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EFFECT OF SURFACE MODIFICATION ON COMFORT PROPERTIES OF INNER LAYER LYOCELL FABRIC IN MULTILAYERED TECHNICAL TEXTILES

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ABSTRACT: Lyocell microfibre fabrics were produced using rapier weaving machine, which is to be used as inner layer while developing the Multilayered Technical Textiles. The lyocell microfibre fabric has been treated with plasma using low pressure Oxygen. Then the plasma treated and untreated fabrics were dyed using reactive dyes. The dyed lyocell fabrics of plasma treated and untreated were tested for the comfort properties such as Wickability, Air Permeability and Water Vapour Permeability. The results of the study confirmed that there is a significant improvements in Wickability and Air permeability of plasma treated fabrics which are essential characteristics for inner layer of the Multilayered Technical Textiles. The significant improvements due to new porus in the treated fabrics allow more air to penetrate and also to increase the Wickability. Where as the Water Vapour Permeability characteristics of the untreated fabric have better results than plasma treated fabrics due to new etching on the surface of the treated fabrics which retain more vapour than untreated fabrics. The Plasma treated lyocell fabric can be used as inner layer for the development of Multilayered Technical Textiles.

Keywords: Microfibre, Lyocell, Plasma, Reactive, Water Vapour, Wicking, Multilayered Fabrics.

1. INTRODUCTION

The plasma is an ionized gas and at a high temperature the molecules in the ionized gas gain energy. The energy is used to modify the surface of the textile materials to produce new pores and etching effects. This resulting in improvements in certain characteristics of textile material such as absorbency, wickability and air permeability when compared to conventional fabrics. From an ecological point of view plasma technology has many advantages such as ecofriendly and less pollution when compared to conventional methods of chemical wet processing.

Recently, plasma treatments have been investigated for producing hygroscopicity in fibers, making them more comfortable which suit for sports and active wear. Plasma treatment of polymers results in etching and changes in a microstructure on the surface by occurrence of new functional groups and cross linking of macromolecular chains.

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Plasma processes have been utilized to improve the surface properties of fibres in many applications. The fibres that can be modified by plasma include almost all kinds of fibres, likes metallic fibres, glass fibres, carbon fibres and organic fibres. Microfibers are very fine fiber compared to conventional fibers that define its unique and desirable properties. Microfibers are synthetic fibres that are finer than any other natural fibres. Microfibers are usually produced in polyester, polyamide, acrylic, modal, Lyocell and viscose in the range of 0.5-1.2 dtex. In this work Lyocell Microfibre is identify to develop inner layer fabrics.

Lyocell is a biodegradable material made from wood pulp cellulose and it is recyclable. Lyocell is an improved fibre, in terms of performance & properties and also friendly to the environment. This work aims at plasma treatment for lyocell microfiber fabrics for improvement in comfort properties and dyeability. The plasma treated fabrics has significantly suitable as inner layer which is kin to skin towards the comfort characteristics.

2. MATERIALS AND METHODS

In this work the inner layer Lyocell fabrics is made out of both warp and weft in Ne 60^s by using 0.7dtex denier fibre in the yarn. The fabric has plain weave with 80grams per square meter weight. The light weight fabric more suitable for the inner layer of multilayered fabric which enhance the better comfort characteristics. In plasma treatment the Oxygen is used and Hydroprneo Vac Technologies apparatus was employed for the treatment of low temperature plasma on the Lyocell fabric. In the treatment, oxygen gas was used as plasma throughout this study. The gas flow rate and plasma temperature were kept at 10 Pa, 4 cc/min and 33°C respectively. The output power used was kept at 300 V and the experiment was carried out for 10 minutes.

The plasma treated and untreated fabrics were subjected to test the comfort properties like Wickability (AATCC 197 /198), Air Permeability (ISO 9237) and Water Vapour Permeability (ASTM E96) by using standard testing procedures.

3. RESULTS AND DISCUSSION

The surface modified lyocell inner layer fabric and untreated fabric have been tested to assess the characteristics of wickability; air permeability and water vapour permeability. The test report have been critically analysed and details are given below

3.1 WICKING

The table 1 shows wicking time in seconds for untreated and plasma treated lyocell fabric in both warp and weft direction at different wicking heights. The wicking time to reach a height of 5cm is 34.34 seconds in warp and 30.20 Seconds in weft direction. The wickability of lyocell fabric treated with oxygen plasma increased from 28% to 40 %.

Table 1. Wicking tests for untreated and plasma treated tencel fabric samples.

Sl No	Sample Particulars	Untreated fabric		Plasma treated fabric	
		Warp wicking Time in Sec	Weft wicking time in Sec	Warp Wicking Time in sec	Weft Wicking Time in sec
1	1 CM	02.99	00.55	02.00	00.57
2	2 CM	08.43	03.42	04.70	02.54
3	3 CM	18.27	10.32	08.99	05.60
4	4 CM	49.55	24.41	19.58	16.21
5	5 CM	56.95	41.89	34.34	30.20

The fig 1 indicates the wicking behaviour of plasma treated and untreated samples and it is absorbed from that the plasma treated lyocell fabrics in both warp and weft directions show a significant reduction in wicking time (sec) indicating a faster rate of absorption.

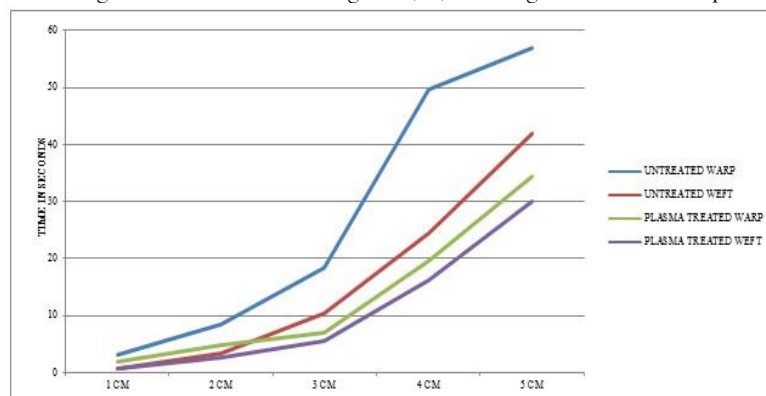


Fig 1. Wickability Curve for untreated and plasma treated samples in warp and weft direction.

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The improvements in the wickability of plasma treated samples are due to the enhancement in the surface roughness property. It is because of the introduction of polar groups which are generated during the oxygen plasma treatments. The wickability of warp is 39.5% and weft is 27.90%.

3.2 AIR PERMEABILITY

In Air permeability test the plasma treated and untreated samples have been assessed by using ISO 9237 standard methods. The Air permeability in of plasma treated sample is 74.16* (cm³ cm² sec) and untreated samples is 56.66*(cm³ cm² sec). The plasma treated samples have 30% more air permeability due to the formation of new pores on the surface of the fabric. The untreated sample has lower value than plasma treated fabric.

*indicates that the samples were statistically significant.

3.3 WATER VAPOUR PERMEABILITY

In water vapour permeability test, the plasma treated and untreated samples were weighed in grams before and after water vapour treatment. The difference in mass is converted into water vapour permeability values which are given in Table 2

Table 2 Water Vapour Permeability for untreated and plasma treated fabric samples

S No	Sample Name	Weight in Grams [Before test] M1 In grams	Weight in Grams [After test] M2 In grams	Loss of Mass in grams M [M1-M2] in grams	Water Vapour Permeability [g/m ² /day]
1	Plasma treated Sample	140.23	132.80	2.43	2155.49*
2	Untreated Sample	139.24	136.55	2.69	2386.12*

*indicates that the samples were statistically significant.

In table 2 indicate that the moisture vapour permeability of the plasma treated sample is lowered than the untreated samples. This may be due to the surface etching that occurs due to the plasma treatment. Surface etching opens the fibres on the surface of fabric which in turn hinders the flow of water vapour through the fabric.

4. CONCLUSION

In the development of multilayered fabrics, the inner layer fabric should have better wickability and air permeability properties in view of comfort characteristics. In this work, the effect of surface modification on comfort properties of inner layer lyocell fabric has been studied. The air permeability of plasma treated fabric has been increased to 30 % when compared with untreated fabric, it is due to new pores have been developed on the surface during plasma treatment which allows more air to penetrate. Similarly the wickability characteristics of plasma treated fabrics has been increased in the range of 28 to 40 %. This is due to its etching nature on the surface while doing plasma treatment. Whereas the water vapour permeability of untreated sample has more as compared to plasma treated sample, it may be due to the pores imparted during the plasma treatments accumulate more water vapour than untreated fabrics.

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