RESEARCH ARTICLE OPEN ACCESS

Disposable Natural Scrubber from Sisal and Bamboo Fibers

T. Rasigha*, S. Kirthika**, M. V. Dheepika**, K. Giridharan**, N. Jeyaprakash**,
*Assistant Professor, Department of Fashion Technology, Kumaraguru College of Technology, Coimbatore
**B.Tech Scholars, Department of Fashion Technology, Kumaraguru College of Technology, Coimbatore

ABSTRACT
Medical Textiles describes a textile structure that has been designed and produced for use in any of a variety of medical applications. The medical textiles include a vast range of applications, viz, adhesive tapes, bandages, beddings, blankets, castings, diapers, dressings, eye pads, gauzes, protective clothing's, sutures, surgical covers, surgical clothing's, swabs, supports, sanitary products, hospital gowns, etc. Consumers have become more aware about the repercussions of leading an unhygienic lifestyle, which has lead to the increase in the number of hygiene conscious people. This has lead to the smart take off of the medical textiles which enables the common man in prevention and treatment of diseases and maintain health and hygiene.
A range of natural fibers and biodegradable polymers is being utilized for developing new products in medical textiles. Medical textiles adding a more serious dimension to the textile domain, they are required to undergo stringent testing and hygienic criteria. This has led to innovative use of a variety of natural unconventional fibers and a lot of developments are taking place in this area. One of such unconventional fibers finding good application in the medical textile is Sisal (Agave sisalana).
Agave sisalana, consisting a rosette of sword-shaped leaves has been used to extract fibers. Fibers have been extracted by decortication process. The extracted fibers have been cleaned with Sapindus Mukorossi, an herbal cleaning agent which is also hypo allergenic. The cleaned fibers have been softened using various methods, one with alkali treatment and another with citric acid. The various stages of fibers namely raw, cleaned, alkali treated and citric acid treated fibers have been tested for their absorbency and anti-microbial activity. Agave sisalana fiber has been found to have better antimicrobial properties which make it suitable for medical textile application.
Key words — *Sisal, Antimicrobial, Sapindus*

I. INTRODUCTION

Medical Textiles has always been a part of Healthcare. Medical Textiles are products and constructions for Medical applications. As Healthcare is growing, off take of Medical Textiles is also on increase. Present day society is undergoing changes like large population size, need of increasing his life span of every individual, various situations and hazards of human activity and civilization including transport accidents, chemical materials, fire, cold, diseases, and sports. Such factors increase the demand of medical textiles.so there are several researching work are going on all over the world in medical textile materials [1].

Although textile materials have been widely adopted in medical and surgical applications for many years, new uses are still being found. Research utilizing new and existing fibers and fabric-forming techniques has led to the advancement of medical and surgical textiles. At the forefront of these developments are the fiber manufacturers who produce a variety of fibers whose properties govern the product and the ultimate application, whether the requirement is absorbency, tenacity, flexibility, softness, or biodegradability [2].

Fibers undergo degumming to reduce the plants' glue-like or gum content and render them clean and spinnable. The fiber degumming technology will make it more competitive and enhance its suitability for end uses [3].The fibers can be degummed and biodegradability of fibers can be improved with alkali treatment [4].

A scrubber is generally used for rubbing out or removing the dirt and dead cells present on the surface of the skin. There are varieties of scrubbers available like body scrubber, foot scrubber, face scrubber which can be selected for using based on the skin type. A foot scrubber is mainly meant for the feet exfoliate or moist the skin. Since the skin on feet tends to be coarser than elsewhere, it takes a stronger kind of scrub.

Sisal fiber is biodegradable, it is recyclable, it has high antistatic property, it absorbs dye easily, it can be treated with borax for fire resistance properties, it has an impact absorbing property. Depending on climatic conditions, sisal will absorb air humidity or release it, causing expansion or contraction, it has antimicrobial property. It naturally exfoliates and deeply invigorate, leaving skin feeling ultra-smooth and revitalized. Massage over the body in a circular motion to create lather and cleanse skin.

It also helps to shed dead skin cells to improve the texture of the skin, leaving it soft, silky and radiant. These sisal fibers to be softened to enhance its property to be suitable for the end use [5] [6].

Bamboo fiber is a biodegradable, it is recyclable, it has antimicrobial property, it has antistatic property, it has high deodorization property, it has high hygroscopicity, it has excellent permeability, it has a good property of easiness to straighten and dye [7].

The objective of the project is to replace artificial fibres in to natural fibres for the production of natural scrubber. There are variety of fibres available for using up in medical textiles. Among them sisal and bamboo fibres are chosen because they are natural, bio degradable and ecofriendly for the manufacture of the natural scrubber.

II. EXPERIMENT

2.1 Materials:

2.1.1 Sisal Fibers have been extracted by decortication process. After procurement of the fibers, they were cleaned with sapindus, an organic cleaning agent, in order to remove impurities. The fibres cleaned with Sapindus is subjected to a pre-treatment process called degumming so as to remove wax and other pectin contents using NaOH,HNO_3,$Na_2CO_3$of varying concentrations [8].The degummed fibres which showed the better chemical composition are then subjected to softening using citric acid. Finally sisal fiber is then blended with bamboo fiber in order to improve its suitability for various composition of scrubber such as

SB 30:70 – 30% Sisal and 70% Bamboo
SB 40:60 - 40% Sisal and 60% Bamboo
SB 60:40 - 60% Sisal and 40% Bamboo
SB 50:50 - 50% Sisal and 50% Bamboo

2.2 Methods

2.2.1 Cleaning of fibers with Sapindus (Soap Nut):
For cleaning organic cleaning agents called (Soap Nut) were used. They were used as a traditional method of cleaning. Organic cleaning products have major health and environmental advantages [11]. The 10% concentration of Sapindus solution was prepared to treat 10 grams of bagasse fiber with a M:L ratio of 1:0.1 till the boiling point.

2.2.2 Degumming of Sisal Fibre

The cleaned fibres with sapindus is subjected to a pre-treatment process called degumming so as to remove wax and other pectin contents [5][6]. The cleaned fibers was degummed with the following chemicals in varying concentration as shown in table 2.1 till boiling temperature.

Table 2.1 Chemicals used for sisal fiber degumming

Chemicals	Chemical Concentration	Time
Na_2CO_3	3%	30MIN
Na_2CO_3	4%	30MIN
NaOH	1%	30MIN
NaOH	2%	30MIN
HNO_3	3%	30MIN
HNO_3	4%	30MIN
NaOH	1%	3HRS
NaOH	1%	6HRS
NaOH	3%	3HRS

2.2.3 Softening of Sisal Fibre:

The degummed fibres are then subjected to softening. Citric acid of 3% is added to sisal fibre for 30 mins till boiling point with m:l ratio of 1:10 .Then the fibres are removed from the solution , washed and dried. Thus the softened fibres as shown in Figure 2.1 are taken for further process.

Figure 2.1 : Softening of Sisal Fibre

2.2.4 Evaluation of processed fibers

The processed sisal fiber with NaOH should better chemical composition result was further softened with citric acid was blended with bamboo fiber in varying ratio to form non – woven sheet using needle punching. These blended non woven fabric are tested for following tests as shown in Table 2.2

Table 2.2 Test methods and standards for blended non-woven fabric

Non woven fabric	Testing standards
Abrasion Test	ASTM D4966
Tearing Strength	ASTM D5734-95(2001)
Fabric Thickness	ASTM D 5729 (07.02)
Water Absorbency Test	MA001-1-diapers-worldwide.com

III. RESULTS AND DISCUSSION

3.1 Chemical Composition:

Table 3.1 Degumming of sisal fiber- Lignin and Cellulose

Chemicals	Chemical Concentration	Time	Lignin	Cellulose
Raw Fibre	-		8%	80%
Na_2CO_3	3%	30MIN	6%	80%
Na_2CO_3	4%	30MIN	6%	81%
NaOH	1%	30MIN	7%	80%
NaOH	2%	30MIN	7%	80%
HNO_3	3%	30MIN	8%	80%
HNO_3	4%	30MIN	8%	80%
NaOH	1%	3HRS	7%	80%
NaOH	1%	6HRS	5%	83%
NaOH	3%	3HRS	4%	85%
Citric Acid	3%	3HRS	3%	90%

From the Table 3.1 the amount of lignin and cellulose content% in each processed fiber can be analyzed based on the concentration of chemicals, time and lignin and cellulose ratio. The sisal fiber treated with Na_2CO_3 (3%) for 30min the lignin content is 6% and cellulose content is 80%. The sisal fiber treated with Na_2CO_3 (4%) for 30min shows the lignin content of 6% and cellulose is 81%. The fibers treated with NaOH (1% & 2%) for 30min the lignin content is 7% and cellulose is 80%. The sisal fibers treated with HNO_3 (3% & 4%) for 30min the lignin content and cellulose content is 8% and 80% respectively. The sisal fiber treated with NaOH (1%) for 3hrs and 6 hrs shows the lignin content as 7% and 5% respectively, the cellulose content is 80% and 83%. The sisal fiber treated with NaOH (3%) for 3hrs shows the lignin content as 4% and cellulose content as 85%.

Table 3.2 Chemicals used for softening sisal fiber

Chemicals	Chemical Concentration	Time	Lignin	Cellulose
Acetic Acid	3%	3HRS	3.5%	85%
Citric Acid	3%	3HRS	3 %	90%

From the table 4.2 the amount of lignin and cellulose content% in each processed fiber can be analyzed. The sisal fiber treated with actic acid (3%) for 3hrs the lignin content 3.5% and cellulose is 85%. The sisal fiber treated with citric acid (3%) for 3hrs the lignin content 3% and cellulose is 90%.

Among them NaOH (3%) and Citric acid (3%) are chosen because of presence of higher cellulose content ie.,85% in NaOH treated and 90% in citric acid treated fibres and also less lignin content ie.,4% in NaOH treated fibres and 3% in citric acid treated fibres. These fibres are chosen for further processes.

3.2 Abrasion Test:

Table 3.3 Abrasion test results of non-woven samples

Test sample	Abrasion (%)
SB 30:70	10.85
SB 40:60	10.38
SB 60:40	9.16
SB 50:50	9.45

The table 3.3 shows the abrasion test for the blended nonwoven sample. The sample SB 30:70 shows higher abrading capacity of 10.85% followed by SB 40:60 of 10.38%. The samples SB 50:50 show the result of 9.45% which is merely similar to SB 60:40 which show the result of 9.16% which is comparatively lower than other blends. The results indicates that the samples ` less sisal content and more bamboo content gives maximum abrasion% to the fabric when compared to the ss ratio of nonwoven fabric samples.

3.3 Elmendorf Tearing Test

Table 3.4 Tearing strength results of non-woven samples

Test sample	Tearing strength (CN)
SB 30:70	1600
SB 40:60	1380
SB 60:40	1813
SB 50:50	1646

The Table 3.4 shows the tearing strength for the blended nonwoven sample. The sample SB 60:40 shows higher tearing strength of 1813 CN followed by SB 50:50 of 1646. The sample SB 30:70 shows the strength of 1600 CN which is merely similar to SB 50:50 and the sample SB 40:60 shows the strength of 1380 CN which is comparatively lower than other blends. The results indicates that more blend ratio of sisal fiber in the sample gives more resistance to the fabric from tearing and this indicates higher sisal blended non-woven fabric can withstand maximum tension when compared to the higher ratio of bamboo blended nonwoven fabric sample.

3.4 Thickness:

Table 3.5 Thickness test results of non-woven samples

Test sample	Thickness (MM)
SB 30:70	24.6
SB 40:60	24.8
SB 60:40	32.4
SB 50:50	20.8

The table 3.5 shows the thickness for the blended nonwoven sample. The sample SB 60:40 shows higher thickness of 32.4mm followed by SB 60:40 of 24.8mm. The samples SB 30:70 shows the thickness of 24.6mm which is merely similar to SB 40:60 and the sample SB 50:50 show the thickness of 20.8mm which is comparatively lower than other blends. The results indicates that more blend ratio of sisal fiber in the sample gives more thickness and this indicates higher sisal blended non-woven fabric can have maximum thickness when compared to the higher ratio of bamboo blended nonwoven fabric sample.

3.5 Water Absorbency:

Table 3.6 Water absorbency of non-woven samples

Test sample	Water absorbency(sec)	Distance travelled(cm)
SB 30:70	10	7
SB 40:60	12	8.2
SB 60:40	8	6.4
SB 50:50	11	5.8

The table 3.6 shows the water absorbency for the blended nonwoven sample. The sample SB 60:40shows higher water absorbency rate of 8 sec with a distance of 6.4cm travelled in spreading followed by SB 30:70 of 10sec which spreads up to 7 cm. The samples SB 50:50shows the absorbency duration of 11sec with a spreading rate of 5.8cm and the sample SB 40:60 that spread upto 8.2cm. The results indicate that availability of maximum amount of sisal fibers in the sample absorbs the fluid easily when compared to other blends.

IV. CONCLUSION

Based on the physical tests results, the following conclusions have been made:

In chemical composition test the result shows a positive version for NaOH and citric acid

- Citric acid shows a maximum cellulose content of about 90% and minimum lignin content of 3%
- NaOH shows the next maximum amount of cellulose content of about 85% and less lignin content of about 4%

In abrasion test, the samples with high bamboo content shows maximum abrasion % when compared to other samples

- The sample SB 30:70 shows high abrasion% of 10.85%
- The sample SB 60:40shows very less abrasion% of 9.16%

In Elmendorf tear test the sample with high sisal content showed more strength when compared to other samples.

- The sample SB60:40 showed maximum tear strength of 1813CN
- The sample with less sisal content ie., SB 40:60 showed minimum tear strength of 1380 CN

In thickness test the maximum result was shown in the ratio having maximum sisal content

- The sample SB 60:40 showed maximum thickness of 32.4 mm
- The sample SB 50:50 showed less thickness of 20.8mm

In water absorbency test, the result indicates that the sample with high sisal content shows maximum absorbing capacity

- The sample SB 60:40 absorbed 5ml of water in 8secs which is maximum when compared to other samples
- The sample SB 40:60 absorbed 5ml of water in 12 sec which showed less absorbing capacity.

REFERENCES

[1.] K.Nagappandy, "Emerging trends and opportunities of medical textiles in health care industry," Apollo hospitals, Chennai.

[2.] Richard Horrocks, and Subhash C Anand, "Handbook of Technical Textiles", Woodhead Publishing, October 2000.

[3.] D. Gopalakrishnan & R K Aswini, "Nonwovens For Medical Textiles", fiber2fashion.com

[4.] Jackson, M.B. 1977. Review article: The alkali treatment of straws. Animal Feed Science and Technology 2:105-130

[5.] Khan MR, Tsukada M, Gotoh Y, Morikawa H, Freddi G, Shiozaki H, " Physical properties and dyeability of silk fibers degummed with Citric acid", Bioresour Technol 2010 Nov; 101(21): 8439-45.

[6.] Enguo Wang, Wenxing Chen and Jiaye Wu, "Microwave Effect in Sisal fiber Degumming", Advanced Materials FResearch Vols.332-334(2011) pp 213-216.

[7.] K Saravanan and C Prakash, Bamboo fibres & their application in textiles The Indian textile journal, April 2007

[8.] P. E. Zwane1 and R. M. Cloud, "Degumming of Sisal Fibres", Food Science Department, Faculty of Agriculture, University of Swaziland,