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Active Sportswear with Engineered Fibres and Fabrics-A Review

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Abstract

It is clear that clothing is the key to body comfort. Comfort is difficult to define since it covers both quantifiable data and subjective characteristics. The highly competitive world of sports have increased awareness among the professional sports persons who use to demand more specific functions to be performed by sportswear in real time to increase their efficiency. Because of increasing interests and participation in sports and leisure activities, the consumption of sports goods and equipment and attendant, consumption of textiles in such goods and equipment has already shown steady growth. Non-woven textiles in the indoor environment can contribute to the amount of space and visual privacy being used as free standing constructions that divide the indoor space into smaller areas. Textile products contribute to the athletes in terms of safety and performance in many types of sports, especially in outdoor sports. The three different types of sportswear fabrics were tested to observe the influence on the physiological response and performance of volunteers in sports conditions was investigated. 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. Consumer spending has been restrained in many parts of the world, demand has buoyed by sharp increase in disposable income in key economics in the developing world, along with the major advances in fabric technology. Sports composites usage in India includes boxing equipment, inflatable balls and protective equipment for cricket. The sportswear and sports goods sector of the textile industry has seen market diversification for fibrous materials and has also contributed toward

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the elevation of textile science and technology to a level approaching that of other high-tech industrial sectors.

Keywords: *Engineered fibres, Polymeric coating, Artificial Turf, Floor coverings, Professional athletes, Physiological response*

INTRODUCTION

Constant pursuit of victories and record braking performance by top level professional athletes, outstanding marksmanship by popular ball players and the maximum enjoyment of amateur sports activities need creative engineered sports garments. It means that the products have to be more than functional if encouraged to buy them, as they are currently demanding new looks and fabrics with different feel to them. The sportswear goods sector of the textile industry has not only resulted in market diversification for fibrous materials but has also contributed towards the elevation of textile science and technology to a level which starts become at par with high-tech industrial sectors. New technological developments, more fragmented niche markets and increasing demand of customers' expectation are just some of the factors relentlessly driving this industrial sector. To drive out the problems, environment companies are implementing radically new product development practices [1].

In the last three decades there has been a significant increase in the participation of various active sports all over the world. Healthier lifestyles are leading to the greater sports participation. Recently ore numbers of sports have been invented and also many of the sports have been again popular. The highly competitive world of sports has increased awareness among the professional sports persons, who use to demand more specific functions to be performed by sportswear in real time to increase their efficiency. Design of active sportswear is still a subject of research to the academician and industrial professional. To fulfil the demand of the existing and up-coming market the new fibres, fabrics and finishes are to be developed to satisfy specify specific requirement of each sport. In this context man-made fibres have enlarged the sphere of application f these products from the simply apparel clothing to high-tech sports textiles owing to the high potential for scientific creation. The products mentioned, later development concept, technical characteristics and performance

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capability, were verified in the some international games like Olympic [2].

Parachutes are used for areal delivery of men, materials and cargo, heavy equipment, vehicles, etc. Besides they are widely used as air decelerators for arresting the high speed of fighter aircrafts during landing to reduce wear and tear of the braking mechanism of the aircrafts. Parachutes are also used for accurate bomb dropping, controlled decent of flares, etc. parachutes canopy fabrics and other technical textiles accessories are required for following types of parachutes. Man carrying parachutes for paratroops, air crew parachutes, heavy dropping parachute systems for dropping vehicles, guns, etc, cargo parachutes system for supply dropping, flare parachutes, parachute bomb dropping, paragliding , steerable parachutes, high altitude parachute, sports parachutes. Parachute canopy fabrics are woven from high tensile nylon filament in the denier range of 32 to 200deniers. Cargo parachutes are woven from cotton having high tensile strength. Harness webbing tapes are made from high tensile nylon yarn of denier range 210 to 840 denier. Major consumers of parachute are Defence Forces. Besides, sports parachutes and paragliding are used in civil sector, which is gaining popularity slowly. It is estimated that defence requirement for parachute fabrics was Rs Six Cores during 2003-04, which is expected to increase to Rs. 10.67 Cores by 2007-08 [3].

Needle punched non-woven textiles can be found as backing of carpets and wall coverings and also as low quality blankets, hidden layers in furniture systems and wadding/padding. Spun laced/hydro entangled non-woven materials are used in furnishing and bedding as coverings and sheets. Spun bonded non-woven fabrics are applied as backing layer for wall coverings, carpets, curtains and furniture. They are also used as upholstery layers, filters and tablecloths. Table cloths are also made of wet laid and spun laced non-woven fabrics. Chemically bonded non-woven textiles are applied as wadding and padding. The same is the application of the thermally bonded non-woven, which are also applied in carpets under lying and furniture systems, including as upholstery textiles. The tufting technology is used for production of carpets for both built environment and car interiors [4].

Sport is a physical activity based game with specific technique and rules. Sports activities are universal and can be carried out at any age and sex regardless of the

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social and physical characteristics of people. Since beginning of the history, sporting practices have gone through a long period of development from the primitive form, of hunting, running, swimming to modern sports.

The instinct of fun and competition, which is pure form of sport, was transferred to the related co-activities from the day but the increasing needs and demands of the largest industries in the world. Due to size and special needs of the sports industry it is supported by many auxiliary sectors and one of these is the textile sector. Each branch of sports has its own list of needs and the main issues on the list are how to improve the performance and how to ensure the safety. These two main concerns are the important topics of interest in the science of the sports, which affect current sports activities. Stretching the physical boundaries of human beings sports science is interested in any material or technique that makes athletes better. As in daily life textile products are used at the time of sporting activities and the effect of their properties on sports is understandable [5]

In active and endurance sports, the performance of a sportswear is synonymous with its comfort characteristics. The wear comfort of sportswear is an important quality criterion that affects the performance and well-being. Foe instant an active sportsperson that wears poor breathable sportswear will experience an increase in their heart rate and rectal temperature more rapidly than one who wears breathable sportswear. Hence fabric breathability and thermal properties should be tailored in order to meet the requirements of sportswear. The type of fibre the fabric structure and fabric constructions are amongst the parameters that may affect the thermal and breathability properties of sportswear fabrics. Studying these properties of sportswear fabrics is important u a he same time it is also important to connect them with the performance of on athlete when wearing this kind of clothes during the course of exercise. Generally four different aspects can define wear comfort: physiological, psychological, ergonomic and skin sensorial aspects. Thermal insulation, breathability and the moisture transportation process are a fabric’s physical properties that can affect the comfort sensation from a physiological point of view. The psychological aspect can include personal preferences, fashion, ideology, etc. Ergonomic wear comfort depends mainly on the garment’s pattern and fabric elasticity which influence the

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clothing fit and freedom of movement. Skin sensorial wear comfort characteristics and mechanical sensations caused by the the direct contact of clothes to skin [6].

Sustainable design in many sportswear brands is moving forward with innovative strategies to reduce waste during production. Since 2010, nearly three billion plastics in the form of bottles have been diverted to make footwear products. The waterless technology introduced in the companies saves about 20 million litres of water and helps to dye the fabric without using water. Nike is now focusing on zero waste. Recycled products are produced from natural sources of raw materials. The advance design and functionality of Fly Knit Technology produced 60% less waste than traditional cutting and sewing methods. Since 2012, the technology has reduced waste by about 3.5 million pounds. Adidas has the technology to create a product made with 95% recycled sea plastics recovered near the Maldives. A type of shoes is being made from Bio-steel fibre that replicates natural silk and completely bio-degradable. Some of the trade names of sportswear are cited as follows: Cool Max, Lumiace, Dryarm, Killat N, Dri-release, Field-sensor, Water Magic, Tri actor, Sports Wool, Entrant, SYPMPA TEX, Gore Tex, Navia, Hygra, etc. Some of the top brands of sportswear in the world such as Nike, Adidas, Sky Sports, ESPN, Under Armour, Puma, ASICS, UFC, MLB Advanced Media and Reebok [7].

Demand for indoor sportswear and fitness apparel is robust. Thanks to rising levels of participation in individual and team sports and fitness activities. Although consumer spending has been restrained in many parts of the developed world, demand has been buoyed by sharp increase in disposable income in key economics in the developing world, along with major advances in fabric technology. Spending on such activities is also being encouraged by companies developing sophisticated wearable systems which are compatible with various devices, such as smart phones and tablets and make physical exercise a more enjoyable rewarding and engaging experienced. Participation in sports and fitness activities is likely increase with greater awareness of the benefits of physical exercise-indoor and outdoor and greater emphasis on healthy living [8].

Sports composites usage in India concludes boxing equipment, inflatable balls, and protective equipment for cricket. Boxing equipment consist for boxing gloves, boxing punching gloves, boxing

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head guards, boxing punching pads, abdominal guard, punching bag, etc. Inflatable balls consist of football, volley balls, handballs, etc. Footballs account for 50% of the market of inflatable balls. Footballs having variable sizes, i.e. size-3, size-4, size-5. Circumference for size is 5 is 68.5 cm. Official weight of the football is 420-445 gram with full pressure of 0.8 bar. Protective equipment for cricket comprises of leg guards, batting gloves, wicket keeping gloves, thigh pads, caps, and hats, cricket kits, etc. Indian sporting goods industry is concentrated primarily in the cottage and small scale sector. It is a highly labour oriented industry and also employs a large number of woven as well as well most units work on a job work basis for the major manufacturing/exporting and also sells their produce to whole sellers who in turn sell them to sports goods retailers [9].

Textile materials are used in all sports and sportswear and in many games as sports equipment and sports footwear. Examples of sportswear are: aerobic clothing, athletic clothing, football clothing, cricket clothing, games sorts, gloves, jackets, pants, shirts, shorts, sweat shirts, socks, swimwear, and tennis clothing. Examples of sports equipment are: sails, trampolines, camping gears, leisure bags, bikes and rackets. Examples of sports footwear are: athletic shoes, football boots, gym shoes, tennis shoes and walking boots. The sportswear and sports goods sector of the textile industry has seen the market diversification for fibrous materials and has also contributed towards the elevation of textile science and technology to a level approaching that of other high tech industrial sectors. New technological developments, more fragmented niche markets, and increase demand and expectations are just some of the factors relentlessly driving this industrial sector. To thrive the environment companies are implementing radically new products development practices. Global market volume of sportswear varies depending on the type of end use of applications [10].

FIBRES AND FABRICS FOR ACTIVE SPORTSWEAR

The evolution of fibre developments has gone through the phases of conventional fibres, highly functional fibres and high-performance fibres. Polyester is the single most common fibre used for sportswear and active wear. Other fibres suitable for active sportswear are polyamide, polypropylene, acrylic and elastone. Synthetic fibres can either be modified during manufacturing or be optimally blended with natural fibres to improve

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their thermo-physiological and sensory properties. Synthetic fibres with improved UV resistance and having anti-microbial properties are also commercially available for use in sportswear. New technologies for producing micro fibres have also contributed towards productivity of high-tech sportswear.

Phase changing materials produce micro capsules full of paraffin. When the capsules are heated the paraffin liquidities and heat energy is stored. When the environment cools the paraffin crystallizes again releasing heat. The paraffin which is available in different recipes with various melting points is referred to the phase changing materials or PCM. Because the paraffin can be formulated with different melting points, the micro capsules can be designed to keep the wearer either warm or cool. The warmer paraffin is suitable for skiing and other cold weather sports, the cooler wax is good choice for biking gear mountaineering.

A special suit based on a membrane employing memory polymer was developed for Swedish sailors. He suit designed and employs the Diaplex smart fabric technology. Diaplex can be simultaneously and completely waterproof, wind proof and breathable. The material can remember and retain its shape or return to a previous form. A garment made from Diaplex is able to sense changes in the surrounding environment and evaluate then intelligently and control its expenses to ensure the highest level of comfort. Its intelligence lies in the unique way in which it takes advantages of micro Brownian motion. Micro Brownian motion occurs with the Dipalex membrane when the temperature rises above a predetermined activation points. As a result of this motion micro-pores are created in the polymer membrane which allows water vapour and body heat to escape. Because permeability increases as the temperature rises, the membrane is able to respond intelligently to changes in the wearer's environment and body temperature.

Air Vantage System by W. L. Gore is the first personal thermal climate management system for clothing in the world. It enables wearer to react as though they had own personal Air Conditioning system. The secret of the system is that it is based on age-old piece of wisdom air is a poor conduction of heat and therefore the best natural insulator. On the one hand trapped air protect against the cold, on the other it keeps in existing body heat. Air Vantage

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Membrane system specially developed for the construction of permanently air tight and breathable chamber is based on the same PTFE technology as Gore Tex [1].

MODERN TEXTILES FOR SPORTSWEAR APPLICATION

Moisture management in textiles during the intense physical activities is the key challenge that needs to be addressed to ensure maximum all round comfort to the sports men. Principally the comfort characteristics of the clothing are influenced by the wellness or dryness of the fabric and thermal condition in that particular micro-climate. As a result of this, the sport garments worn next to the skin should have good sweat absorption, transmission and desperation properties. In moisture management some of the textiles manufacturers claim that absorbance fibres like cotton, or viscose in important as they could easily absorb the liquid moisture. While the others say that the fibres for sports application should not absorb moisture and it should allow rapid wicking capillary action. In this context, the synthetic fibres preferred over the natural fibres like cotton, ramie, flax, etc, as they do not retain moisture and keep the garment dry and lighter in wet condition. Also wet synthetic fibres are dried faster due to their lower liquid absorbance.

Waterproof breathable fabrics are designed for use in garments that provide protection from the foul environment like wind, rain, and loss of body heat. Waterproof fabrics completely prevent the penetration and absorption of liquid water while allowing air and moisture vapour to go through it. Therefore it is important to design such advanced structure and finished with suitable chemical so that it will remain in breathable without reducing the comfort properties. Waterproof breathable textiles can be developed by three technologies such as high tensile fabric, polymeric coating and film lamination.

The demand for anti-microbial clothing is surging as the consumers are more aware about their health and hygiene in addition to advance effect of micro-organisms to human body. Anti-microbial finished textile plays an important role in lowering down the psychological discomfort associated with foul odour in textile due to microbial growth and skin infections caused by fungi. They also create a power full barrier against the spread of anti-biotic resistant bacteria which are responsible for hospital related infection. Anti-microbial textile products are expected to grow in the coming years, as it increases the longevity of the product and give pleasant feel. Anti-microbial textile need to exhibit high

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degree of performance in terms of odours neutralization and skin related problems.

UV protective finishing of textiles is important as it can cause skin aging, sun burns, weak immunes system, sun-tanning, photo carcinogenic and even skin carrier. In the past, various chemicals, such as silicate and metal nano particles such as Ti2 and ZnO have been explored for imparting UV protective finishing on textiles as they are nontoxic, environmental friendly and low in price. The UV radiation is categorised in three zones: based on their wave length namely UVC (200-280 nm), mostly absorbed in the ozone layer; UVB (280-320 nm), penetrates the top larger of skin and causes skin ageing sun burn, etc; and UVA (320-400 nm), penetrates through the skin and causes skin ageing [2].

SPORTSWEAR FABRICS AND THEIR INFLUENCE ON THE HEALTH AND PERFORMANCE OF ATHLETHES

For sportswear one can find that the physiological aspect is extremely important because of its major effect on the efficiency and performance of athletes. Thermal comfort refers to sensations of hot, cold or dampness in clothes and is usually associated with environmental factors such as heat, moisture and velocity. Water/moisture vapour transmission and air permeability are important factors that affect the thermal comfort of sportswear. Fibre content and geometry are two primary factors that may affect water/moisture vapour transmission. Textile material used in normal work garment has a significant influence on the dissipation during intermittent in a cool environment. Fabric thermal resistance, thermal conductivity, thermal absorptive, heat flow, relative water vapour permeability and air permeability are physical properties that need to be measured to obtain better understanding of heat and water transmission through fabric. Three groups of knitted fabric samples made from fabrics that are commercially used for sportswear chosen for this work. The fibre composition of each group was 100% cotton fibres, 65/35 polyester/cotton blended fibres and 100% polyester fibres. In active and endurance sports, the performance of a sportswear is synonymous with its comfort characteristics. The wear comfort of sportswear is an important quality criterion that affects performance and well-being. For instance an active sports person who wears poor breathable sportswear will experience an increase in his/her heat rate and related temperature more rapidly than

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