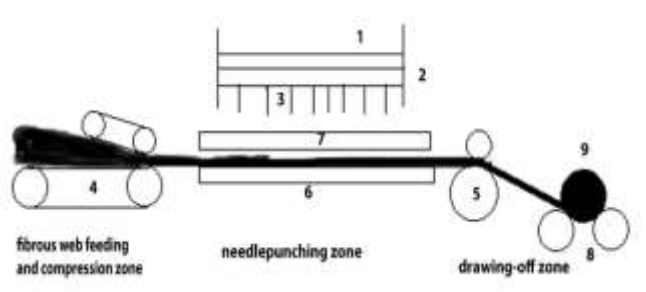
Investigation on Nonwoven Fabrics Made From Mesta Fibre



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INTRODUCTION

Mesta is a bast fibre, which grows extensively in India and in some parts of Eastern Asia. It is used as a substitute for jute.

The fibre of Mesta is obtained from stem of *Hibiscus sabdariffa* var*altissima* and *Hibiscus Cannabinus*, family Malvaceae. *Hibiscus sabdariffa* and *Hibiscus Cannabinus* denote varieties of the two species.

The area, which favours for Mesta fibre cultivation are within the jute belt, the yield of Mesta is high in West Bengal, Bihar, Assam and Tripura. Outside the jute belt, the highest acreage is in Andhra Pradesh and the areas assuming importance are Dandakaranya, Orissa, eastern Madhya Pradesh, Maharashtra, Karnataka and Uttar Pradesh. Other states grow *Hibiscus Cannabinus* types over small areas, mostly for home consumption. Yield in the drier areas is a less than that in the humid ones.

The favourable climatic conditions are a warm and humid climate suits both *Hibiscus sabdariffa* and *Hibiscus Cannabinus* varieties. Both these varieties grow in drier rain fed areas, the latter being more drought-resistant.

In areas with 500-900 mm of rain fed, *Hibiscus Cannabinus* suits better by virtue of its shorter duration and faster growth. Neither variety can withstand prolonged water-logging. Both the kharif crops and are sown in April-June with the first showers of the monsoon. Heavy, continuous rains and low temperature are harmful.

It is extracted as a bast fibre retting is done in the same manner as in the case of jute, but the low temperature and the paucity of water or both pose a problem. The harvested stems of both *Hibiscus Sabdariffa* and *Hibiscus Cannabinus* can be stored under dry conditions for retting next season during the middle of the monsoon. The resulting *Hibiscus Cannabinus* fibre is better than that of *Hibiscus Sabdariffa*. Retting in the current season, if possible, is always preferable.

The quality of the Mesta fibre is judged based on almost the same criteria as in the case of jute and the grading is done on the same lines, although the I.S.I. specifications are now due.

In previous studies, S.K.Sen stated that the molecular structure of the hemi-cellulosic Mesta fibre is same as that of jute and flax so Mesta can replace jute but the stiffness of the fibre is little high so the fibre requires softening treatment for further processing.

Article by Vigneshwaran & Jayapriya stated that Cellulase enzyme and mixed enzymes would modify the stiffness, tenacity and strength of the Mesta fiber. The effect of mixed enzyme is greater than Cellulase enzyme.

Samanta stated application of 4% mixed enzyme on jute fiber offers much finer, softer, cleaner and brighter jute fiber with some lowering of bundle tenacity.

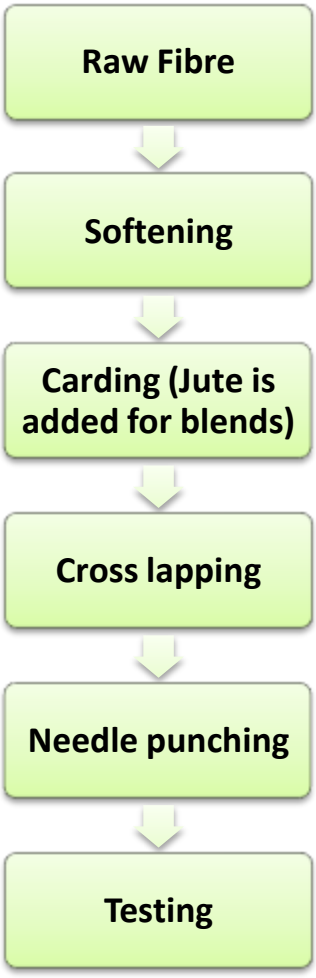
The research by Gautam Basu stated treatment of jute with 0.5-1% amino-silicone softener under specified condition causes noticeable reduction in co-efficient of friction. With some lowering in tenacity values 1% mixed enzyme treatment of jute fibers shows some advantages like reduction tenacity and specific work of rupture.

In this paper, we used the softening technique suggested by Samanta.

MATERIALS AND METHODS

Raw Fibre:

The fibres used for producing the nonwoven is the Mesta fibre with 50mm staple length and the fineness of the fibre is about 249m.tex and the jute fibre with 50mm staple length.



Softening:

We have treat the raw mesta fibre with 4% of mixed enzyme solution consist of cellulase, xylanase and pectinase at room temperature for about 1 hour.

Carding:

To produce the 100% mesta nonwoven fabric we have carried out the usual carding process used for jute fiber and for the rest of the blend proportions we have blended the jute and mesta fibre during the feeding of carding process.

Blend Propotions

We have processed the follwing blend proportions:

- 100 mesta
- 50% mesta with 50% jute.
- 70% mesta with 30% jute
- 80% mesta with 20% jute
- 90% mesta with 10% jute

Cross-Lapping :

The web which is obtained from the cading process are laid using the cross lapper to have a required thickness inorder to process in the needle punching machine to have a uniform nonweven fabric. For all the blend propotions we have carried out the same procedure and same thickness.

Needle Punching

The needle-punching process is illustrated in Figure-1. This mechanical interlocking is achieved by thousands of barbed felting needles repeatedly passing into and out of the web.

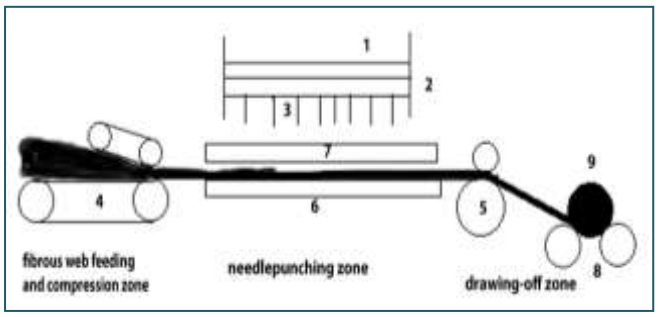


Figure 1

1. Needle beam,
2. Needle board,
3. Needles,
4. Feed table,
5. Draw in rollers,
6. Bed plate (lower hole plate),
7. Stripper plate (upper hole plate),
8. Draw off rollers,
9. Nonwoven.

The material is processed in dilo loom of OD-2/6 model. The working width of the loom is around 600mm with two down strokes of 60 mm. the stroke frequency of the loom is about 120strokes/min.

The infeed of the material is 0.40 m/min and the out feed of the material is 0.36 m/min. the stitch density of the loom is 1cm and the stitch density is 15 needles/inch^2.

Results & Discussions:

GSM: (AATCCD3776-96)

Sr. No	50M:50J	70M: 30J	80M: 20J	90M:10J	100M
1	1055	1097.5	1085	902.5	1032.5
2	1152.5	1002.5	832.5	792.5	1257.5
3	1120	1087.5	1080	967.5	1050
4	1040	1110	810	975	1030
Avg	1091.8	1074.3	951.87	909.37	1092.5

Table-1

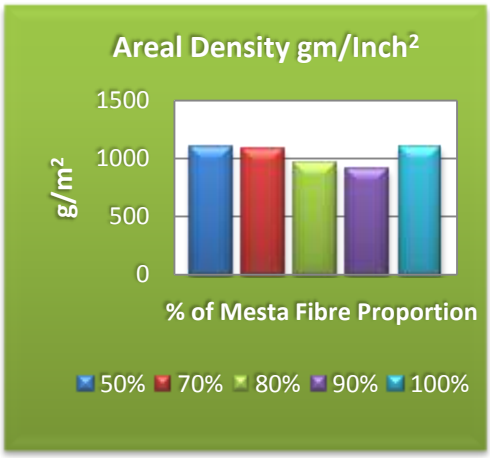


Figure 2

From the above result it observed that the GSM of the 100 % Mesta fibre 70-30 and 50-50 blend is more or less equal. But while analyzing the individual GSM results 100 % pure Mesta fibre have wide range of GSM variation this is due to the high fibre stiffness.

Spray Rating Test:

The blends are tested under AATCC-22 & CNS 10461 for spray test the sample size is 152 sq mm. the results as follows

Sr No	Sample	Standard
1	100M	50 ISO 1
2	90M:10J	0
3	80M:20J	0
4	70M:30J	0
5	50M:50J	0

Table-2

From the above results the absorbency property for all the blend proportions are lower when compared to pure 100% mesta this is due to the inherent property of the fibre so these three blends can be used for sweeping cloth, table mats for the purpose higher absorbency.

Air Permeability:

The testing procedure carried out for testing the air permeability is ASTM D 737-96.

Sr No	Air Permeability (Lt/Min)				
	100M	90M:10J	80M:20J	70M:30J	50M:50J
Area	50 cm^2	50 cm^2	50 cm^2	50 cm^2	50 cm^2
1	89.9	98.5	94.7	91.1	92.2
2	89.9	121.9	97.5	104.2	94.5
3	94	114.9	96.8	91.4	104.2
4	101.6	123.2	95	101.6	94.3
5	85.8	95.6	94.7	93.7	98.3
Avg	91.57	115.97	96.64	95.75	97.27

Table-3

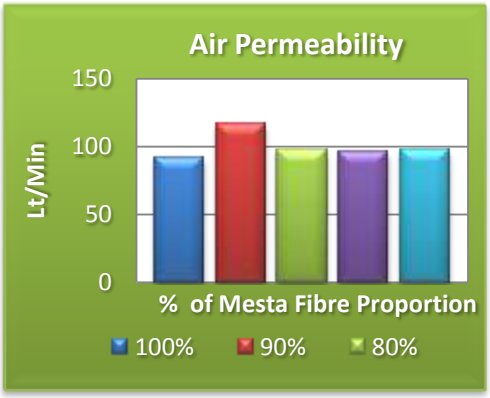
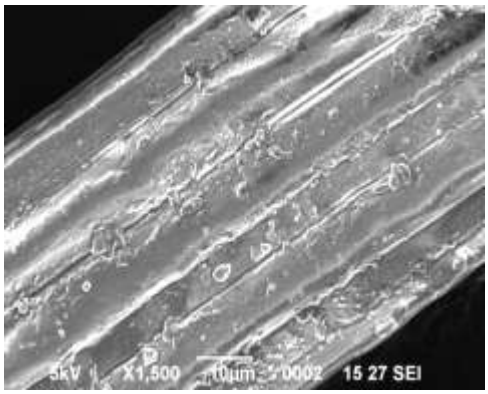


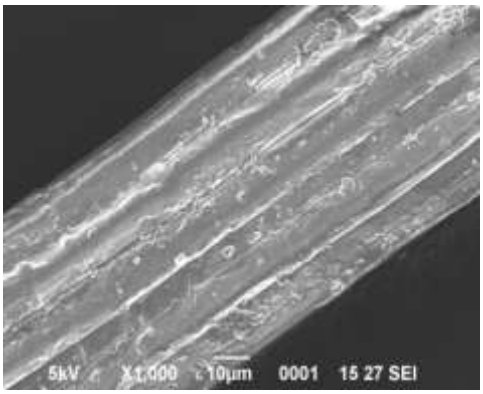
Figure 3

From the above figure-3 it is clearly understood that the air permeability of the 90% Mesta with 10% jute nonwoven is high when compared to other samples so this material can be used as air filtration fabrics. And this can be used as back filling fabrics in A/C ductile instead of jute.

Surface Analysis: (SEM)



Raw Mesta fibre surface



Enzyme treated Mesta fibre surface

Figure 4

SEM report shows that the surface of the enzyme treated Mesta fibre is changed from raw Mesta fibre so it clearly indicates that the enzyme treatment has a desired effect on the Mesta fibre as discussed by Samantha [3]. When it is blended with jute those blends will provide good compatibility due to reduced stiffness.

Tensile Testing

The tensile testing is carried out as per the IST Standard-110.0-70(R82). The results are discussed below.

Maximum Load:

Samples	100M	90M:10J	80M:20J	70M:30J	50M:50J
1	1513.67	1677.25	1097.39	1024.31	1046.19
2	1301.18	1241.83	1129.93	1086.2	1011.93
3	1366.45	1264.45	1120.2	1031.86	1069.58
4	1363.93	1292.86	1113.28	1051.27	1016.98
Avg	1386.31	1369.09	1115.2	1048.41	1036.17

Table-4

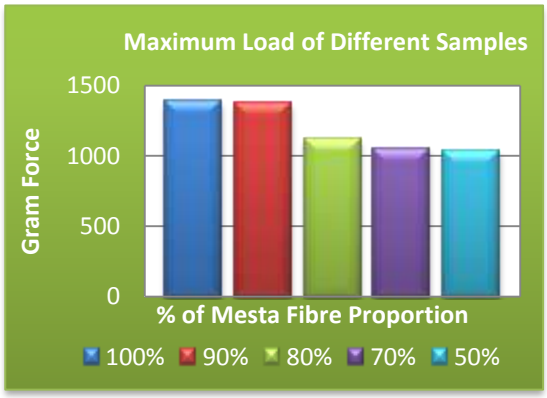


Figure 5

From the above graph (figure-5), it is concluded that the load bearing capacity reduces along with Mesta proportions in its decreasing proportion of Mesta.

Extension at Maximum Load

Sample	100M	90M:10J	80M:20J	70M:30J	50M:50J
1	16.75	5.5	13	8.25	13.75
2	18.5	8.5	9.75	7	22.25
3	15.25	7.75	11.25	6.75	9.5
4	17.2	8.25	4	8.5	16.25
Avg	16.9	7.5	9.5	7.625	15.4375

Table-5

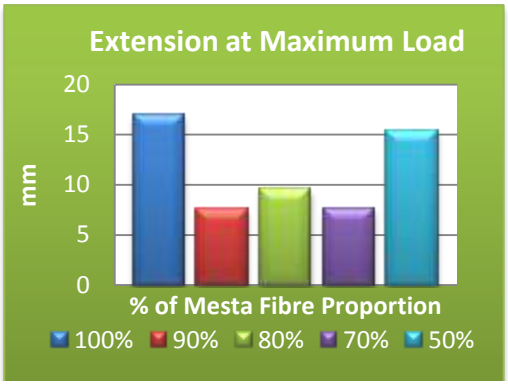


Figure 6

From the above graph, it is noticed that the extension at maximum load of the Mesta and 50% Mesta and 50% jute is high when compared to other samples.

Tenacity at Maximum Load:

Samples	Tenacity at Maximum Load (gf/tex)
100M	255.74
90M-10J	84.61
80M-20J	53.06
70M-30J	197.39
50M-50J	47.42

Table-6

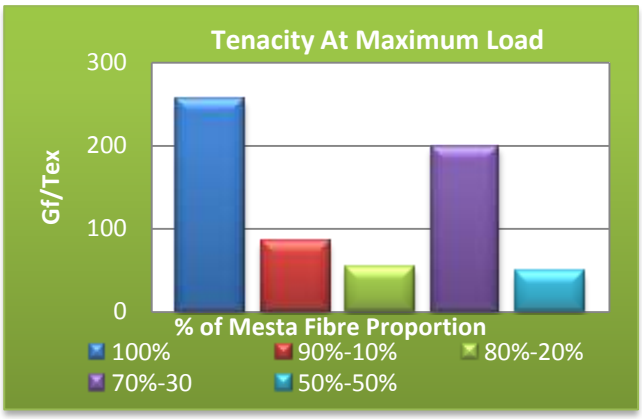


Figure 7

From the above graph (figure-7) it is clearly shown that the tenacity at maximum load of 100% Mesta nonwoven is high the reason for this is due to its higher stiffness of the fibre even though the stiffness is reduced to some extent by enzyme treatment one cannot remove the entire stiffness in the fibre.

Tearing Strength:

The fabric tear strength is tested with the help of Elmondorf tear strength tester under IST standard 100.0.70(R82). The results as below.

S.No	100m	90m: 10j	80m: 20j	70m: 30j	50m: 50j
1	145	148	148	144	148
2	143	149	147	130	146
Avg	144	148.5	147.5	137	147

Table-7

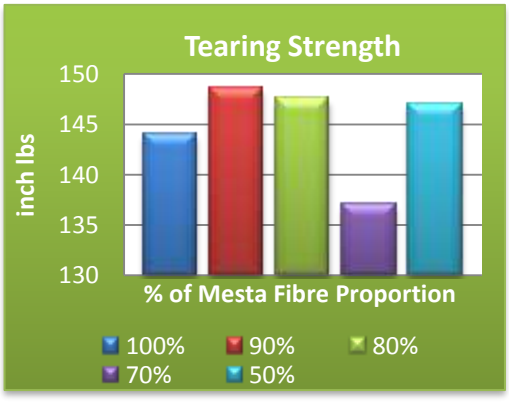


Figure 8

From the Tear strength results it is clear that 90-10 blend have higher tearing strength value. Here the pure Mesta have lower tearing value when compared to 100% Mesta sample due to the internal GSM variations in the pure mesta sample.

Stiffness Testing

The fabric stiffness is assed with the help of cantilever stiffness tester according to the IST 90.1-86 standard and the results are discussed below.

Bending Length:

Samples	50M:50J	70M:30J	80M:20J	90M:10J	100M
1	69	82	83	80	72
2	67	84	81.5	78	75
3	72	85	84.5	75	73
4	69	87	80.5	81	76
5	75	83	81	77	74
Avg	70.4	84.2	82.1	78.2	74

Table-

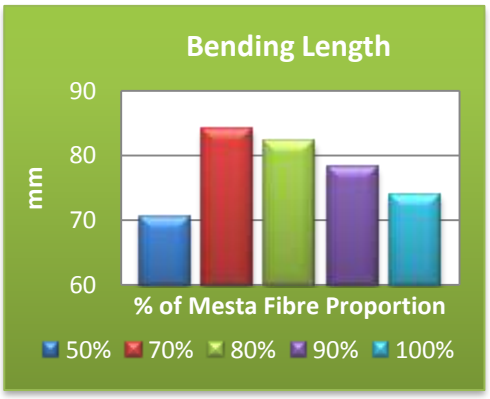


Figure 9

From the bending length result it is clearly noticed that the bending length of 70% Mesta with 30% jute is very high when compared to other samples.

Flexural Rigidity:

Sample (%)	Flexural rigidity in µN.M (×1016)
50M:50J	1.217
70M:30J	1.216
80M:20J	1.253
90M:10J	1.273
100 M	1.279

Table-9

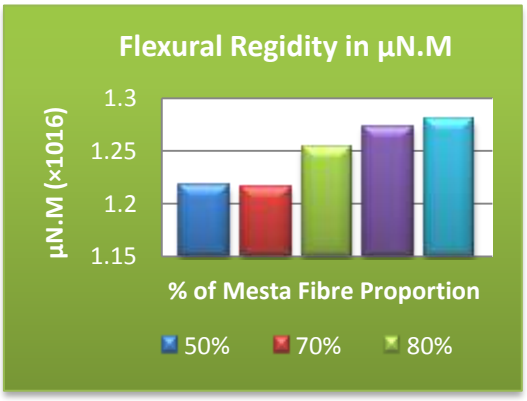


Figure 10

We have come to the conclusion from the above flexural rigidity result that the 100% Mesta fibre sample have high flexural rigidity than the other samples due to the high stiffness of fibre. The flexural rigidity decreases as the amount of Mesta fibre in the sample decreases.

Sound Absorbency Test

The results from obtained from the sound absorbency test as follows.

Sample	Percentage of Absorption
50M:50J	11.65
70M:30J	11.5
80M:20J	11.58
90M:10J	11.36
100M	11.3

Table-10

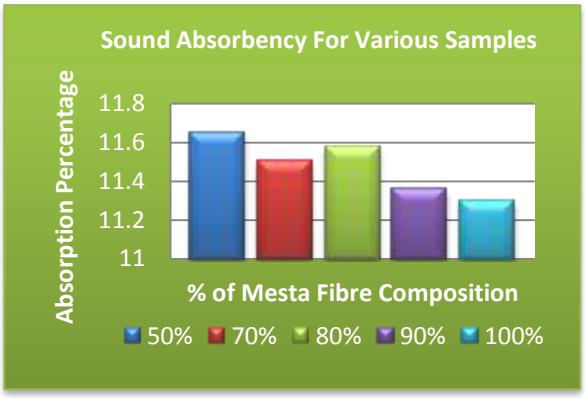


Figure 11

From the sound absorbency, result for various samples the percentage of sound absorbed is more or less equal but the values slightly reduced as the reduction in the Mesta fibre content.

CONCLUSION

From the above study, we have concluded the following:

1. Mesta fibre have high stiffness by proper enzymatic treatment we can reduce the stiffness.
2. 100% pure Mesta nonwoven has more unevenness due to the fibre stiffness.
3. The Mesta fibre blended samples have very good absorbency.
4. Air permeability and tearing strength is high for 90% Mesta 10% jute sample.
5. 100% Mesta sample have good tensile properties and flexural rigidity.
6. Sound absorbency reduces as the reduction in composition of Mesta fibre.

These nonwoven materials can be used as:

- Scrubber
- Floor mats
- Carpets
- Quilting for automobiles
- Heat insulation materials in home textiles
- Apparel accessories