

COMFORT ASPECTS OF SPORTSWEAR BASE FABRICS: A REVIEW

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Abstract: In recent time fabrication of textile suitable for sports and other functional wear becoming essential due to its potential market. The diversified textile substrate production not only focussed on development of new fibres, but also with innovation on yarn and fabric production too. The fabric formation technology is also continuously enhancing towards the novel products to meet the demand of contemporary sports activities. There are lot of influencing factors, which decides the performance of any functional wear such as polymer type, fibre blending, yarn structure, and fabric/laminate nature etc. The critical factors for any sport fabric are moisture management behaviour, thermal behaviour and its breathability. So this review of literature has focused on reviewing the work done on moisture management, thermal properties, and its base fabric nature types

Keywords: Sportswear base fabrics, thermal, moisture management, knitted fabrics.

I. INTRODUCTION

The sports base layer fabric remains in direct contact with the athlete's skin, which influences the athlete's critical performance by providing better thermo-physiological comfort performance. The base layer worn next to the skin should have the following characteristics: good thermal conductivity, good moisture management and good tactile properties (Cao et al. 2006). The fabric structures and fibers used to produce base fabrics are to be relatively soft and smooth, while the fabric assembly able to transport the moisture away from the skin without restricting the comfort of the wearer and the body movement. (Inna Konopov *et al.*2010).

II. SPORTSWEAR

Sports garments, particularly the base layer garments which is next to skin, are important to the thermo-physiological comfort of a sportsperson, and their performance attributes to the athlete's critical performance. During the sports activity, due to the increased metabolism rate human body-creates heat ranges between 300W at mild to 1000W at intense physical activity. To maintain the body core temperature at 37°C, body transport the heat away from the body to the environment through a mode of dry flux (conduction, convection, and radiation) as well as latent flux produced by perspiration. The dry flux depends on thermal comfort properties, while the latent flux depends on the moisture management properties of the sportswear fabrics. It's important

for any sports clothing to transmit human body heat, liquid and vapour moisture transmit effectively from the skin to the outer surface, during the physical exertion which causes a high rate of sweating and heat (Kothari VK and Sanyal P, 2003).

Sportswear garments can be categorized into four groups such as basic sportswear, performance sportswear, sports leisurewear and high active sportswear garments. The basic sportswear garments are cheaper and more stylish because they retain as many of the material characteristics as possible. The performance sportswear is high technical-oriented garments, which enhance the performance of the wearer by providing special functionality. The functional requirement of performance sportswear depends on the nature of sports, climatic conditions and the amount of physical activity. Sports leisurewear is replicable of performance sportswear, used as casual sports garments and fashion garments. High active sportswear clothing, are used in sports activity, which is being played for a short duration with maximum physical activity as in tennis, soccer, running, jumping, etc. (Manshahia, M & Das, A 2014).

III. Comfort aspects of Sportswear

Comfort perception of sportswear users can be divided into four different aspects, such as thermo physiological, psychological, skin sensorial comfort and ergonomical (ease of body movement) wear comfort. The thermo-physiological comfort is influenced by the fabric breathability and moisture management properties. Figure 2.1 shows the microclimate area between the human body and the environment. The clothing acts as a barrier for heat and vapour transfer between the skin and the environment. The moisture transmission through fabric occurs through three ways, like moisture diffusion due to the moisture vapour gradient across the fabric, moisture sorption-desorption by hydrophilic sites on the fabric and moisture transmission through the convection mode through the moving air close to skin (Parson K C, 1994).

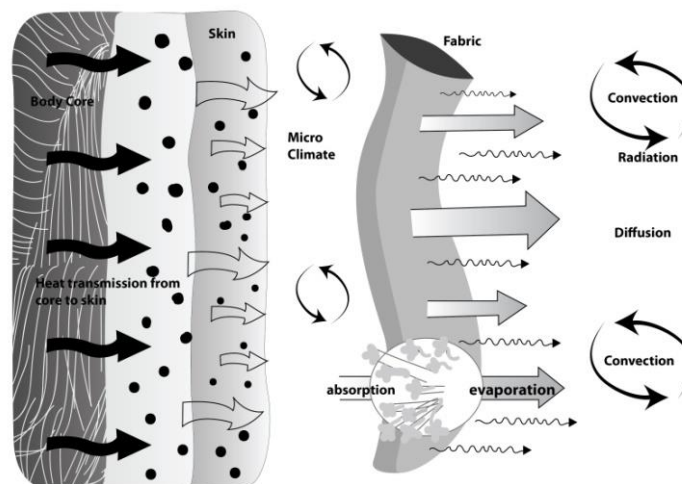


Figure 1. Heat and moisture vapour transmission from human body to the environment through fabrics

Zimniewska M *et al.* (2010) affirmed that skin temperature, of the sports person and moisture content of microclimate are strongly stimulated by the level of physical activity. The fabric moisture absorbency and transmission rate have a significant effect on the moisture of skin.

3.1 Influencing parameters of thermal comfort properties of sportswear fabrics

The thermal comfort, tactile comfort, and psychological comfort are three important comfort aspects of human clothing is usually associated with the transportation of heat, liquid moisture, and air through textile materials and it keeps the wearer dry at a constant body temperature of $37\pm 1^{\circ}\text{C}$ (Ilhan *et al.* 2015). According to Pac *et al.* (2001), the individual fibre characteristics, yarn spinning techniques and the fabric construction variables are major factors responsible for warm cool feeling of any fabrics. The characteristics such as fabric surface roughness and hairiness influence the thermal comfort properties. The rough fabrics have a smaller skin contact area and fabrics with more hairiness that provide space for air still layers, offer warm feel. Also the fabric made of micro-denier polyester exhibits better heat transfer and quicker sweat evaporation, in addition to cool feel to human skin at the initial touch than the spun polyester fabrics (M B Sampath *et al.* 2011). With the single jersey plated interlock fabrics, fabric thermal resistance increased significantly with an increase in yarn linear density. Fabrics made up of finer yarns, and higher stitch lengths indicated better comfort for humid conditions as it is more permeable to air and water vapour (Y Jahanji *et al.* 2017).

3.2 Influencing parameters of moisture management properties of sportswear fabrics

M. Manshahia & A. Das (2013) investigated the liquid moisture transportation properties of active sportswear fabrics produced using polyester filament of non-circular cross sections and affirms that the fine filaments had better in plane wicking than coarse filaments, and vertical wicking is observed. With the multi directional moisture with increase in cover factor, the wetting time increased, maximum wet radius, rate of absorption, spreading speed decreased and overall moisture management capacity also decreased (W Wardiningsih & O Troynikov 2012). The polyester knit fabrics have better overall moisture management capacity values than cotton and viscose fabrics. The liquid transportation capability has decreased with increase in tightness level and fabric structures do not show significant influence (E Öneret *et al.* 2013). Suganthi *et al.* (2018) assessed the moisture management characteristics of bi-layer knitted fabrics made up of different combinations of viscose, polypropylene, modal and polyester fibres in outer and inner layers. They conferred that the micro-fibre polyester in the inner and modal fibre in the fabric outer layer provided better comfort properties and were the most suitable for active sportswear applications. Zhou *et al.* (2007) analysed the moisture management properties of wool, wool blends with cotton and polyester was analysed by reported that 100% wool knitted fabrics were poor at spreading liquid on the fabric top and bottom surfaces, whereas wool/cotton-plated fabrics are good at spreading liquid in the bottom surface. The yarn count of inner and outer layers has also affect the sweat transfer rate and sweat spreading over the surface of outer layers. The wetting time and spreading speed enhanced with the increase in inner and outer layer yarn counts (Yaminiet *al.*(2017).

IV .SPORTSWEAR BASE FABRICS

The sportswear, particularly the base layer which is worn close to the skin, is important for the physiological comfort of a sportsperson (Kothari & sanyal 2003). The primary moisture management properties of base layer fabrics were achieved through rapid wicking of liquid moisture away from the skin. The tight fit base layer garments, enhances the comfort properties than slack fit (Higgins & Anand 2003). Cao *et al.* (2006) affirmed that the preferred characteristics of inner fabric layers used in active applications are good thermal conductivity, moisture management, and tactile properties. Good thermal conductivity of base layer fabric could improve cooling efficiency, and better moisture management and tactile properties of fabric would provide the necessary comfort to the wearer. B. C. Roberts *et al.* (2007) assessed the human body thermoregulatory response to base-layers with hot and cold garment and found that synthetic base-layer garments were more effective than cotton garments at actively reducing moisture retention, at the same time as maintaining the desired skin temperatures. Pratima *et al.* 2014 endorsed that during the sports activity, to control the body temperature in the comfortable value, the heat produced must concurrently be dissipated through base layers of the fabric. Depends upon the sports activity, human body is expected to produce half to one litre perspiration per hour. The base layer fabrics should absorb and simultaneously dissipate the heat and moisture to achieve high level of comfort .Olga Troynikova *et al.* (2011) reported that the blending of wool with polyester fibre and bamboo fibres gives improved moisture management properties. The liquid moisture absorption rate is increased to 20% and 35%, respectively with the 50/50 blend ratio. Supuren *et al.* (2011) investigated the moisture management properties of double face knitted fabrics, and found that polypropylene x cotton fabric on the inner and outer face has better moisture management property.

V. KNIT STRUCTURES FOR SPORTSWEAR BASE FABRICS

Single knit structures are widely preferred as the base layer for winter sportswear fabrics. The single jersey fabrics have better softness, which provides more comfort, less tactile sensations with skin fit garments. It also has good extensibility and recovery, freedom of movement, shape retention, and tailored fit (Ozdil & Anand 2014). Single jersey slack fabric structural form has higher transfer wicking ratio and lower liquid moisture contact angle than tight fabric structural form. The fibre type, yarn and fabric variables, are significantly influences the fabric moisture management properties and microclimate drying time (Manshahia & Das 2014). Kane *et al.* (2007) investigated the dimensional, comfort and handle properties of single knit fabrics such as plain single jersey, single pique, double pique and honeycomb structures with the varied structural cell stitch length (SCSL) and with ring and compact yarns. The study implied that the fabrics made up of compact yarn provide better performance in all the structures. With increased SCSL, the dimensional parameters like course and wales density, fabric areal density and tightness factor decreased for all the structures, while comfort properties like air permeability and water absorbency increased. The handle properties like tensile, bending and compression properties of single knit fabrics have been improved and compression, resilience and surface

properties usually decreased. The interference that was cotton double pique fabric has better performance for the summer outer wear and cotton single jersey fabric has better performance for summer inner wear. Shekar et al. (2000) state that knitted under garments made up of wool-acrylic blends; provide an optimum level of thermal insulations than woven fabrics, due to more entrapped air in the knit structures.

VI. Conclusion

Nowdays, the use of sports wears have increased due to its awareness with the users about its functional property. Consumers are interested to spent higher amount for purchasing these products, so there is a huge growing market potential is exist in the world wide. On the other side, customers are expecting high quality sport and leisure wears with reference to its comfort aspects, elastic behavior, breathability and other sensorial aspects. But it is also the fact that the sports cannot be a common product throughout the world because of different environmental conditions in worldwide, so region specifies and sports specify product development is also an important task. In addition to that, while garment designing protection and safety functions of the garment is also an important consideration. Though there are huge potential market exist for sportswear and leisure wear, the challenges are also very high. The roles of researcher and manufacturers have to work together on engineered fabric and garment production will meet the demand of the sports industry

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