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A Study of Asphalt Mixes with Natural Fibre (Sisal Fiber) By Experiment

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ABSTRACT- The main aim of this study was to determine the benefits of use of naturally available Fibre called SISAL fibre used as additive in Bituminous concrete. Bituminous Mixture In which all component were mixed, placed and compacted at High temperature is called as Hot Mix Asphalt. HMA grade is referred as Dense Grade mixture (DGM). Asphaltic concrete is also called Bituminous Concrete (BC). Pavements are vulnerable to cracks, potholes, distresses and permanent deformation. In this study, SISAL fiber used in bitumen mixtures to study the benefits of using natural fibers, Eco-friendly design. Standard Marshall mix design test and drain down test were carried out. The process of mixing and preparing aggregates,The grading was done according to the specifications of (ISMORTH).Various percentages of binder changed to (4.5% -5.5%) and the added fiber changed to (0.1% -0.7%) of total aggregate and dust as a filler. The optimal value for bitumen is determined using the Marshall method and was found (5%). Similarly, the optimum fiber content of bitumen concrete (BC) was found (0.3%). Samples of Bituminous concrete (BC) mix were made and run those for obcs and of cs, then run them in tests such as Marshall Stability and Drain Down test to evaluate the result of adding fiber to the bitumen mixture. The test results indicates that the modification of bitumen with sisal fiber is used as an additive for bitumen mix, the Blends help increase stability and durability, reduce air void and flow value. After all, it was found that the use of Sisal fiber as an additive improves the properties. Like Stability, strength, durability, reduce drain down of bituminous concrete (B.C).

KEYWORDS: Asphalt mix, Sisal Fibre, Bituminous Concrete, Dense Grade mixture, Aggregates.

I. INTRODUCTION

For the development of the country, the development of transportation plays a fundamental role. As flexible pavement is usually used in India, and because it has greater advantages than rigid pavement[1]. Flexible pavement requires detailed engineering design and provides correct and reliable highway performance in service. Natural fiber has become the research focus of scientists and researchers [2]. Sisal fiber is a natural and regional fiber in India. In addition to showing good characteristics, it also has economic benefits. Sisal fiber is obtained from the pores and skin of the leaves after the pulp is removed [3]. Dust, water and humidity will not attract SISAL fibers. The use of SISAL fiber provides greater resistance, durability and prevents drainage[4]. The length of the SISAL fiber used in the sample description is 8mm to 20mm, and the diameter is 0.2mm to 0.6mm. According to Grade1 IS: 1072386 and the specifications of the Ministry of Transport and Roads (MORTH, 2013), the classification of aggregates has been achieved[5]. The calculation of the optimum value and the optimum fiber content of bitumen was found with the help of the Marshall test program. Stability, flow value and voids in mineral aggregates VMA, voids filled with bitumen (VFB) and air content (VA) are used to determine the values of the Marshall test parameters[6]. Sag determines how much of the mix separates from the pattern and moves downward [7]. Good disposition of the asphalt mix will produce long lasting elastic fatigue, which is environmentally friendly, strong and cost effective [8]. This study attempts to collect these basic elements and observe them by preparing multiple samples in different ratios of asphalt mixtures and observing them to find their best values[9].

II. MATERIALS AND METHODOLOGY

Aggregates have been used for the study and prepared for bituminous mixes. Aggregate consisted of stone dust, coarse and fine aggregates. The aggregate gradation was taken as per IS: 107-2386 Grade1 Revision 5 and as per Ministry of Road Transportation and Highway Specification (MORTH, 2013) (Table 1). Moisture Content, Impact Value, Flakiness Index, Elongation Index (Table 2) have been tested for the physical properties of aggregates as per Indian standards.

Table 1: Gradation of aggregate as per MORTH specifications

IS Sieve (mm)	Cumulative % by weight of total aggregate passing	Gradation Adopted as per MoRTH	% Cumulative Retained	% Retained	Retained weight of aggregates (g)
26.5	100	100	0	0	
19	90-100	91	9	9	108
13.2	59-79	79	21	12	144
9.5	52-72	64	36	15	180
4.75	35-55	54	46	10	120
2.36	28-44	44	56	10	120
1.18	20-34	33	67	11	132
0.6	15-27	24	76	9	108
0.3	10-20	14	86	10	120
0.15	5-13	9	91	5	60
0.075	2-8	5	95	4	48
Filler				5	60
					Total = 1200 g

Table 2: Properties of Aggregates

PROPERTY	TEST RESULT	MORTH specifications	TEST METHOD
Moisture content (%)	0.20	Max 2%	IS:2386 Part-III
Aggregate Impact value (%)	19.22	Max 24%	IS:2386 Part-IV
Flakiness Index (%)	12.64	Max 30%	IS:2386 Part-I
Elongation Index (%)	15.81	Max 30%	IS:2386 Part-I

Asphalt and Sisal Fiber

To prepare the mixture and samples, pitch of viscosity grade VG40 was used. The physical quality of the asphalt is shown in Table 3. SISAL (additive) fiber length was (750-900) mm, fiber diameter (0.2 mm to 0.6 mm). diameter [10]. The Slow Setting SS-1 emulsion coated the SISAL fiber and stored for 24 hours in a heated air stove at 110 ° LC. In a length of 8 to 20 mm SISAL fiber was produced to be cut into small sections of fiber [11].

Table 3: Physical Properties of bitumen (VG-40)

Property	Requirement as per IR IS 73: 2013	Test result
Penetration at 25°C 0.1mm ,100gm, 5sec	40-60	55 cm
Ductility at 25°C, (cm)	Min. 25	25 cm
Softening Point (R&B) (°C)	Min.50	52°C
Specific gravity At 27°C	Min. 0.99	1.052
Absolute Viscosity at 60°,Poises	Min.3200	3250
Flash Point, °C	Min.220	220

B. Preparation of Mix

The experiment was carried out using the Marshall test procedure described in ASTM D1559 and MoRTH specifications. Coarse and fine aggregates and stone dust are mixed with asphalt concrete by classification [12]. At a temperature of 150 ° C, the bitumen is heated. In an air oven, the mixture is continuously heated to 180 ° C so that it completely mixes with the heated adhesive. The process proceeds accordingly (IRCMORTH) [13]. The fibers were coated with SS1 emulsion and stored in a hot air oven at 100°CL for 24 hours. Then the emulsion-coated sisal fiber was cut into small portions by weight and length and added directly to the mixture. The total aggregate is kept at 20°C above the bitumen temperature [14]. The required amount of pitch is added to the heated mixture of aggregate and fiber. The mixing is done manually by hand to ensure the color of the mixture and a constant and uniform consistency[15]. Mixing time lasts between 25 minutes. The mixture is placed in a preheated mold and the mixture sample is compacted 75 times on both sides. The sample has been kept overnight to cool to room temperature 16]. The extract and test sample at a temperature of 60 ° C are then used in the standard test procedure. In this

Experimental study the bitumen mixture was made according to the following steps:

A study was conducted to prepare Marshall samples with different ratios of asphalt (4.5 to 5.5) to determine the binder content of the asphalt mixture to obtain the best asphalt (OBC) Use Marshall stability test [17]. Marshall stability, formula and parameters are used to detect the best value of asphalt content, which is 5%. At this stage, it helps to determine the optimal fiber content (0.3%), keeping the asphalt content constant (5%), SISAL is different from (0.1% -0.7%) and different lengths of fibers (418 mm) and coatings Use slow-setting emulsion. In the final sample of the asphalt mixture tested by the drainage test, the sisal fiber was 0.3%, the sisal fiber length was 12 mm, no fiber and 5% pitch [18].

III. RESULTS AND DISCUSSIONS

A. Marshall Stability Test

The Marshall Stability Test is a standard procedure and is generally widely used for highway work. Asphalt concrete or asphalt mix is generally designed in the Marshall test procedure. In this study, the stability, flow value, porosity, Vma and Vfb characteristics of Marshall were learned to obtain the best binder content and optimal fiber content (OFC) and the corresponding Marshall ratio (ISMORTH) 10. In this study, the results are available. Figure 3 shows the characteristics of the Marshall asphalt mix containing sisal fiber. This experimental study evaluated the Marshall mix design method of adding sisal fiber to modified asphalt concrete. The binder content varies (4.5% to 5.5%). The number of samples of bituminous mixture obc is 20 samples. The best binder content has been found to be 5%. The fiber content varies with the percentage of length (0.1% 0.3% 0.5% 0.7%) and 8 mm, 12 mm, 16 mm and 20 mm, and the Marshall test was performed on 32 Asphalt Mix Samples.

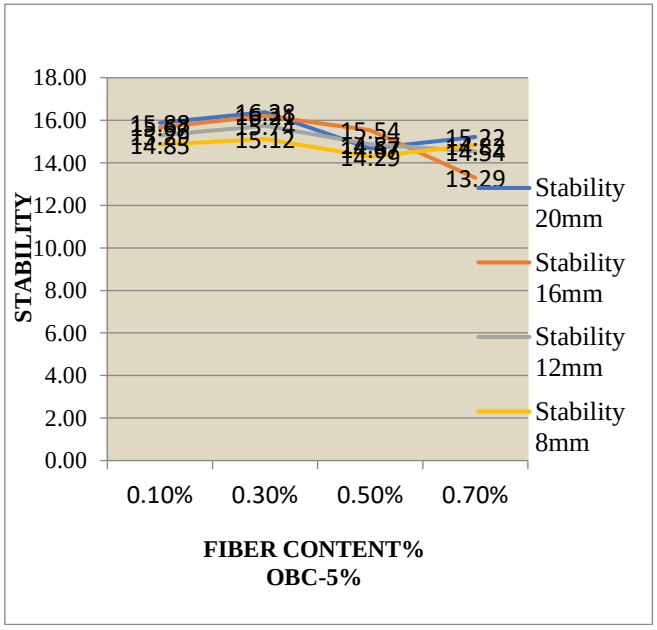

Figure 1: Asphalt Mix Samples

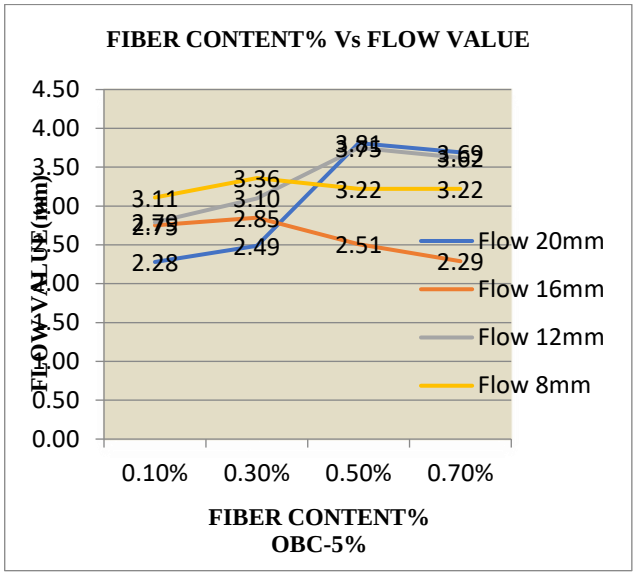

Figure 2: Fiber Content % vs flow value

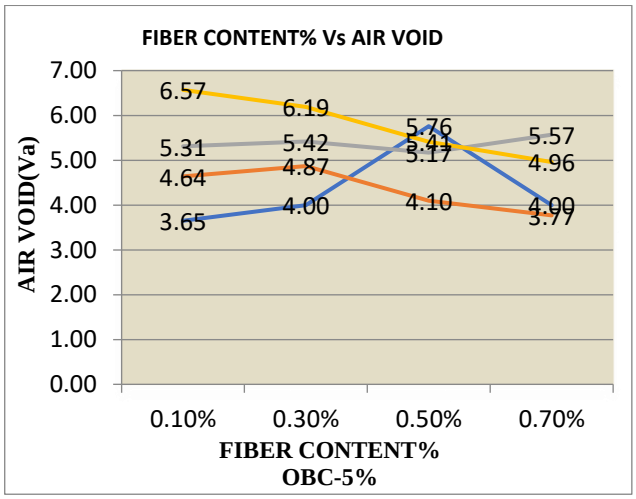

Figure 3: Fiber content % vs Air void

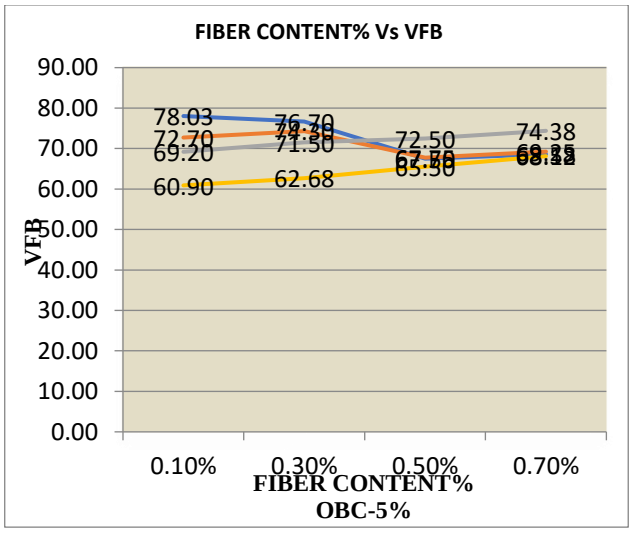

Figure 4: Fiber content % vs VFB

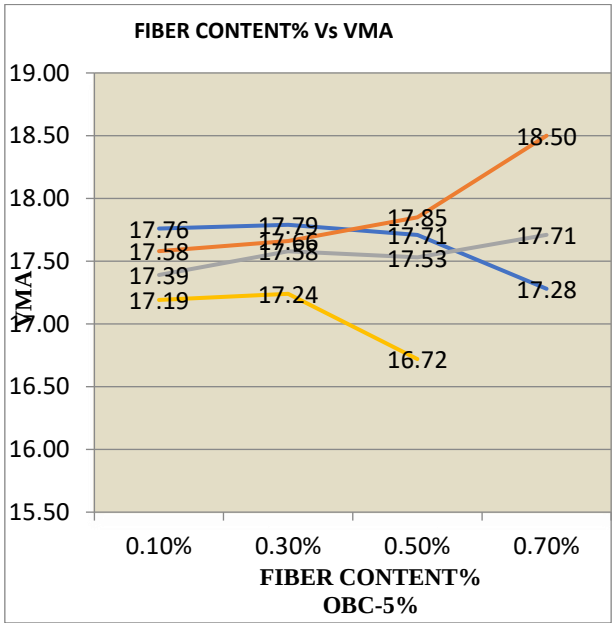

Figure 5: Fiber content % vs VMA

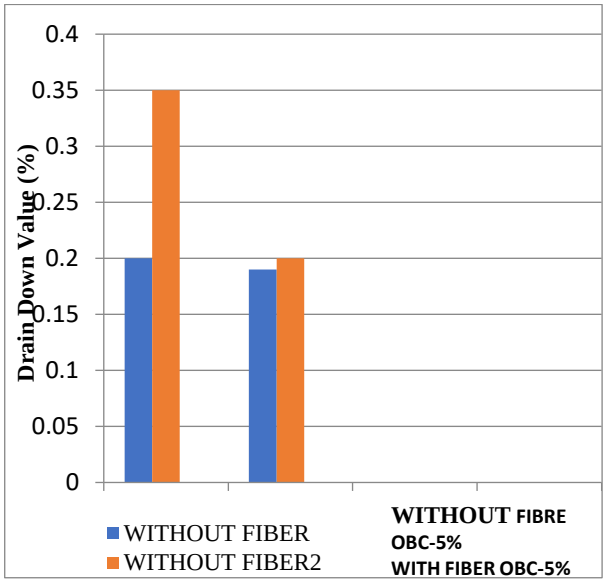

Figure 6: Show the different variations of flow for the different ratios

B. Drain Down Test

Various methods are available for assessing the drainage properties of bituminous mixtures. The drain down proposed by MORTH (2001) was taken up by this study. Shows local drainage baskets produced in accordance with MORTH (2001) requirements [19-20]. The loose and uncompacted blending was then transferred into the drainage bucket and maintained for three hours in a pre-heated oven kept at 150 ° C. Under the drainage baskets, weighted plates were kept for collection of drained binding drippings. Bituminous concrete has been obtained in this current study with the content of optimum bitumen and fiber content. The drain tests were performed by drain-down method of fiber-and fiber-free samples ans Table 4 shows the different values of drain test for Sample 1 and sample 2. Fig1 to 6 Show the different variations of flow for the different ratios.

Table-4 Drain Value for Sample 1 & Sample 2

Bitumen mixes	Drain down value (Sample 1)	Drain down value (Sample 2)
1. Without Fiber (OBC-5%)	0.2	0.35
2. With fiber (OBC-5% FC-0.3%)	0.19	0.2

IV. CONCLUSION

Following are the conclusion from entire research:

- It is observed that after adding 0.5% sisal fiber, 16mm fiber length and 4% pitch content, the stability of the mixture increases, but when adding more than 0.5% fiber content, the stability begins decrease.
- The fiber content is increased to 0.5%, the fiber length is increased by 16mm and the asphalt content is increased by 4%. Porosity and flow value have been shown to have decreased. Therefore, the consistency of the asphalt has changed and it becomes difficult.
- After adding SS1 emulsion coated sisal fiber, the mix drainage stops or slows, showing good asphalt characteristics.

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