

# Effect of Various Parameters on Comfort Properties of Knit's

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Abstract - Weft knitted structures have made significant contribution in the current technical textile application areas specifically in the field of active sportswear due to its comfort, crease resistant, higher air permeability and highly extensibility properties in knitted fabric. The present review is based on an investigation related to comfort properties of single layered and double layered weft knitted structures. The main objective of this review is understand the influence of fabric parameters such as stitch length, stitch density, type of stitch, type of yarn, structure of a knitted fabric on the mechanical properties and comfort level of knitted fabric. As all these parameters act as a useful tool for active sportswear to handle the moisture.

Keywords – Active sportswear, Stitch density, Stitch length, & Weft knitted structures.

# I. INTRODUCTION

A comfortable condition of a person in any particular atmospheric conditions is defined as a condition in which heat energy produced by a body is equal to the heat energy interchange by the body with atmosphere. Therefore, heating or cooling of the body is remaining sufficient. A human body has to maintain thermal homeostatic through metabolic activities and should maintain inner core temperature of 37°C. Due to high level of metabolic activities in active sports, more heat energy is generated in the range of 800-1300 W [4]. Due to this, heat stress in active sports is the reliable thrust area to control. This heat stress is responsible to increase the inner temperature of the body by 1.5°C -20°C. As a result of this, body generates sweat to control this inner core temperature. The amount of sweat generation is near about 2.51/h. In view of this, active sportswear should possess good sweat absorption property along with quickly drying and cooling property. Therefore Technical textile industry now days paying more attention for active sportswear particularly for moisture management properties such as sweat absorption, sweat dissipation and quicker drying and cooling of fabric, through which enhancement of comfort level is achieved. The comfort sensation of player is depends on above said desirable property of sportswear. There are so many outcomes are arrive in the past to enhance the comfort level [4]. In recent years, the consumption of textile fibers and fabrics in manufacturing of sportswear has seen a significant growth. Evolution in sports clothing has been going to execute high results in comfort [2]. The manufacturing groups are mainly focus on the utilization of innovative science and technology in textiles in production of high performance

sportswear. These using this innovation, the performance of active wear continuously enhancing day by day [24].

Knitted fabrics are popularly consumed in sports textiles due to its simple production technique, less price, more comfortable for body movement and more air permeable than woven fabrics. This type of fabric forming technology encounters the today's demands of rapidly change fashion [31]. Knitted fabrics are having high stretchability due to the bending structure of yarn which possess freedom of movement during sports activity and also have high moisture absorption property [4]. Therefore, knitted structures are more readily preferred in sports clothing than woven fabric [7]. The research study concluded that not only fabric structure is contributing factor for sports clothing but also fiber technology, yarn technology and finishing techniques are plays very crucial role [14]. This review on active sportswear developed from polyester and cotton fibre, by using single layer and double layer knitted structure with weft knitting technique.

## II. CLOTHING COMFORT

Clothing comfort is the comfort which persuade physical, thermal and psychological stability between the human body and the environment [12, 26]. Many authors consider the views for comfort as thermo physiological comfort, psychological comfort and sensorial comfort [19]. The most important feature of functional clothing is to create a stable microclimate next to the skin in order to support body's thermoregulatory system. Factors affecting comfort are air permeability, heat exchange within clothing, the transfer and evaporation of moisture [30]. All these characteristics play an important role during designing of active sportswear.

## A. Physiological Comfort

This type of comfort is related to physical activity of a wearer which affects his performance [14]. This is again judged on various parameters such as thermal balance, mobility of a body part. Thermal balance is also called as thermic stability and is defined as the heat loss from the body is similar to the heat generated by the body due to physiological activity. This comfort plays main role to balance body temperature during sports when body generate higher heat [14]. For playing different types sports various physical activities are required. Therefore, the fabric should have sufficient stretchablility to become active sportswear and also the player can be able to move body parts easily and freely. By considering this, heavy weight and stiff fabric is not appropriate to use in sports textile as this fabric reduces the extensibility [12].

#### B. Sensorial / Tactile Comfort

This type of comfort is not related to the thermal balance of body with environment, but is associated with apparel next to skin property. Therefore it is related to the surface characteristics of fabric along with moisture transport and buffering capacity. Sensorial comfort is also called as tactile comfort as it is relating to the sense of touch. Therefore, it is expressed in terms of feelings of softness, smoothness, clamminess, clinginess, prickliness and the like [14].

## C. Psychological Comfort

The person feels after wearing cloths is called as psychological comfort. The psychological comfort is interconnected with aesthetic properties mainly with design or fashion. This type of comfort is does not play a vital role in functional performance of garments. All types and levels of players are associated with psychological comfort to much extent than other types of comfort [12].

## III. REQUIRED ESSENTIAL PROPERTIES OF ACTIVE SPORTSWEAR

Following are the essential properties required to be present in active sportswear [2].

- The protection/safety functions to protect wearer in adverse condition.
- The wear comfort consists of thermo-physiological

Comfort, tactile comfort and psychological comfort

- The body movement function
- Aesthetic appeal and high fashion ability [2].

#### IV. COMFORT PROPERTIES OF KNITTED FABRIC

Generally knitted fabric is used in sportswear due to its high comfort properties. Knitted structures provide high degree of extensibility and better guiding shield to body parts [2]. This is very useful to design sportswear. There are so many parameters which can be effectively controlled in knitted structure on the basis of which we can design different sportswear as per requirement of sports activates. Some parameters are studied by researchers are mentioned as follows.

## A. Effect of Stitch Length

Stitch length plays very important role in quality of knitted fabric. All physical and mechanical properties of knitted fabric are influenced by changing the stitch length in fabric. Stitch length is defined as the length of yarn required to produce one loop and number of loops present per unit area is called as stitch density. Porosity is one of the important mechanical property of knitted fabric is associated with the air permeability of the fabric is largely influenced by the stitch length, stitch density and fabric thickness. By increasing stitch length loose structure is obtained which increase air permeability of knitted structure [13]. The stitch length was also affecting other properties such as number of courses, wales, and tightness factor. It is observed that when the stitch length increased, wales/cm, courses/cm and tightness factor decrease correspondingly [18]. By increasing stitch length stitch density goes decrease which results into instability of the fabric due to changes in viscoelastic behavior of Lycra yarn [19]. If the stitch length increases bursting strength is decreased. This is attributed due to that by increasing stitch length, stitch density decreases, therefore less number of loops present per unit area of fabric. It concludes that stitch length and bursting strength are indirectly proportional to each other. Pilling tendency of fabric is also depends on the stitch density. When stitch length increases the surface density decreases and resistance to pilling decreases [27]. But stitch length and fabric tightness factor are inversely related. Many researchers studied that stitch length has more significant effect on tightness factor of weft knitted fabric along with fabric stitch density. The fabric thickness decreased with increased stitch length. Thickness of the knitted fabric depends on the count of yarn, structure and relative closeness of the loops [21]. The plain Single jersey fabric has high elasticity in width that results in changes of dimension fabric after relaxation. Weft knitted fabric shrinkage increases with increases in stitch length. It was established that the abrasion was less for higher density fabrics because more loops contributed to the wear and so its abrasion resistance increases [29].

## B. Effect of yarn type

The presence of Lycra filament changes the mechanical properties of single jersey knitted fabric more adversely than double jersey knitted fabric [6]. The mechanical properties that are adversely affected by introducing Lycra fibre are fabric mass per unit area, air permeability, and



porosity, stitch length, bursting strength, Spirality, shrinkage and pilling [31]. By introducing the Lycra filament in single jersey knitted fabric increases the course density, fabric thickness, bursting strength and elastic property, but fabric width, air permeability and extension were decreased [7,20]. Slater Kinve studied the dimensional properties of plain single jersey; its derivative like knitted with knit and tuck loop and also fleece fabrics found that the fabric weight and loop densities were higher than they were knitted only by cotton yarns. He also reported that the extension of both widths wise and lengthwise increased as relaxation progressed [26]. The shrinkage of weft knitted fabric knitted with Cotton/Lycra yarn is found less than knitted with only cotton yarn. This effect is appearing more pronouncedly in single jersey knitted fabric. This happened due to the fact that Lycra retains fabric dimensions in original state after finished relaxation [6]. The relaxation process is adversely effect on the dimensional stability of knitted fabric. After finished relaxation the width wise difference in dimensions were found higher than the lengthwise variations in cotton fabric [6]. Weft knitted fabrics knitted with compact yarns had higher value of strength, stretchablility, air permeability and pilling resistance as compared to knitted with ring spun yarns. This is attributed because fibre packing density is higher for compact yarns. Yarn linear density and level of twist has a correlation with air permeability. Finer yarn gives higher air permeability in knitted fabric. Because more porous structure is form with finer yarn leads to more air permeable. The air permeability increases with increase in twist multiplier [21]. The bursting strength of fabric knitted with compact yarn show more value because higher single yarn strength and regular and uniform fibre arrangement than ring yarn. The compact folded yarn gives more porosity than compact folded yarn and ring/compact folded yarn. The compact yarn also show better results for abrasion resistance and pilling performance of knitted fabric [5]. Many researchers studied on the effect of cotton siro-spun and ring hosiery yarn on properties of knitted fabric. They concluded that fabric knitted from cotton siro-spun yarn shows higher bursting strength and shrinkage than ring hosiery yarn. This is due to the fact that the strength of sirospun yarn is more than single and plied yarn. After relaxation the Spirality of fabric is also found more. The siro-spun yarn also shows good abrasion resistance than single and plied yarns [11]. The air and water permeability of knitted fabric made from regenerated bamboo fibre found more [15]. Comparison of plated fabrics with different fibre types in the back layer shows that polyester/cotton fabric exhibits the highest value of air permeability and polypropylene/cotton fabric is the least permeable to the passage of air. The bursting strength of knitted fabric found higher with increase the percentage of polyester fibre in blends. When it was made a comparison at the same rate of polyester/cotton blends with the polyester/viscose blend, the strength was higher [9]. Single jersey knitted fabrics from polyester/cotton (70% / 30%) blend yarn have the highest bursting strength values. Due to a higher immediate elastic recovery, this length is further reduced, which results in a shorter loop. It is observed that in the courses where cotton yarns are accompanied with Lycra fibre, the yarn length for cotton loops is reduced as compared to the courses of Lycra yarns, the reduction being in order of 2 to 5%. The higher the feeding load of Lycra yarn, the more prominent the yarn deformation, which means a reduced length of Lycra yarn in the cotton yarn loop [17, 31]. The abrasion and pilling resistance of dyed knitted fabric found higher than the grey fabric [11]. The tensile strength of single jersey weft knitted fabric made from cotton yarn show better results along the length and width of the fabric than double jersey rib knitted fabric. But, the width wise strength of plain double jersey rib fabric is lower than the single jersey fabric lengthwise and width wise strengths. But by including elastane fibre not only adversely influence on bursting strength but also on elongation properties of single as well as double jersey knitted fabric. The strength of single jersey fabric along the length direction slightly decreases but found increased along the width of fabric. This effect is only appears in cotton Lycra blended yarn than cotton yarn [9, 31].

## C. Effect of structure in knitwear

The air permeability of single jersey fabric is higher than double jersey weft fabric. This is because rib and interlock fabric is more stable as compared to single jersey fabric. This happened because double jersey fabrics have high stitch density results into more compact structure. This resistance helps the needles to obtain long yarn during knitting [27]. Among all knitted fabrics fleece fabric have lower air permeability values because of their double layered knit structure. Air permeability of double piquet patterned fabric is also low because the two consecutive tuck stitches make the fabric compact. While plain single jersey, pique and double-pique knitted fabrics have high resistance to pilling and the resistance of fleece fabrics are more than the other knitted fabrics. Various study examined the thermal properties of different weft knitted structures produced from cotton and polyester yarns. The results concluded that double jersey rib and interlock fabric could be preferred in cold climates depending on their high thermal resistance. Besides, it was stated that single jersey fabric should be used in active sports and hot climate wears because of their better moisture properties. Because single jersey fabric has higher water permeability and air permeability results than double jersey rib weft and interlock weft fabrics. [3]. Fabric show lower thermal conductivity and higher resistance to thermal by polyester knitting than cotton [3, 24]. It is seen that the single jersey fabric and the fabrics having tuck stitches give high air permeability values [10]. Shrinkage is one of the serious



problems for knitted fabric, particularly found more for knitted with only knit loops in single jersey fabric [18]. The effects of rib design on thermal properties of rib fabrics by using three different rib structures and reported that with increasing density, results in air permeability and heat loss decreases [8]. Single jersey fabrics showed higher airflow resistance and honeycomb fabrics showed less airflow resistance and in between these came single pique and double pique fabrics [4]. The single jersey fabric showed higher bursting strength values than the other fabrics, due to its high elongation nature [15]. The interlock fabric was intermediate in stiffness, smoothness, fullness and softness [9]. The plain rib fabric is the least stiff and the cross miss interlock is the stiffest of all knitted fabrics. The halfcardigan fabric and single-pique fabrics, which had a combined tuck stitch compared to plain rib and interlock with only a knit stitch, were smoother fabrics and showed the most fullness and softness than other knitted fabrics [2, 11]. The doubled layered knitted fabric show high performance than single layered knitted fabric, particularly for moisture management property. This doubled layered fabric made up of hydrophobic layer in next to the skin layer and hydrophilic layer in outer layer. Therefore, this type of fabric absorbs the body heat rapidly and transmits it to environment by means of capillary action and wearer feel cool. On next to the skin layer, manmade fibers are used, as they have better moisture transport property to the outer layer and on outside natural fibers are preferred, as natural fibers have good moisture absorption property [2, 7].

This trend was the same for both the fabrics from ring and compact yarn [23]. Knapton et al. reported that the dimensional stability and knit performance of fabrics are influenced by components such as knit structure, stitch length, and cover factor. The type of stitches influences on the shrinkage of knitted fabric in both directions. The double jersey fabric consists of knit and tuck loops has higher width wise shrinkage than single jersey fabric but less length wise shrinkage. The presence of tuck loops along with knit loops show more pills on the fabric surface in single jersey fabric than double jersey fabric [19].

## V. CONCLUSION

In developing the active sportswear, fibre technology, yarn technology, fabric production technology and finishing techniques plays a very important role [7]. The present review paper make an attempt to emphasis on parameters accountable for comfort properties of knitted fabric. A lot of researches are done on effect of loop length and elastane percentage on physical and comfort properties of knitted fabric [15]. Researchers concluded that stitch length is indirectly proportional to the stitch density, bursting strength, pilling, and abrasion resistance, courses per inch and wales per inch but directly proportional to the air permeability of knitted fabric. As increases the percentage

of Lycra in knitted fabric bursting strength increases but air permeability decreases. The Lycra percentage does not show significant effect on stitch density. The shrinkage of the knitted fabric is found greatly influenced by presence of Lycra percentage. The stitch length has found more influence on the tightness factor, bursting strength, pilling, porosity and air permeability [19]. Stitch length is directly proportional to the air permeability of fabric. The results revealed that when the stitch length increased, the tightness factor and bursting strength decreased. Stitch length and stitch density both significantly influence on pilling performance of knitted fabric. Stitch length is negatively interrelated with pilling resistance.

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