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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 Tecxtiles. 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 Wickablity, Air Permeablilty and Water Vapour Permeablilty. The results of the study confirmed that there is a significant improvments in Wickablilty and Air permeablilty 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 penterate and also to increase the Wickablilty. Where as the Water Vapour Permeablilty 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 temperatur the molecules in the ionized gas gain energy. The energy is used to modify the surface of the textile materials to produced new pours and etching effects.This resulting in improvements in certain characteristics of textiles material such as absorbency,wickablilty and air permeablilty when compare 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 comfort 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 palin weave with 80grams per squre meter weight .The light weight fabric more suitable for the inner layer of multilayered fabric which enhace the better comfort charcteristics. In plasma treatment the Oxygen is used and Hydropneo 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 Wickablity (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 wickablity; air permeablity and water vapour permeablity. 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	
	Wicking Height in CMS	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.

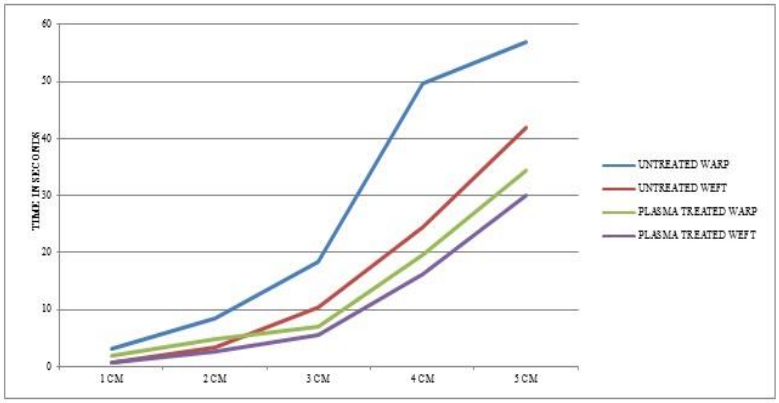

Fig 1. Wickablilty Curve for untreated and plasma treated samples in warp and weft direction.

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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 treatements. The wickablity of warp is 39.5% and weft is 27.90%.

3.2 AIR PERMEABILITY

In Air permeablility test the plasma treated and untreated samples have been assessing by using ISO 9237 standard methods. The Air permeablility in of plasma treated sample is 74.16* (cm3 cm^2 sec) and untreated samples is 56.66*(cm3 cm^2 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 weighing in grams before and after water vapour treatment. The difference in mass is converted into water vapour permeablility values which are given in Table 2

Table 2 Wwater 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 sholud have better wickability and airpermeabliltiy properties in view of comfort characteristics. In this work, the effect of surface modification on comfort properties of inner layer lyocell fabric has been studyed. The air permeablility of plasma treated fabric has been increased to 30 % when compare with untrearted fabric, it is due to new porus has been developed on the surface during plasma treatment which allows more air to pentrate. Smillarlly the wickablity 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 treatement. Where as the water vapour permeablilty of untreated sample has more as compared to plasma treated sample, it may be due to the pours imparts during the plasma treatements accumulates more water vapour than untreared fabrcis.

5. REFERENCE

1. Shishoo.R, *plasma technology for textiles*, **2007**, Woodhead publishing.
2. Keiko Gotoh and Akemi Yasukawa., "Atmospheric pressure plasma modification of polyester fabric for improvement of textile-specific properties", *Textile Research Journal*, **2010**, 81: 368.
3. MoriM and Inagaki N., "Relationship between anti-felting properties and physicochemical properties of wool fibres treated with Air-plasma", *Textile Research Journal,* **2006**, 79: 687-694.
4. Canal C, Erra P, Molina R and Bertran E., "Regulation of surface hydrophilicity of plasma treated wool fabrics", *Textile Research Journal*, **2007**, 77: 559-564.
5. Moravej M, Yang X, Hicks RF, Penelon J and Babayan SE., "A radio-frequency nonequilibrium atmospheric pressure plasma operation with argon and oxygen", *Journal of Applied Physics*, **2006**, 99: 093305. 6. S. Mukhopadhyay. S & Ramakrishnan .G., Microfibres, *Textile Progress,* **2008**, 40:1, 1-86.
6. Marija Gorjanc, Vili Bukošek and Marija Gorenšek, "The Influence of Water Vapor Plasma Treatment on Specific Properties of Bleached and Mercerized Cotton Fabric", *Textile Research Journal,* **2010**, 80: 557.
7. Muryam Naebe, Peter G. Cookson, John Rippon, Rex Peter Brady, Xungai Wang, Narelle Brack and Grant van Riessen., "Effects of Plasma Treatment of Wool on the Uptake of Sulfonated Dyes with Different Hydrophobic",*Textile Research Journal*, **2010**, 80 (7). 611-622.
8. C.M.Mak, C.W.M Yuen, S. K. A.Ku & C.W. Kan, "Low-temperature plasma treatment of Tencel", *Journal Of Textile Institute*, **2006,** vol 97(6), pg 533-540.
9. B. P. Saville., *Physical Testing of Textiles*, Jan **1999**, Woodhead Publishing Limited.

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10. Zeynep Ömerogullari and Dilek Kut, "Application of low-frequency oxygen plasma treatment to polyester fabric to reduce the amount of flame retardant agent", *Textile Research Journal,* **2012**, 82: 613
11. Karahan H.A, Ozdogan E, Demir A, Ayhan H and Seventekin N, "Effects of atmospheric pressure plasma treatments on certain properties of cotton fabrics" *Fibers Text East Eur*, **2009**, vol 73, pg 19-22.
12. Ozdogan E, Demir A, Karahan AA, Ayhan H and Seventekin N. "Effects of atmospheric plasma on the printability of wool fabrics", *Tekstil ve Konfeksiyon* ,**2009,** vol 19, pg 123-127.

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