

Sports Textiles Applications with Functions and Opportunities-A Review

Dr. Nemailal Tarafder

Ex-Emeritus Professor

Department of Textile Design

Hooghly Engineering and Technology College

Corresponding Author's Email: - tarafdern.14@gmail.com

Abstract

Sports textiles belong to a category called sports tech, which is one of the main stream of technical textiles. In various sportswear, the items like jersey or T-shirts, shorts, caps, footwear. Etc and some sports accessories are known as sports textiles. Performance enhancing smart clothing for outdoor sports such as in running and cycling should be suited to all seasons along with hygiene characteristics and functionality, in addition to that an exceptional aesthetic appearance also. Textile plays a major role in sports and without textiles sports existence is very difficult. Smart fabrics allow for greater and more precise control over how our body perform and they similarly alter our understanding of the materiality and bodily presence with regards to fashion. The high-tech textiles comprehend compression garment, smart textiles and wearable technologies. Smart textiles will result in great benefits for athletes, such as performance, data analysis, health, training technique and comfort. Major companies have been in research for smart textiles for new possibilities to incorporate fabrics or textiles with emerging technologies to improve the consumer's life style. Polyester has a tendency to cause dye migration between the fabric dye and the decoration. Active wear fabrics are important to the comfort of athletes.

Keywords-: *sport tech, smart textiles, high-tech performance, artificial turf, wearable technology, intelligent textiles, micro electronics, temperature sensitive*

INTRODUCTION

Amongst the various textiles in which the individual textile occupies relative importance to the other sports textiles contributes 10% of the world technical textile market. Increase in demand of sports textiles is due to the demand and also by new innovations in fibre manufacturing processing and finishing treatments. Two different raw materials like hydrophobic and hydrophilic are used to develop the functional knitted structure for leisure wear, sports wear which improves the comfort of the wearer. Sportswear textiles belong to a category called sport tech, which is one of the main streams technical textiles. The rising interest in the sport tech is due to a number of social factors that include increased considerations of wellbeing and good health, growth of indoor and outdoor sports facilities and the ever increasing pursuit of the adult population of activities outside the home or work place. Among the fabrics, knitted non-woven or woven, knitwear fabrics have always been associated with relaxed clothing and fashion. Hence, sportswear has been developing as a strong element in the present conditions finding its applications in many sports like cricket, football, etc. Many definitions were given for sportswear and broadly defined as clothing

designed for comfort or informal wear. Sports garments are now standardized every year especially among younger generations. The interactions between these two areas on influence sports and fashion are important source of new trends in both industries [1].

Sports textiles have the features of adjustability, easy to wear, easy handling, etc. It should have the ability to transport heat and moisture i.e., fast drying and cooling function. Sports textiles have very high electrical conductivity, so that they must have anti-static performance. It has the resistant to anti-microbial. It must have the ability to provide protection from ultraviolet rays. There should be good air and water permeability along with low water absorption of the layers of clothing facing the skin. It must have the ability to absorb moisture fast, so that the body absorbs sweat from the skin quickly and helps to keep the skin dry, it must be strong and durable and should be as light as possible. Since these sports textiles are known as thermal conductive, it makes them possible to feel cool in summer and warmer in winter. Sports textiles guarantee for a better level of defence than natural and man-made fibres. They also block UV-A and UV-B rays, which are dangerous for skin. For functional sportswear it is

required super light weight, low fluid resistance and super high persistence and stretch ability. For those that are seeking comfort and healthy persist crucial characteristics include thermal regulation, ultra-violet resistance, sweat absorption and quick drying and vapour permeable [2].

Smart textiles are also known as technical textile, which are made from a variety of fibres and filaments based on the goal of the end products. Thus these are enhanced to add functionality through various technical textile applications. Applications of textiles for sports and leisure items are a fast growing business area. The most popular technical textiles are explained in the discussion, from the high-tech fibres to textile coatings, functional apparel fabrics and smart textiles to composites and non-woven that interact with their environment by responding it. As the use of composite structures are increasing in every field, technical textiles are enhancing smart clothing for outdoor such as running, cycling should be suited for all seasons along with hygiene characteristics and functionality in addition to having exceptional aesthetic appearance. During these sports athletes are in motion actively every minute so sweating occurs. Garments made with smart textiles in

sports are designed in line with the needs of the athletes. For instance they often use thermolite based fabrics that evokes a dry warm feeling to relieve from the strain. The use of this technology is wide spread, especially for tight fitting [3].

Sports textiles are one of the various branches of technical textiles. In various sports, the sportswear that players wear such as: jerseys or T-shirt, trousers, shorts, caps, footwear, etc and some sports accessories are used known as sports textiles. This type of clothing has some special features, which have been made possibly by the use of high-tech and smart textile technology methods. The increasing interest in active sportswear and outdoor leisure activities like flying, sailing, climbing and cycling have led to immense growth in the consumption of textile materials in manufacturing of sportswear, leisure wear and related goods and equipment. Some of the essential features of special textiles are: sports textiles must have the features of adaptability, easy to wear, easy handling, fast drying and cooling function, sports textiles have very high electrical conductivity, so they must have anti-static performance, must have the ability to provide protection from ultraviolet rays, there should be good air and water permeability with low water

absorption of the layers of clothing facing the skin, They must have the quality to absorb moisture quickly, so that the body absorbs sweat from the skin quickly and helps to keep the skin dry. It should be strong and durable and should be as light as possible. Since this sports textiles are known as thermal conductive it makes it possible to feel cool in summer and warmer in winter. These are easy care able, smart and with functional designs. Sports textiles guarantee a better level of defence than natural and man-made fibres[4].

Underlying the surface decoration and cut of contemporary tennis costume is a fabric that enacts its own performance and studies the athletes who wear them. Whilst designers such as teddy Tinling created tennis costumes that brought glamour and theatrical flair to the player's performance. Modern sports companies are increasingly using costume to approach human performance from a Big Data perspective. In the late 19th century, women players in tennis wore corsets and long skirts which impeded movement; today the top players utilize fabric science that enables costumes to control and record the temperature, sweat and muscle movement of the performer whilst also presenting a vehicle to show case their personality through their aesthetic choices. Smart fabrics allow for

greater and more precise control over how our body perform and they similarly alter our understanding of materiality and bodily presence with regards to the fashion. The use of smart fabrics in sports where the patterns of data collected by the costume visually and numerically display the condition of performance, holds potential for the ways in which we interrogate the interrelationship of clothing and performance across a range of arenas [5].

Wearable technology stands for textiles in which sensors and wiring are directly integrated into textiles. With this technology it is possible to measure vital parameters like heart rate, blood pressure, body temperature and respiratory sound directly without any further device. Up to now these features are mainly used in the sectors of medicine and work protection. Therefore numerous studies on this topic were found of which some will be discussed here. There are several studies reported about different possibilities of integrating wearable technology into textile for measuring vital parameters. Besides monitoring vital parameters and bio-feed back of the analysis of movement are of great interests. There are several investigations have done to detect the movement during impact and release of

human body with strain gauge and pressure sensors. The usage of wearable electronics in the sports field is compared with health sector really rare. Nevertheless there are some innovative products available on the market and the “Mi Coach” training system that can track movements and the intensity during exercising. An innovative skiing coach invented by a spinoff company „Motion“ from TU Munich [6].

Smart textiles or intelligent clothing are becoming ever more important. Slowly but surely they are entering the sports world and are here to stay. Applications and advantages are numerous and should lead to better performance of the average elite and amature athlete. New highly advanced textiles are entering the streets, ski lopes, and sports arenas. They are called smart textiles. But what are they?. Smart textile is a kind of an all purpose word and hence it is not always easy to give a straight definition. However, for the purpose of required use, smart textiles can probably best defined as fabrics that can sense the environment on one hand and react and respond to it on the other hand. For both amature and elite athletes smart textiles will bring some great benefits. We are aware about all kinds of wearable electronics such as tracking bands and

watches of household name such as Fit Bit, Nike Polar, Garmin and Run Tastic. Increasingly the functions of these wearable technologies can be taken over by smart textiles. They offer the same functions as wearable can taken over by smart textiles. They offer the same functionality as wearable and in many cases are or will be even more precise and better than that. However, wearable such as watches and glasses will stay around us. Because in many cases the user wants to read/view what sensors in textiles are measuring. Hence it could well be that more and more manufacturers in both fields will start to co-operate [7].

The recent developments in microfibers technology have enabled the production of textiles with advanced features like breathability, waterproofing, etc. These additional abilities to react to heat or light give them a significance edge in adapting to external environmental stimuli over traditional fabrics. The recent development in micro-electronics industry has resulted in developing components scaled down to nano scale. These advancements are expected to boost the growth of smart fabrics for the sports and researching smart fabrics for new possibilities to incorporate fabrics or textiles with emerging technologies, to consumer’s life style. In

July last year, Microsoft designed smart fabric with objective and gesture detection. Layers of interconnected sensors that can modify an object or motion are woven into the fabric. It can take data from the smart fabric,, process it and durable. At the same time, the fabric must be stretchy and able to wash without damaging electronics. Due to the novel COVID-19 outbreak the market may not see significant growth as smart fabric manufacturing requires a high level of automation and advances in textile processing technique. Bio-metric sensors, micro computers, circuits or metallic yarns are all incorporate into innovative fabrics for various functionalities. These materials can be tailored practically any sports athlete or fitness enthusiast’s requirements. The smart fabrics for sports and fitness market is segmented by product types, function by geography such as in Europe, Asia Pacific and Latin America and Middle East and Africa [8].

It is important to know by the garment decorators about the advantages and disadvantages of cotton and polyester fabrics and also the cotton/polyester blended textiles. There are pros and cons in both types of fabrics, knowing those facts will help them to narrow down which fabric type is best for the customer. Cotton is the most widely used natural fabric for

apparel manufacturing across the world. Being natural fibre cotton is a renewable resource and is biodegradable. Natural fibres as oppose to synthetics like polyester tends to more expensive and is not the best option when trying to keep cost don for promotional items. The greatest advantages of cotton is its breathability in hot weather, it is a great option for keeping our body cool, even though it may hold moisture longer than polyester in hot weather. This actually becomes a way to keep our body cool. When choosing the next order, it is to be kept in mind about the end use of the apparel. It is very important to know whether the fabric is needed to decorate for a breathable, flexible fabric or to decorate for an electrician or welder, who needs a fabric that will not melts to their skin if it comes in contact with sparks. It is found that cotton is the best option for these professions. As discussed cotton can hold its fair share of moisture, which can be a problem for heat applied to transfer. The reason is due to moisture release as steam of the heat press raises it to a high temperature [9].

There are several benefits for using polyester as an active ear fabric. It is soft and breathable and wicks moisture away from the skin, is also extremely durable,

ensuring that workout clothes stay wear. Active wear fabrics are important to the comfort of athletes. Polypropylene is one of the most popular and durable options available for moisture and regulate temperature which are essential for sportswear. Other benefits of polyester fabrics include durability, and moisture-wicking. It can withstand the rigors of sports yet can easily transmit active wear garments, affect the temperature and ensure maximum comfort. If the fabric is resistant to stains it can be used as a trouser that can be worn as gym gear without worrying about it looking out of place [10].

Sports Textiles Applications, Functional Properties and Opportunities:

Any fabric made out of woven or knitted materials should have adequate comfort characteristics required for some specific application. In the case of a normal wear where the activity of the body movement is not severe, the fabric may have sufficient air permeability able to transmit the heat out from the body and better moisture management capability. However for sportswear fabrics when the activity is severe, it requires the above mentioned properties in an improved manner so as to provide comfort to the sports personnel. Conventional sportswear lacking is there in

proper absorption of sweat from the body and hence leads to stickiness and clogging of pores. This leads to increase in body temperature and brings down the performance of the player. Active wear needs to provide a thermal balance between the heat generated by the body while engaging a sport and the heat released into the environment. Normal active wear garment does not always fulfil this requirement which will eventually lead to thermal stress. Basic requirements of a sportswear fabric during sports activities especially in high active sports like tennis, football, heat stress will be of great concern due to generation of metabolic heat which is in the range of 800 to 1200 W depending on the activity and physical conditions of the wearer. Due to this core temperature of the body increases by 1 to 2 degree celcius and the sweat generation is about 2.5 litres/hour [1].

For functional sportswear the requirements are super light weight, low fluid resistance and super high persistence and sustainability. For those that are seeking comfort and healthy pursuits the crucial characteristics include thermal regulation, ultra-violet resistance, drying of sweat, vapour permeable, etc. Currently the use of sports textiles is increasing day by day. Clothing and mats used in yoga exercises

are all contributions of sports textiles, T-shirts, trousers, shorts, jerseys, track suits, caps, sports bras, shoes and various sports equipment such as football/volleyball, sports net, gloves, pads, mats, etc, are used for all types of sports in golf, tennis, mountaineering, skiing, football, swimming, summer and winter sports and Olympic games. It also includes some inner wear and jock straps for athletes. Also among the special uses of sportswear are swimming costumes, sleeping bags, ballooning fabrics and parachute fabrics. Artificial turf technology is also used in sport tech. The use of high-tech textile materials in sports is nothing new. In recent years some fabrics and designs have been observed that can quickly remove moisture from the body meaning it absorbs sweat faster and dries the skin. The matches with all black jerseys help players dry their hands faster. On the other hand some smart technologies are being used equally so that the clothes can understand the player's heart rate, temperature and other physiological information. Technological textiles have been able to produce some materials harder than wood which keep the skin dry, waterproof like rubber and at the same time environmental friendly and highly profitable, Due to the widespread use of advanced and smart technology in today's sports textiles. It is

becoming possible to produce high quality and high performance sports garments and the quality of the sports textiles is increasing day by day [2].

Different motives in the work place make it mandatory for some people to wear special protective clothing. However, those who play different sports prefer the desired outfits that directly affect the performance as the comfort and ease of the outfit is associated with the performance. As a result it is quite useful to make sure that sportswear has certain features. The most basic property of sportswear, of course is shortness of breath. The word respiration refers to the fact that there is active ventilation through the fabric. Breathable fabrics measure the moisture or vapour transmission rate that is whether moisture enters the fabric quickly or slowly. Breathable sportswear must ensure maximum heat and humidity control, good air and water vapour permeability rapid moisture absorption and easy mobility, flexibility near the skin, quickly drying, minimal water absorbance through the fabric, easy care, light and delicate feel. Special finishing processes can be used to increase the difference in surface strength between the front and back of a fabric to increase the ability to keep sweat away from the body [4].

The compression technology has been applied for medical purposes from long time. Therefore, the grade of innovation is slow. Concerning the performance improving effect opinions break up. In this field of research this discrepancy could result from the different designs. Studies show in most of the cases the number of test persons involved was very low to get statistical significance. More the level of performance and the age of the persons were not matched. Again, the intensity of test, the material used in the tests and also the sports discipline found differently in each investigation. It is also true that not any related double blind study was conducted to gather the psyche had any great influence of the test results. The attitude of the compression garments of the athletes might be due to the lack of experience. As per the experts opinion the grade of innovation of smart textiles is very high. They endorse a high potential for performance on physiologically or biochemically for performance improvement. The performance enhancing effect of these clothes is argumentative. It may be due to the fact that most of the studies were conducted in the 80's but in the meantime a lot of changes took place. The literature studies on researches, the interviews and the queries indicated that the grade of innovation related to wearable

electronics is rated very high. But at the same time no such studies are available that can improve the performance of the wearable technology. The collected literature reviews show that there is enough scope or potential of wearable technology in the sectors should be aimed to convert the knowledge how to utilize the technique in the field of sports [6].

Performance Improvement:

Considering the athletes of the types such as amateur and elite the smart textiles are of great benefits as well as important also. There are many areas in which smart textile are playing a very important role and have the potential to improve the performance of the users. In the professional sports maximization of potentiality of the athletes is very important. At the same time amateur sports persons are also looking to improve and monitor performance. For both the classes of players data collected can play a great role to improve their potential and performance. At the same time the market of wearable technology can be benefitted from this new approach. Watches and strap bands equipped with sensors are able to deliver all possible various data like heart rate, GPS, related distance covered, acceleration related speed, temperature of body, and series of different parameters.

Undoubtly it is observed that television, which rugby players carrying in little box fitted into a small pocket of the player's jersey on the shoulder blades is also coming under wearable electronics. The box is connected to a heat ate monitoring system and both elements down load information to a docking station which can be viewed during and after matching by the r coaches and also by the scientists. We should imagine what are the functions of big data and artificial intelligent and they can do in favour of players. Again how the players performance and trainers will get benefits from it and how players will be capable of doing out of it. Generally these types of sensors are integrated with the costumes and they can record temperature, sweat and muscle movement and sometimes the athlete's emotional response. To many people data plays an important role and it is for sure smart textiles will play a vital role for the improvement of skill or fitness levels, in order to avoid injuries or deploying the type of players [7].

It is forecasted that smart textiles are going to cover the fitness market to register a CAGR of 25.7% over this period. The application of micro fibres has enables the production of textiles with advanced features such as breath ability, water

proofing, etc. The additional benefits react to heat and light to give them a significant edge in adapting to extend environmental stimuli over the traditional textiles. The recent developments in textiles components have the area of micro-electronics industry in their components scaled down to the nano-scale. The ultimate result shows the boosting up of growth in smart textiles for the sports and allied fields. Research is going on over the smart fabrics for new technologies and their possibilities to incorporate fabrics or textiles with the emerging technologies. This is the purpose to improve the life style of consumers. The new approach has been attempted by the micro soft to design smart fabric with the objective and gesture detection. The spots elements like different objects and motions are woven in the fabrics at different layers by interconnections of sensors. The ultimate result is to collect data from the smart textiles for the purpose of processing and transmitting them.

Microcomputers with biometric sensors, circuits of metallic yarns are all incorporated into innovative textiles for various functions. These materials are tailored made to any sports athletes or fitness purposes. The smart fabrics for sports and fitness purposes are the by-

product types ultra-smart fabric, active smart fabric, passive smart fabric, by function (energy harvesting, sensing, thermoelectricity) and by geography (North America , United States, Canada), Europe (Germany, UK, France, Spain, and Rest of Europe), Asia Pacific (China, Japan, India, Australia and Rest of Asia Pacific) and Latin America (Brazil, Mexico, Argentina and Rest of Latin America) and Middle East and Africa (UAE, Saudi Arabia, South Africa and Rest of MEA).The forecasting and sizes are provided in terms of value (USD million) for all the above segments [8].

Advantages and Disadvantages of Activewear Fabrics:

It is important to s that garment decorators know that the advantaged and disadvantages of cotton and polyester fabrics and of course the cotton/polyester blended fabrics. There are pros and cons to both types, knowing those facts will help us narrow down which fabric is best for us. Cotton is the most common natural fabric for apparel manufacturing across the whole of the world. As a natural fibre cotton is renewable resource and biodegradable. The greatest advantage of cotton is its breathability. In hot weather it is a great option for keeping our body cool. Even though it may holdmoisture linger than

polyester, in hot weather, this actually becomes a way to keep our body cool. It is always important for retailers to know about the end use of the apparel before placing any order. It is to be understood correctly whether the order placed before any athlete's need which require breathability or flexibility or any welder who needs a fabric that ill not melt to their skin when it contact with sparks . From the above discussion we get an idea that cotton can hold fair moisture which can be a problem for heat applied transfers. The reason is because, moisture released as steam as the heat press rises to a high temperature. Advantages of cotton are: breathable having great option for hot wath3 hyd3ophllic and dos not i33itat skin and b3ns as oppose to melt like polyester. Disadvantages are cotton is expensive, natural fibre wear down faster holds moisture longer and prone to shrinking. Advantages of polyester are it is strong, flexible, dries quickly, resists wrinkles and shrinking and inexpensive. Disadvantages of polyester are it tends to stick perspiration skin, not as breathable, temperature sensitive and subject o dye migration [9].

Active wear fabrics are important to the comfort for athletes. Polypropylene is one of the most popular and durable options

available for low odour, which is ideal for active wear and because it can be worn with many different styles and cuts, it can also be easily transmit moisture and regulate temperature are essential features in sportswear. Other benefits of polyester fabric includes durability and moisture wicking. It can withstand the rigors of sports yet can easily transmit active wear garment effects the temperature and ensures maximum comfort. If the fabric is resistant to stains, it can be used as a track suit to wear as gym gear without worrying above it looking out of place. The main benefit of polyester is its durability and is cheaper than natural fabrics and offers better wicking property. Another advantage of polyester is that it is less expensive than natural fabrics. Typically heat is transferred through vapour liquid transmission. A thermodynamically efficient polyester fabric is light weight and quick drying. Polyester active wear is advantageous for breathability and light weight also. It is easy also to wash and easier to make synthetic fabric active wear [10].

CONCLUSION

Natural, Synthetic, Regenerated and specially developed fibres are available to manufacture sports textiles. The most basic property of sportswear, of course is

shortness of breath. Sensor integrated in some smart clothing can trace nearly anything. Posture, body and arm movement, biometrics and other features live as it happens. Adding Lycra to a fabric gives it stretch and recovery, particularly in gymnastics and swimwear where body skin flexing and stretching are available. Smart textiles allow for greater and more precise control over how our body performs. Experts presume wearable technology becomes more popular in sports and will therefore be established very soon. Big Data analysis and Artificial Intelligence can do to players" performance, coaches and trainers will precisely know what a player will be capable of Biometric sensors, micro computers, circuits or metallic yarns are incorporated into innovative fabrics for different functionalities. Polyester has a tendency to cause dye migration between the fabrics dye and the decoration. An alternative to polyester is a material from nylon or a blend of polyester fabrics.

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