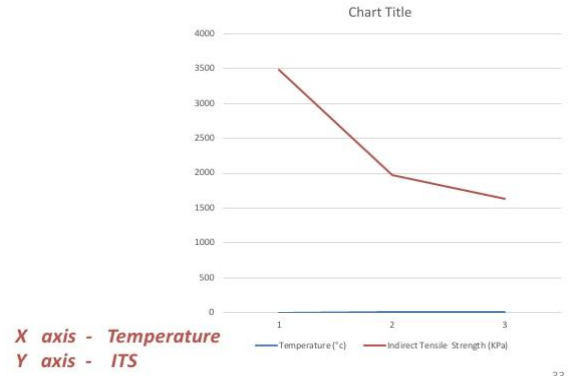

Fig : Graph Obtained from ITS Test (Without Fibers)

Temperature (°c)	Indirect Tensile Strength (Kpa)
5	2505
10	1680
15	1324

Fig : Result Obtained From ITS Test (With Fibers)

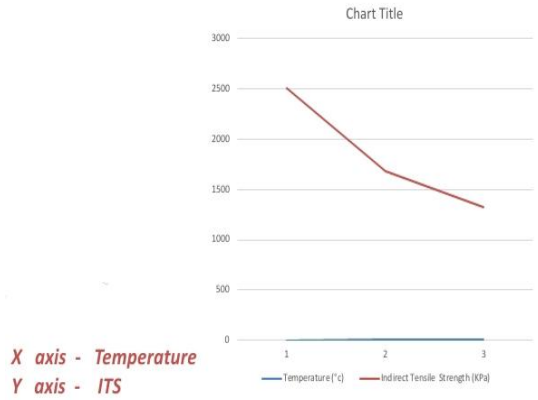

Fig : Graph Obtained from ITS Test (With Fibers)

VII. CONCLUSION

- We have completed our experimental Study as final year project . We concluded as Coconut fibre used in this study is a low cost material, therefore a cost-benefit analysis can be made to know its effect on cost ofconstruction. Moreover, to ensure the success of this new material, experimentalstretches may be constructed and periodic performances monitored.
- In general addition of coconut fiber increases the stability and unit weight value. Satisfying all the Marshall criteria, it is observed that a marginal 0.3% addition offiber is enough to bring in substantial improvement in Marshall characteristics.The paving industry is facing acute shortage of well graded aggregates at severalplaces for bituminous pavements. Hence it is desirable to explore use of gap graded aggregates such as SMA in bituminous paving.
- The present investigation provides a scope of effectively using ripe coconut fiberwhich is relatively water resistant and abundantly available as waste, in SMA mixes.
- Coconut fibre used in this study is a low cost material, therefore a cost-benefitanalysis can be made to know its effect on cost of construction. Moreover, to ensurethe success of this new material, experimental stretches may be constructed andperiodic performances monitored.

REFERENCES

[1]. American Association of State Highway and Transportation Officials (AASHTO). T283. Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage. Washington DC, USA; 2007.

[2]. American Society of Testing Materials (ASTM). D1559. Test Method for ResistanceOf Plastic Flow of Bituminous Mixtures Using Marshall Apparatus. WestConshohocken, PA, USA; 1989.

[3]. American Society of Testing Materials (ASTM). D6931. Indirect Tensile (IDT)Strength for Bituminous Mixtures. West Conshohocken, PA, USA; 2007.

[4]. Bose S., Kamaraj C. and Nanda P.K., Stone Mastic Asphalt (SMA) – A Long Life Pavement Surface. International Seminar on Innovations in Construction and maintenance of Flexible Pavements. Agra. 2–4 September. Technical Papers-Volume1; 2006, p. 169–176.

[5]. Brown E.R., Haddock J.E. and Crawford C., Investigation of Stone Matrix Asphalt Mortars.Transportation Research Record 1530, National Research Council, Transportation Research Board USA; 1996, p. 95–102.

[6]. Busching, H. W., and J. D. Antrim. Fiber reinforcement of bituminous mixtures. AssocAsphalt Paving Technol Proc. 1968. Vol. 37, p.p. 629–659. Kennedy T.W., Practical Use of the Indirect Tensile Test for Characterization ofPavement MaterialsProceedings of Australian Road Research Board, Vol. 9, Part 3;1978; p. 38–45.

[7]. Kumar P., Chandra S. and Bose S., Laboratory Investigations on SMA mixes withDifferent Additives. International Journal of Pavement Engineering, Volume 8, Issue1;2007, p. 11–18.