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DEVELOPMENT OF NON -WOVEN DISPOSABLE SWEAT PAD FABRICS FOR PROTECTIVE APPLICATIONS

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ABSTRACT

Natural fibres are abundant in nature and easily degradable but goes unnoticed. Sweat pads are of prime importance to protect the garment from unwanted stains and keeps your odour free. It is made of non-woven fabric by forming webs taken from fibre and bonded together by chemical, mechanical or solvent treatment. Mostly synthetic materials and PE film is used which may be hazardous to environment as it takes time to decompose. Natural fibre such as bamboo, banana can be good substitute for synthetic materials in terms if wicking effect. The sweat pad developed in this study is a sandwich of three layers made of natural fibres which plays its role in these layers. The developed fabric was tested under qualitative physical, mechanical, and comfort properties, the results expressed the good comfort and strength properties and also it can be more pertinent for developing sustainable products using textiles.

KEYWORDS: Natural Fibres, Wicking, Absorption Capacity, Non-Woven, Wettability, Air Permeability.

1. INTRODUCTION

Sweat pads are of prime importance to protect the garment from unwanted stains and keeps the fabric odour free. It is mostly made of non-woven fabric by taking out webs from fibre and bonded together by chemical, mechanical or solvent treatment. Mostly synthetic materials and PE film are used which may be hazardous to environment and skin as it takes time to decompose and made of chemical components. Natural fibres such as bamboo, banana can be a good substitute for synthetic materials in terms of wicking effect. This sweat pad is a sandwich of three layers made up of natural fibres.

Top layer is hydrophilic in nature. It should transfer the fluid to the absorbent core. The best suited fibre is organic cotton.It is super comfortable as it comes in contact with the skin. Organic cotton wicksmoisture and dries quickly; resists pilling and abrasion.

Middle or absorbent layer is made of bamboo cotton blended yarn. Bamboo cotton blend is the best suitable for this product as cotton is porous and breathable and bamboo is said to have softness and air permeability and anti-microbial (Afrin et al,2009).The main function of this layer is to absorb and retain fluid. It should be placed between top layer and barrier layer. Here, we are using bamboo cotton as it has the appropriate properties. Special property of bamboo cotton is fast drying behaviour. 50:50–blended fabric gives better thermal comfort and mechanical properties (Abdul Basit et al,2018).

Bottom or barrier sheet should absorb the sweat and moisture.This gets attached to the garment. So, it should prevent from staining or leakages. It should be breathable but fluid impermeable. This is made up of organic cotton.This layer should not let out the moisture as it may stain the fabric where it is attached to (Nalan Devrent et al, 2017).

Aloe vera has good antibacterial property which is an essential aspect for any hygiene wear (Nalan Devrent et al,2017).Terminalia chebula powder is commonly used as fixing agent for aloe-vera finish done by dip and dry method to the centra layer. The three layers are then joined together by stitching. Apart from normal disposable sweat pads made from polyester based raw materials, this innovation is eco-friendly, innovative and with no doubt serves its purpose.

2. MATERIALS AND METHODS

Materials

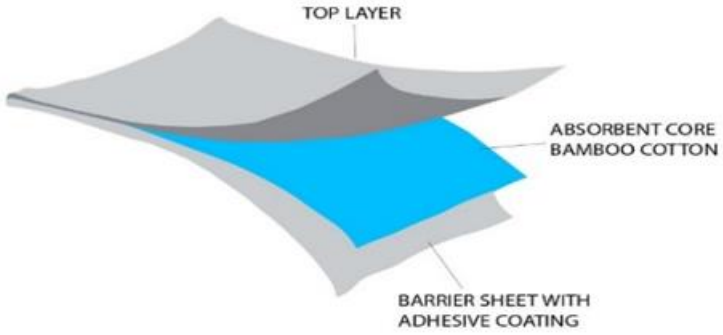
2.1.1 Selection of textile fibres

The selection of fibers are mainly based on the comfort properties of different layers There are three layers were commonly constructed.

The TOP LAYER: Top layer must be hydrophilic in nature.It should transfer the fluid to the absorbent core. The Organic cotton is kind to both skin and the environment. Hence, it is considered to be the best replacement for other super absorbent polymers.

ABSORBENT CORE: The Main function is to absorb and retain fluid.It should be placed between top layer and barrier layer.Here, bamboo cotton blendwas used as it has the appropriate properties like absorbency, super soft innature and being used for other hygiene wears.

BARRIER SHEET: This gets attached to the garment, so it should prevent from staining or leakages.It should be breathable but fluid impermeable.This is made up of organic cotton.



2.1. 2 Blending of fibres

Each layer is a non-woven material made by taking out the web out of selected fibres. Bamboo and cotton fibre were taken and cut into short staple fibres and blend together to produce web. The web was then laid as spunbond non-woven fabric. Bamboo and cotton fibre were blended in 50:50 and 70:30 proportion as well for experiment purpose.

2.1.3 Selection of fabrication method

Bamboo and cotton fibre were procured individually and blended to produce a non-woven fabric by spun bond method. Absorbent layer was given special finish with aloe-veraby dip and dry method. GSM of bamboo cotton is 60s. Organic cotton non-woven fabric was made of GSM 50s which is used as top and bottom layer. The three layers were then stitched together and as an adhesive, the tissue tape was used to attach the pad to the garment we wear.

2.1.4. Fabric Production of samples.

FABRIC LAYERS	GSM
100% cotton nonwoven fabric	25
Untreated 50:50 bamboocotton non-woven fabric	50
Untreated 70:30 bamboo cotton fabric	50
Treated 50:50 bamboo cotton non-woven fabric	50
Treated 70:30 bamboo cotton non-woven fabric	50

2.1.5. Selection of application of special finish

The Developed samples were coated with special coating of aloe vera herbal antibacterial finish by pad dry cure method with standard conditions. The antibacterial finish was carried out using dip and dry method. Aloe-vera was processed using hand filtered. Top and bottom layer of the leaf was removed to extract the gel which was made into a solvent form. The solvent was mixed with water containing terminalia chebula(powder). The container was closed and left undisturbed overnight. The fabric was dipped in the solution for 2 hours. It was then shade dried to remove wetness. The following receipe was followed for coating the finishing on fabric samples namely Temperature - 50 degree Celsius,Ph -5, and Time duration of 30 minutes with the M:L Ratio of .1:10.

2.2 Methods

The are variety of methods are used for assessing the physical, mechanical, comfort and durability properties of untreated and aloevera treated fabric samples.

2.2.1. TESTING OF PHYSICAL PROPERTIES

2.2. 1.1.FABRIC WEIGHT AND THICKNESS - ASTM D3776-96(2002)

Five specimens were selected from each fabric sample. Fabric Selvedge or edge of fabric swatch were excluded while choosing the specimen. Results were commonly reported in grams per square metre (g/m2). mua=m/a where mua=mass per unit area, in g/m^2 :a= specimen area, in m2; and m = mass of specimen, in g.

2.2.2. TESTING OF MECHANICAL PROPERTIES

2.2..2.1. TENSILE STRENGTH-ASTM DS035-9S Standard test method for breaking strength and elongation of textile fabrics (strip test)

The Strip test method was selected.. In the tests the entire width of the specimen was gripped in both the upper and lower jaws. The ravelled strip test is only used for woven fabric and specimens were prepared by removing threads from either side of the test piece until it is the correct width. The cut strip test is used for fabrics that cannot have threads removed from their sides such as knits, non-woven, felts and coated fabrics. The test specimens were prepared by accurately cutting to size. Machine used: CRE (Continuous rate of extension)

2.2.3. TESTING OF COMFORT PROPERTIES

2.2.3.1AIR PERMEABILITY-ASTM D737-96(Standard Test Method for AirPermeability of Textile Fabrics)

This test method covers the measurement of the air permeability--the rate of air flow passing perpendicularly through a known area under a prescribed air pressure differential between thetwo surfaces of a material. A circle of fabric is clamped into the tester and through the use of a vacuum, the air pressure is made different on one side of the fabric. Airflow will take place from the face with advanced air pressure, all the way through the fabric, to the side with the lower air pressure. The rate of air flow and the air permeability of the fabric was determined by test readings.

2.2.4 TESTING OF THERMAL PROPERTIES

2.2.4.1. WICKABILITY TEST

The ability of the material is to not only absorb sweat but to move it away from body. For this test, strips of material were clipped to a bar at a fixed height above beakers of water and dye. The distance of water travels up the material was measured at various intervals over thirty minutes. Specimens was taken and suspended vertically with its ends dipping into the solution (50g dye in 500ml of water) and wicking height with respect to time was noted.

2.2.4.2.WETTABILITY TEST

This test is to determine resistance of fabric to surface wetting. Specimen of say 150mm dia was taken and fixed over a 150mm embroidery hoop which was mounted at 45 degree to horizontal. A funnel was fitted with a standard nozzle containing 19 holes of specified dia was held 150mm above fabric surface.250ml of distilled water was poured into the funnel to give continuous shower on to the fabric. The hoop and specimen were removed and tapped twice against a solid object on opposite points of frame, the fabric being kept horizontal. Spray rating was assigned using standards given.

2.2.5. FINISH DURABILITY PRODUCT TESTING

2.2.5.1. DURABILITY TESTS

The fabric samples were taken and detergent was added and the finish treated fabric samples were washed by hand washing method of different cycles.. By this method, the durability of finish was assessed by different wash cycles.

3. RESULTS AND DISCUSSION

The physical, mechanical, comfort, thermal and durability properties of untreated and treated samples test results were discussed.

3.1 Physical Property tests

The fabric weight and fabric thickness of untreated and aloevera extract treated test results are shown in the table 1.

Table 1: Fabric weight and fabric thickness test results of untreated and aloevera treated samples.

Samples	Thickness in mm	Fabric weight GSM
100% Organic Cotton	1.5	50
Untreated bamboo-cotton (50:50)	0.5	25
Untreated bamboo-cotton (70:30)	0.5	25
Treated bamboo-cotton (50:50)	1	34
Treated bamboo-cotton (70:30)	1	34

The top and bottom layers with organic cotton, 1.50 mm thickness were taken with 50 GSM. For absorbent core, untreated bamboo-cotton of ratios 50:50 and 70:30, 0.5 mm thickness and 25 GSM are taken. It was observed that the thickness and GSM for both 50:50 and 70:30 bamboo cotton were increased after the infusion of special finish with aloe-vera. Hence, the overall product was constructed with 4 mm thickness and 5 g weight with organic cotton as top and bottom layers and 70:30 treated bamboo cotton as the absorbent core.

3.2 Mechanical Property tests -Tensile Strength

The **Tensile Strength** of untreated and aloevera extract treated test results are shown in the figure 1.

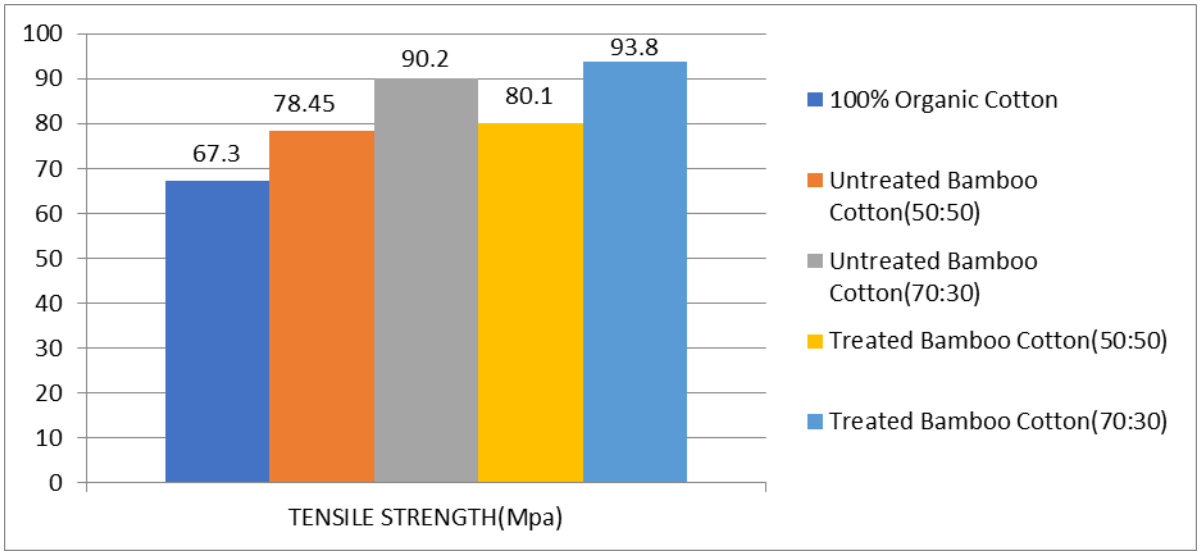


Figure-1: Tensile Strength test results of untreated and aloevera treated samples.

From the above graph, it is evident that the treated 70:30 bamboo cotton shows higher rate of tensile strength. As tensile strength property is essential because of the constant movement of the body, the absorbent core must have the good value in this property to prove the withstanding capacity. From the testing, it is clear that all the three layers showed greater results in terms of tensile strength assuring the durability of the product to be long.

3.3 Comfort Property tests:Air Permeability

The **Air Permeability** of untreated and aloevera extract treated test results are shown in the figure-2

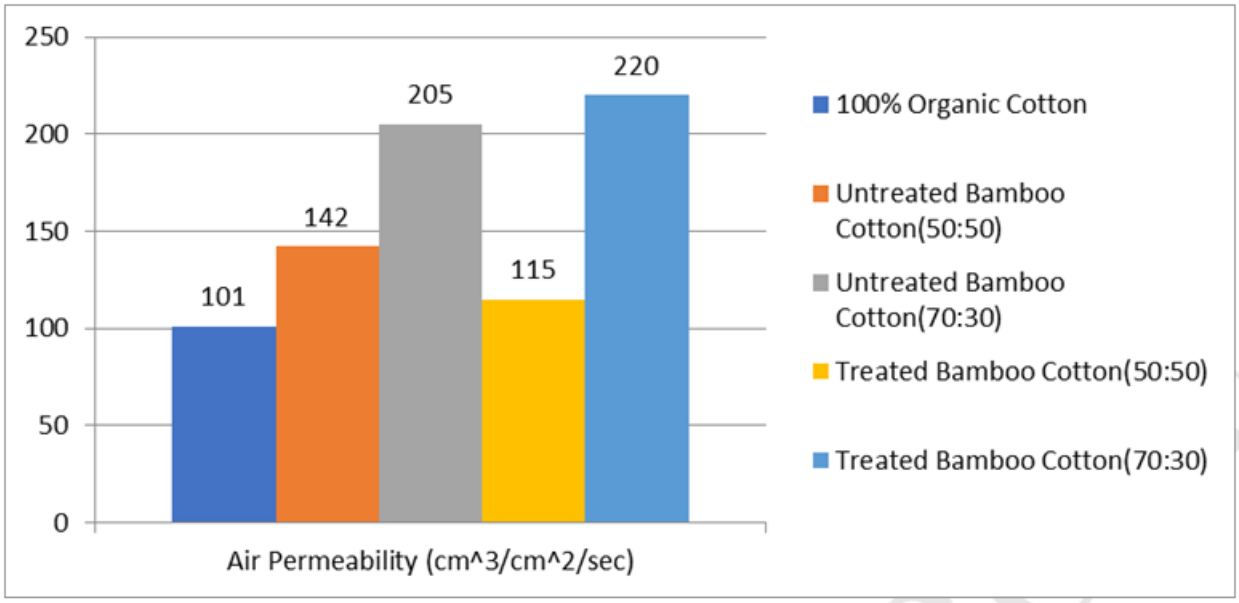


Figure-2: Air permeability test results of untreated and aloevera treated samples.

From the above graph, it is evident that the bamboo cotton blend shows higher value in terms of air permeability assuring the breathability of the fabric. To preserve the odour and not diffuse the sweat smell, air porosity plays its role to let air in and maintain the balance. Though all the three layers show required air permeability readings, treated 70:30 bamboo cotton blend stands higher proving to be the best fabric for the absorbent core to assure the comfort property of the product.

3.4: Thermal Property tests

The Wickability and wettability of untreated and aloevera extract treated test results are shown in the table -2 and table-3.

Table 2: Fabric wickability test results of untreated and aloevera treated samples.

SAMPLES	WICKING FOR 10 MINS (in cm)
100% Organic Cotton	11
Untreated bamboo-cotton (50:50)	14
Untreated bamboo-cotton (70:30)	20
Treated bamboo-cotton (50:50)	16
Treated bamboo-cotton (70:30)	26

From the above table, it is clearly shown that wicking property of treated 70:30 bamboo cotton is higher than that of treated 50:50 bamboo cotton as well as untreated 50:50 and 70:30 bamboo cotton. As wicking property is essential for any hygiene wear, the absorbent core for which the bamboo cotton blend was used has showed higher value as expected. The top layer which was reserved for organic cotton shows required wicking property assuring to pass the absorbed fluid to the next layer.

Table 3: Wetting test results of untreated and aloevera treated samples.

SAMPLES	WETTING TIME IN SECS
100% Organic Cotton	4
Untreated bamboo-cotton (50:50)	4
Untreated bamboo-cotton (70:30)	5
Treated bamboo-cotton (50:50)	4
Treated bamboo-cotton (70:30)	6

From the above tabulated test results, it is clearly proven that 70:30 bamboo cotton has higher rates of wetting property as bamboo is overruling in this proportion. The value for top layer (ie) organic cotton, it was noted as 4 seconds which clearly proves that the layer absorbed the fluid within a short time showing greater result. The product is proven to maintain its finish and strength even after usage for long hours. This shows that the product can hold the sweat for more than 8 hours without any leakage or discomfort.

3.5. FINISH DURABILITY PRODUCT TESTING

The fabric samples was washed and dried for 10 repeated times. Then durability of finish were found by noticing changes when wash cycle increased..After the 10^{th} cycle of wash, the finish on the fabric diminishes..so the finish will withstand up to nearly 10 wash cycles.

4. CONCLUSION

This product was developed with a notion of reducing the use of harmful substances in hygiene wear and to make the product by entirely using natural fibres.Nature's abundant resources like organic cotton,bamboo and aloe-vera which has the desirable qualities is being utilized for different end uses.Organic cotton is used as top and bottom layers due to its various advantages such as good air permeability and bamboo cotton blendis used as absorbent layer for its good absorbency property and softness. Bamboo cotton fabric is proved to be a better substitute for SAP. Through the tests conducted, it was proved that it has considerably good wicking property and soft feel. To impart anti-bacterial herbal finish to absorbent layer, aloe-vera gel with terminalia chebula as a mordent were used to give anti-bacterial finish by dip and dry method .It was then tested and observed that the zone of inhibition showed good result for treated bamboo cotton (70:30) fabric compared to bamboo cotton(50:50).To conduct necessary tests in-order-to evaluate the results, various tests such as Wickability, Air permeability and Durability were conducted. The results clearly stated that Cotton and bamboo is proved to have all the requirements to be used in hygiene wear. After 10 wash cycles, the product was found to withstand the agitation to a greater extent. Overall, these natural resources are available easily and many such products can be developed as there are environment friendly and at the same time kind to skin. Based on the qualitative anti-bacterial assessment, the aloe-vera finished fabric can be used for hygiene wear. As all the raw materials used is 100% natural, it is renewable and has sustainable benefits.

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