International Journal of Innovative Research in Science and Engineering
Vol. No.3, Issue 01, January 2017
www.ijirse.com
ISSN (O) 2454-9665
ISSN (P) 2454-0663

AN INVESTIGATION ON MOISTURE FLOW THROUGH MICRO FIBER BLENDED FABRICS

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ABSTRACT

Moisture flow through the blended material is a complex phenomenon. Clothing should possess good water as well as liquid moisture transmission property, for providing the thermo physiological clothing comfort. Higher hydrophilicity of the material is known for good absorption, but how it helps to transmit the moisture, has been studied in the present work. Micro polyester and micro tencel have been chosen as the blended fabric as well as 100% micro tencel & 100% micro polyester fabrics also have been chosen for effective comparison. Water vapor transmission, Liquid water transmission, moisture spreading, thermal conductivity, thermal resistivity and dryability of the fabrics were examined.

Comfort result indicate that water vapor permeability, liquid water permeability, thermal conductivity and moisture spreading of the material increases with the increase in number of hydrophilic group in the material, but it has an adverse effect on dry ability of the material. The dry ability of the material decreases with the increase in the micro tencel proportion.

Further the durability characteristics such as bursting strength and hand characteristics such as drape also were examined and showed no significant difference among the blends.

Keywords*: *Moisture Transmission, Hydrophilicity, Tencel, Polyester Fabric, Micro Tencel Proportion, Drape.

I INTRODUCTION

Around the world rapid changes are calling for a different look and a newer feel in both fashion and fabric. Whether it is woven or knitted, the demand is for something new and different in the world of high fashion. As the worldwide business gears to tackle the challenges, product diversification has become the key to global opportunities (1). Although in the recent past, the textile industry had increasingly focused its attention on higher machine productivity and lower production cost, the current trend within the industry is towards improved wear comfort. Numerous reports have indicated that most of the queries received by the technologists from the consumers are related in one or another, to the comfort aspects of the substrates and consequently common intentions are heading in the direction of further improvement. Modern consumers are interested in clothing that not only looks good, but also feels good (2). Moisture management property

ISSN (O) 2454-9665
ISSN (P) 2454-0663

is an important aspect of any fabric meant for apparels, which decides the comfort level of that fabric. Every human being sweats during different kinds of activities. An important feature of any fabric is how it transports this water out of the body surface so as to make the wearer feel comfortable. So moisture management can be referred to its ability to transport, store, and dispose liquid water and moisture from the surface of the skin to the atmosphere through the fabric. This can be achieved in many ways, namely, by changing the fiber polymer chemistry and by fabric chemical treatments such as enzymatic or alkali treatment.

1.1 Moisture Management

The term 'moisture management' always refers to the transport of moisture vapors and liquid away from the body (Figure 1.2). Today, this is just one aspect of the concept of 'wearer comfort', as the feel of the fabric against skin may include various descriptors, such as clammy, prickly, stiff or dry, etc. In the case of cotton, the hydrophilicity of the fibre itself wicks away the moisture, which passes through the openings in the fibres or yarns, where distinctly accelerated evaporation takes place, resulting in comfort for the wearer. On the other hand, clothing made up of synthetics such as polyester or polyamide, etc, is unable to wick away the moisture/perspiration due to their inherent hydrophobic nature, so the fabric tends to stick to the skin. This impairs the comfort, which is a function of a fit garment. To maximize comfort and to feel cool in synthetic garments, the fabric must allow liquid to wick on to the surface, spread away and evaporate quickly (46).

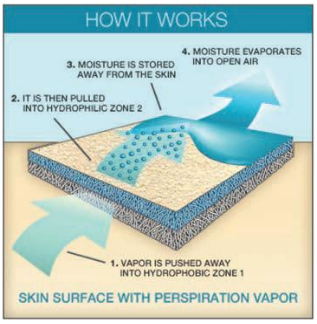

Figure 1: Mechanism of wicking away perspiration from skin

1.2 Need For Moisture Management

For a person engaged in normal routine indoor activity, energy expended is 50 watt/square metre/hour. The metabolic heat generated is readily dissipated through the clothing as sweat. At rest, a body will give off, about 60 ml of water vapor per hour at ambient conditions. Moderate exertion (Walking) will increase the amount to about 450 ml per hour. During high activity eg. Tennis or cycling, the metabolic heat increases six times and perspiration 14 times (840 ml). The energy balance of the human body is shown in figure 2. During such strenuous body activity, the wearer perspires and the cloth worn next to skin will get wet. The sports and leisure wears exert a barrier for efficient transfer of excess heat resulting in a rise in core body temperature and skin temperature greater than 370 C which increases sweating. The excess heat moistures the fabric, which then reduces the body heat and makes the wearer become so tired. So the fabric worn next to skin should have two important properties. The initial and the foremost property is to evaporate the

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perspiration from the skin surface and the second property is to transfer the moisture to the atmosphere and make the wearer feel comfortable (1).

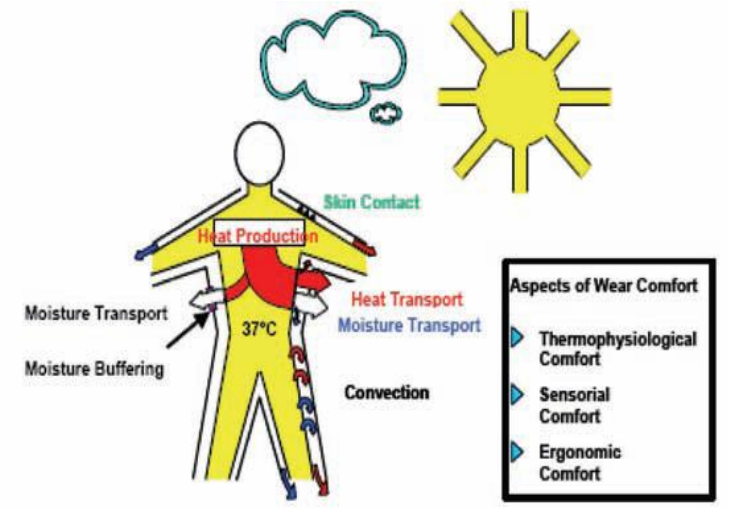

Figure 2: Energy Balance of the Human Body

1.3 Structural Model of Tencel Fibers

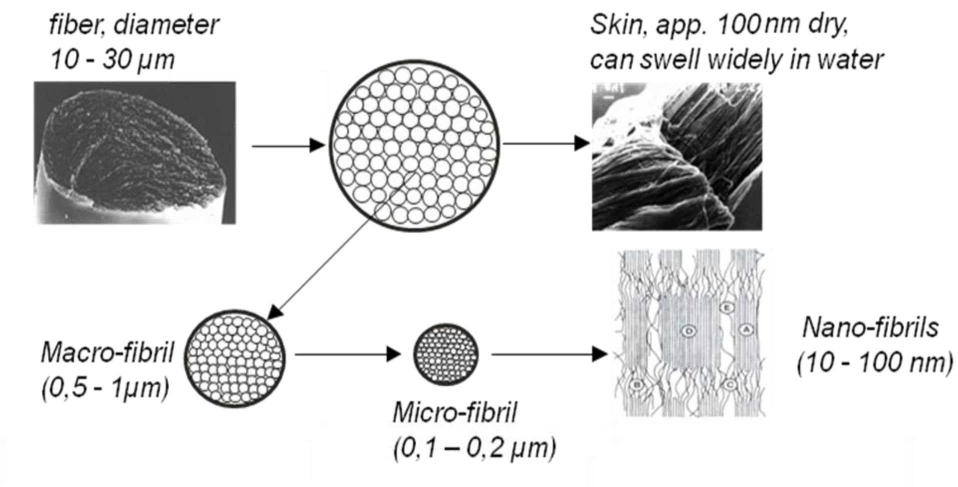

Figure3: Structure of Tencel

1. A TENCEL fiber consists of countless hydrophilic, crystalline nano-fibrils which are arranged in a very regular manner
2. Water absorption occurs only in the amorphous domains and capillaries between the crystalline fibrils
3. A TENCEL® fiber therefore is a unique hydrophilic nano-structure
4. This is the reason for the special water management, the comfort properties and other positive features.

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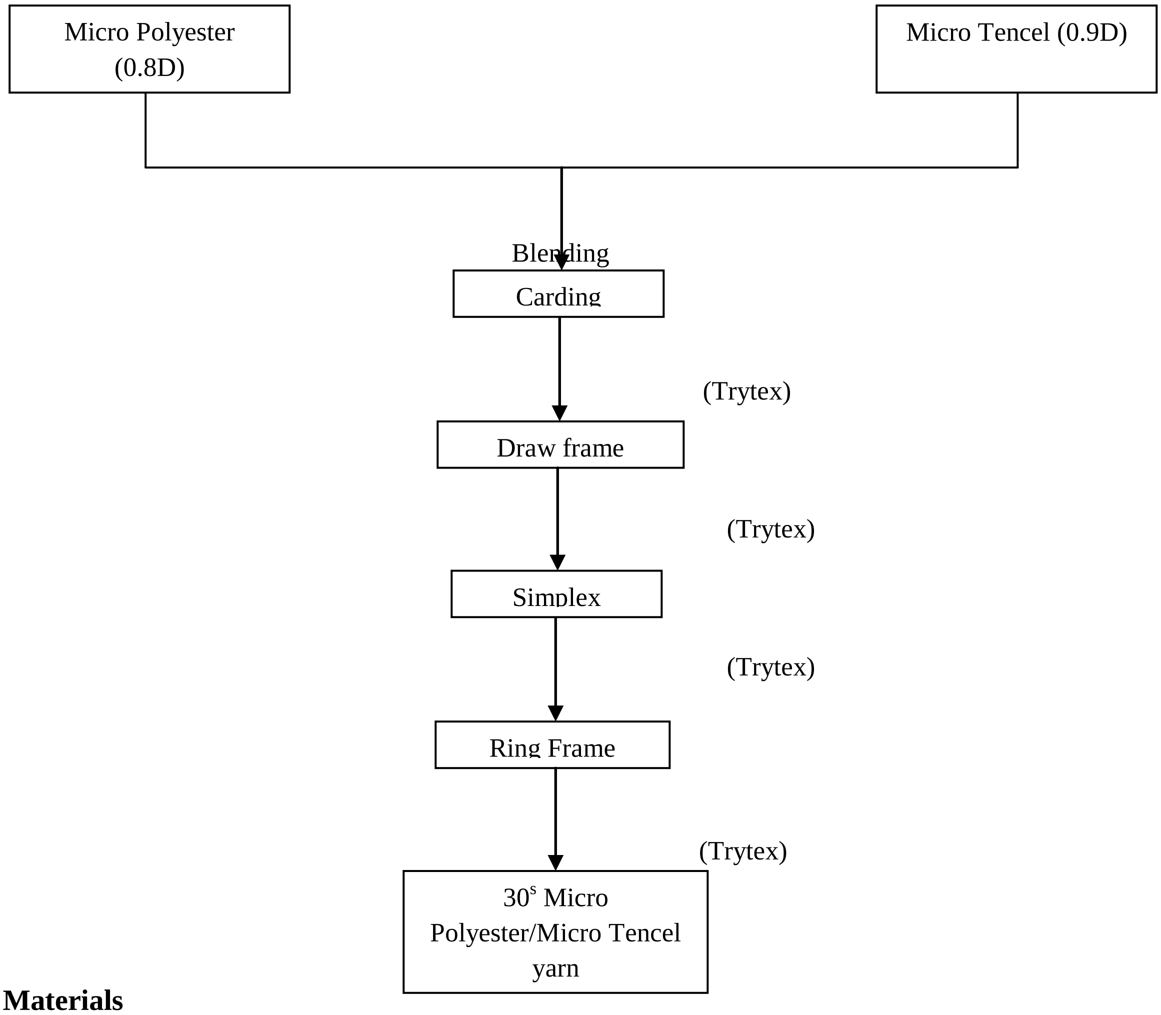
II MATERIALS AND METHODS

2.1 Production sequence of Micro Polyester and Micro Tencel blended Yarns



2.2 Materials

Blending of fibres according to their linear density was carried out at draw frame with the following blend proportion of MP/MT : 85/15, 70/30,50/50,30/70,15/85 and 100% MP & 100% MT. Yarns were spun in the ring frames with a linear density 30s Ne. The yarns thus produced were knitted into single jersey structure.

Yarn count/Type	Fibre	Fibre Denier	Cut length
30^s Ne Ring spun yarn	Micro Polyester	0.8 dpf	38 mm
	Micro Tencel	0.9 dpf	34 mm

Table 1: Material Sample

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III RESULTS AND DISCUSSIONS

The results of this investigation will be discussed in two sections. The first section addresses some of the physical properties of micro polyester and micro tencel blended fabrics. The second section addresses the results of the comfort testing and comparing among the blends and with 100% micro polyester & 100% micro tencel fabrics. The test data for durability and comfort testing are presented with their appropriate graphs in each section. The ANOVA tables are listed in Appendices.

S.No	Properties	100 MT	85:15/ MT:MP	70:30/ MT:MP	50:50/ MT:MP	30:70/ MT:MP	15:85/ MT:MP	100 MP
1.	Count	30^s	30^s	30^s	30^s	30^s	30^s	30^s
2.	Twist/inch	24	26	27	24	23	26	24
3.	Tenacity(gf/tex)	20.81	20.90	25.65	26.48	28.36	28.45	31.70
4.	Extension at maximum (mm)	26	27.5	27.00	26.7	25.3	25.7	25.99

Table 2: Yarn Properties

S.No	Properties	100 MT	85:15/ MT:MP	70:30/ MT:MP	50:50/ MT:MP	30:70/ MT:MP	15:85/ MT:MP	100 MP
1.	CPI(Course per inch)	22	23	23	23	22	22	23
2.	WPI(Wales per inch)	21	22	22	21	21	22	22
3.	GSM	151	152	150	151	152	152	151
4.	Thickness	1.82	1.83	1.81	1.79	1.81	1.81	1.82
5.	Bursting strength(kgs/cm^2)	14.96	14.93	15.46	15.6	15.68	15.75	16

Table 3: Fabric properties

The results of physical properties of such as mass (g/m^2), thickness (mm) and bursting strength are listed in table 3. It shows that the bursting strength increases as increase in micro polyester content in the blend (Appendix7). Further the correlation value is positive and it says that the bursting strength increases as with the increase in the micro polyester content in the blends. (44)

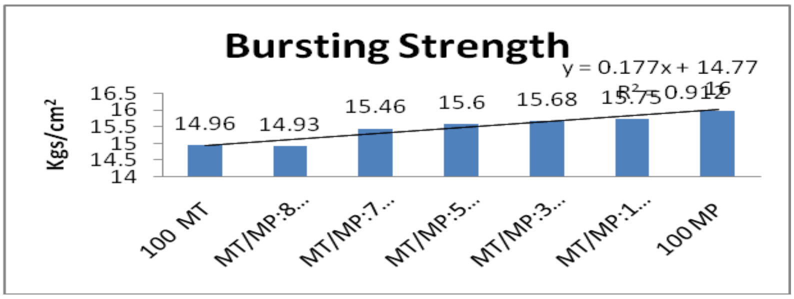

Figure 4: Bursting Strength

It is inferred that the wicking behavior increases with increase in the micro tencel component of the blend. It is stated that the hydrophilicity of manmade cellulosic component of fiber mix governs the liquid moisture transport through capillary interstices in yarns, it may obviously the contributing factor for high wick ability. Further in appendix 2&3, the F (calculated) value in wale direction is 9.913is greater than the F critical (table) value 2.5082 and F (calculated) value in course direction is 14.329 is greater than the F critical (table) value 2.5082. The hypothesis is rejected. Hence we conclude that as the fiber composition varies; there is a substantial variation in wicking behavior.

Brojeswari Das (2009), Dr Naresh M. Saraf explained that higher the spreading rate is due to the decrease in contact angle between the fabric surface & water and increase in inter fibre and inter yarn pores & pores volume of the material. They also stated that the presence of hydrophilic group changed the spreading rate. This may be the reason for high moisture spreading rate for micro tencel rich blends. Further in appendix 6, the F (calculated) value 1803 is greater than the F critical (table) value 2.2464. The hypothesis is rejected. Based on the ANOVA value, the fibre composition varies there is significant difference in the moisture spread rate.

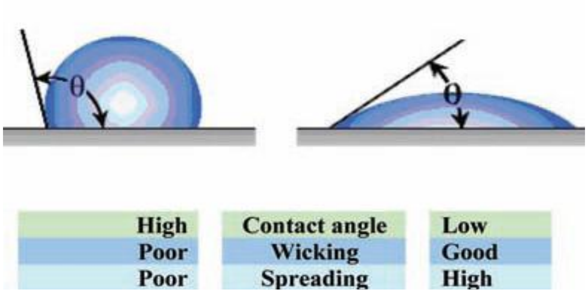

Figure 5: Contact angle between fabric surface and water drop

3.1 Thermal conductivity

It is stated that under a certain condition of climate, if the thermal conductivity of clothing is high the thermal resistivity of clothing is small. So the heat energy gradually reduces, giving a sense of coolness

ISSN (O) 2454-9665
ISSN (P) 2454-0663

and comfort. This may be the reason as the Thermo physiological comfort increases with increase in micro tencel content because of its higher thermal conductivity.

Sample	Thermal conductivity(w/m/k)
100 MT	0.11
MT/MP:85/15	0.095
MT/MP:70/30	0.093
MT/MP:50/50	0.085
MT/MP:30/70	0.075
MT/MP:15/85	0.071
100 MP	0.068

Table 4: Thermal conductivity

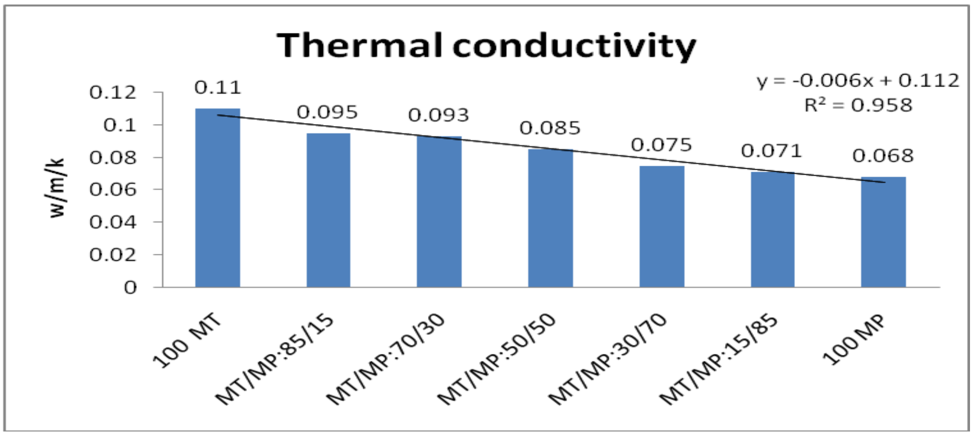

Figure 6: Thermal Conductivity

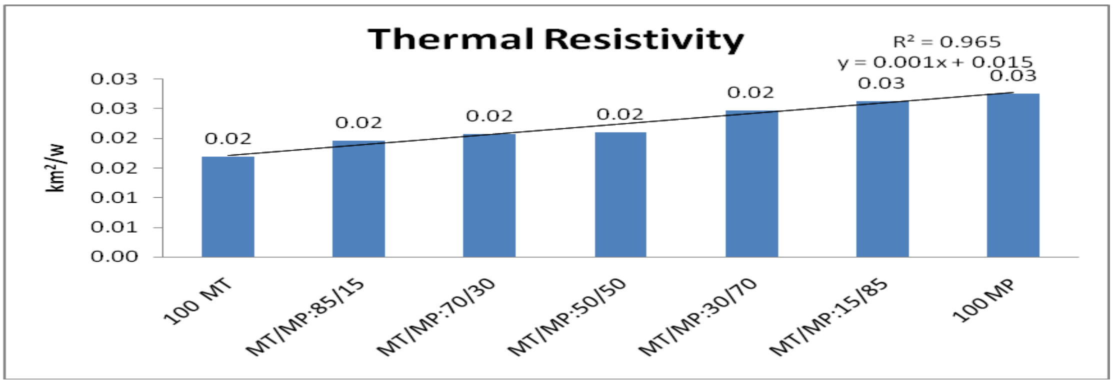

Figure 7: Thermal Resistivity

IV. CONCLUSIONS

The following conclusions are derived from the experimental data:

Regarding durability, for bursting strength the micro polyester rich blend fabric is superior to other blends. Regarding hand, for drape, all the micro denier fabrics shows better drape co-efficient. In addition, statistically speaking, there is no significant difference in the drape among the blended fabrics.Regarding comfort, water vapor transmission, moisture spreading, vertical wicking and thermal conductivity increases with the increase in micro tencel composition of the material. The rapidity or drying rates here greatly influence the thermo physiological comfort, but hydrophilic proportion has adverse effect on drying rate. For high activity wear higher hydrophilicity accounts for moisture accumulation in the clothing causing damp and sticky feeling. Considering the drying rate into account, addition of a small amount of micro tencel enhances the moisture management performance. So among the blends the MP/MT: 85/15 has better moisture management performance for high activity. Generally these blended fabrics are perceived to be more comfortable when worn for normal day-to-day activities. In addition, statistically speaking, water vapor transmission rate, moisture spreading rate, vertical wicking rate and drying rate vary if there is a substantial variation in the fibre composition.

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