

# Comparative Study on Comfort Properties on Modal and Wool Knitted Fabric for Sports Performance

<sup>1</sup>Mrs. S.Geetha Margret Soundri, <sup>2</sup>Dr. S. Kavitha

<sup>1</sup>Research Scholar, R& D Centre, Bharathiar University, Coimbatore, India.

<sup>2</sup>Associate Professor & Head (i/c), Department of Home Science, Mother Teresa Womens University Research and Development Centre, Coimbatore, India.

**ABSTRACT** - In recent years, development in sportswear has been succeeding to perform high function and achieves comfort. It is very important to produce sportswear with comfort, functionality and cost effective. The clothing comfort depends mainly on the feature where human body can sense the state where energy swap over between human body and the atmosphere reaches a state of balance while wearing clothing in different climatic environments. <sup>(1)</sup> The main aim of this study is to develop bi-layer knitted fabric with polyester yarn as an inner layer and wool/modal yarn as an outer layer and analyze the comfort properties.

**Keywords:** Sportswear, comfort, polyester, yarn, bi-layer

## I. INTRODUCTION

Clothing is a important part of human life and has a number of functions: adornment, status, modesty and protection. On the other hand, the prime role of clothing is to form a layer or layers of barriers that protect the body against incompatible physical environments. The term comfort is defined as "the absence of unpleasantness or discomfort" or "a neutral state compared to the more active state of pleasure". In clothing comfort the movement of heat and water vapour through an article of clothing is the most significant factor in comfort clothing. Today comfort is considered as essential property of a textile product. Types of raw materials used, Structure, weight, heat transmission, moisture absorption and skin perception are the necessary comfort characteristics of clothing.

The performance of double layer is better than single layer textile construction. Layering of fabrics in the sports fabric has major effect on thermal resistance; air permeability and moisture vapour transmittance and achieved high level of comfort. Synthetic sportswear shows better performance with significant improvement in the mean skin temperature and comfort sensation rating during exercise. <sup>(2)</sup> In the inner layer of double layer textile, a synthetic layer has good moisture transfer properties and in outer layer a fabric with good absorbency of moisture such as cotton, wool, and modal can be replaced. Wool is hydrophilic fiber, with 13% moisture regain and has good elasticity, with 20–40% elongation at breaking point. <sup>(3)</sup> Wool has good wicking ability and is a good insulator even when wet. Wool fibers have the highest moisture regain of all fiber at a given temperature and relative humidity. <sup>(4)</sup>

Many studies have been carried out to measure comfort factors of clothing. The approaches have been made in this regard, measuring the physical properties of the fabrics which are assumed to be functions of comfort: thermal insulation, air-permeability, moisture management, etc. Considerable researches have been carried out to assess the different factors which influence comfort and methods to impart comfort-lending properties to textile fabrics.

It is very apparent that comfort property take part a complex mixture of properties, both subjective and physical characteristics. Comfort properties like moisture and air through a fabric, movements of heat are more important factor but at the same time some of the subjective factors such as size, fit and aesthetic performance like softness, handle and drape are evidently very essential in the sports clothing. <sup>(5)</sup>

The followings are the physical aspects of comfort:

Thermal properties:

- heat transmission
- thermal protection

Vapour-humidity transmission:

- humidity permeability
- influent elements in vapour permeability

Liquid-humidity transmission:

- water resistant fabrics
- water repellent
- humidity
- absorbent fabrics

Air permeability

- air permeability test
- permeable fabrics production

## II. EXPERIMENTAL ANALYSIS

### MATERIALS

The bi-layer knitted structures were prepared using polyester; wool and modal yarn. Samples were produced in circular interlock jacquard machine with 28 inch diameter, 68 feeders, 18 gauge and 1582 needles. In this work, the bi-layer fabric is developed in which the inner layer is prepared of polyester that is hydrophobic which has good wicking rate. The outer layer is made up of natural and regenerated yarn such as wool or modal which has more absorption character and rapid evaporation. The yarn which has to form as an outer layer is fed into the dial needle and as an inner layer is fed into the cylinder needle. The visual appearance of the structures, the sample code and fabric layers with different views are mentioned below in Figure 1.

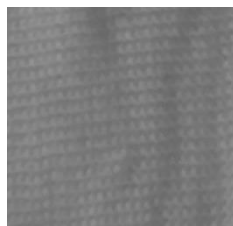



Fabric Type	Inner Layer	Outer Layer	Fabric layer different views	
Sample 1	Polyester	Wool		
			Inner Layer	Outer Layer
Sample 2	Polyester	Modal		
			Inner Layer	Outer Layer

Figure 1 Fabric specifications with different views of bi-layer knitted fabric structures

## III. METHODS

The testing of bi-layer knitted fabric was carried out in the standard room temperature.

### Dimensional Properties

The bi-layer knitted fabrics were measured for their loop length, stitch density, tightness factor, thickness and area density. The thickness measurement of the fabric was carried out according to ASTM D1777-96.

### Air permeability

The air permeability of the clothing was determined by the rate of air flow passing perpendicularly through a set area under given pressure over a given time period. The fabric having high air permeability gives better comfort to the wearer by maintaining the proper body temperature up to 33.3<sup>0</sup> c. The active sportswear also required good air permeability. The air permeability properties of the fabrics were measured using (ASTM D 737:04) (2012) standard. The fabric air resistance is expressed as Kpa/sec/m.

### Moisture Management

Moisture Management is the ability of a fabric/garment to manage the moisture (primarily sweat) by transporting (or 'wicking') moisture away from the skin to the garment's outer surface, thus preventing perspiration from remaining next to the skin. The moisture vapour transfer rate is the difference between the initial height of the water and the actual height of the water in the cups. Unit of water vapour transfer is measured in percentage. It is understood that moisture vapour transfer differs with face and back side of fabric. The moisture management is calculated by ASTM E96 – 95 Option B standard<sup>(1)</sup>.

### Thermal Resistance

Thermal resistance is a heat property and a measurement of a temperature difference by which an object or material resists a heat flow. Thermal resistance is the important factor for sportswear. It is the thermal resistance of unit area of a material. In terms of insulation, it is measured by the R-value. The thermal resistance is calculated by ISO 11092.

## IV. RESULTS AND DISCUSSION

The comfort properties of the developed bi-layer knitted fabrics were measured and the values are discussed.

Table 1. Physical properties of bi-layer knitted fabrics

Property		Sample 1	Sample 2
loop length(cm)	Face	0.329	0.287
	Back	0.290	0.285
Tightness factor	Face	13.61	16.02
	Back	9.44	10.70
Thickness		0.506	0.524
GSM		203.3	181.2
Dimensional Stability	Lengthwise%	+2.10	-6.70
	Widthwise %	_2.05	+1.60

Table 2 Moisture Management of bi-layer wool/polyester and modal/polyester knitted fabrics

TEST	SAMPLE A		SAMPLE B	
	TOP LAYER	BOTTOM LAYER	TOP LAYER	BOTTOM LAYER
Wetting Time in Seconds	21.7154	19.8998	2.4898	2.1156
Absorption Rate %/Sec	30.338	15.4334	52.1103	54.4492
Maximum Wetted Radius in mm	14.0	8.0	23	25
Spreading Speed mm/Sec	0.5331	0.6129	5.5489	6.8754
Oneway Transport Index %	-510.43	-510.43	-69.0015	-69.0015
Overall Moisture Management Capability	0.018	0.018	0.3979	0.3979

Table 3 Air permeability of bilayer knitted fabrics

TEST	Sample A	Sample B
Air permeability	131	232

The properties of two different Bi-Layer structured weft knitted fabric (sample A and sample B) shows that it is suitable for sportswear and winter wear. The sample B (modal/polyester) is good and better compared to sample A (wool/polyester) for sportswear. Moisture absorbency, Thermal resistance, spreading speed and wicking properties is very good and excellent in Sample A. Sample B is fast absorbing and quick drying fabric compared to sample A. It is dimensional stable, wrinkle free with more comfort due to high wicking property of polyester layer and perspiration transfer by the modal layer in the fabric.

## V. CONCLUSION

Comfort is becoming a more importance because of the changing needs of people in textile and Apparel industry. There are numerous of clothing comfort properties of textiles like thermal protection, air permeability, heat transfer, moisture permeability, water absorption, water repellence etc. with increase in technological development comfort is the most essential tool in sports for textile and apparel industry. It is understandable that the comfort can only be achieved when the most intricate exchanges between a range of physical, psychological and physiological factors have taken place in a acceptable manner.

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