Developments in Sportswear Using Functional Fibres with Polyester fiber

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ABSTRACT

In the area of sportswear there have been many inventions. Innovations in fabric technology are in the introduction of a variety of different properties in fabrics. Performance and versatility are becoming increasingly important. Customers are beginning to seek out specially engineered high-tech, high-performance fibres and fabrics. In the sportswear clothing field there have been huge developments in energy transfer fabrics which transfer heat away from the body so allowing sportsmen and women to remain cool during their activity.

The proposed Project aims to develop knitted fabrics for sportswear by using functional fibres. In this project we are going to use Sun Tencel, Micro Modal fibres Blended with Polyester fibre with the proportion of 50/50 processed using Air Vortex method to produce the yarn and knitted in singly jersey structure and to apply the UV and anti microbial finish to the fabric finely test and analyze the comfort properties of the developed knitted fabrics

Keywords: Air vortex, Moisture transport, Sportswear,

INTRODUCTION

Sportswear was revolutionized in the late C20th by the use of Lycra and later by microfibers. Fabrics like fleece and Sympatex were specifically developed for fluctuations in weather conditions. It is unlikely that street fashion would have adopted them so readily if there had not been the status association of sporting prowess. When this was combined with effective functional utility, a fabric fashion was born that encompassed all ages from young skateboarders to elderly golfers.

Men's sportswear includes clothing specially designed for wearing during various sports or exercise. It is also worn as a casual wear. These garments are designed keeping the functional considerations in mind.

Different sports have their own requirements of how a garment should be, what textiles should be used, should it be woven or knitted, in case of knitted garments, what kind of knits should be used? The designing of these clothes is done using latest technology so that the fabric does not restrict the sports person's movement in any way.

Various fabrics are used for designing high quality and high performance sportswear. Some of the popularly used fabrics are:

Spandex, Cotton, Poly cotton, Nylon, Lycra, Cotton mesh, Stretch cotton, Spandex, Nylon and Microfiber these fabrics are mostly used in this project we are going to use functional fibres as Tencel, modal, bamboo, cotton and spandex for men's tennis wear and compare the fabric testing properties.

TENNIS WEAR

Tennis apparel has changed drastically over the years. White was once required for proper tennis apparel, but tennis clothes are now more colorful and made of lighter materials. Today professional
players have a major influence on how tennis clothes are designed. The apparel is manufactured to enhance performance, withstand weather conditions and maximize players freedom of movement.

HISTORY

In the late 1800s, tennis apparel was very easy to shop for. Clothing stores carried tennis clothing in one color, white. Women wore long dresses and men wore long-sleeved shirts and long pants. Over time, pants became shorts and dresses became short skirts. Men tucked in their shirts. Women wore hats. But clothing had to change to allow the players to keep up with the increasing speed of the game.

Shirts, long flannel pants, sweater vests and shirts, these were the earliest tennis clothes for men. Male tennis players changed their tennis outfits from flannel pants into shorts in the 1930s.

Henry "Bunny" Austin, a British tennis player, is known to be the first top tennis player to wear white shorts in a tennis match.

Since then, the fashion in terms of men’s tennis apparel included white pants and shorts. White shorts and pants were replaced by brightly colored polyester shorts.

FABRICS

The difference between tennis clothes of today and of the past lies in the kind of fabric used in making them.

Modern apparel for tennis players are made of performance fabrics such as nylon, polyester, and spandex. Performance fabrics are far better than cotton, which used to be the commonly used clothing textile for tennis. Cotton naturally absorbs moisture, so if you perspire a lot while playing, your tennis clothes will feel heavy since they are drenched in sweat. Unlike cotton, performance fabrics are breathable—meaning it can keep a player dry and cool despite prolonged sun exposure. These fabrics keep players cool and enhance performance.

With regard to fashion, performance fabrics outperform cotton. For example, some polyester fabrics come in various colors and knits. Today’s fabrics for tennis clothes retain their color and shape way better than cotton. So you can still look great even after an exhausting tennis match.

Because performance fabrics are also durable, you can expect your tennis clothes to last for a long time and your sporty look to remain the same in the future. Clothes in bright colors are the trend in tennis fashion nowadays, though the traditional tennis whites are still not out of the game.

Modern clothing for tennis players for performance materials such as nylon, polyester and spandex. Performance fabrics are much better than cotton, which are used for clothing textiles commonly used for tennis. Cotton is naturally moisture, so if you sweat a lot while playing, you play tennis clothes feel heavy because they are drenched in sweat. Unlike cotton, breathable materials are performance, i.e. it can still be a player, cool and dry, despite prolonged exposure to sunlight. Exceed In terms of fashion, high performance cotton fabrics. For example, certain polyester fabrics and knits come in many different colors and retain their shape a lot better than cotton.

Polyester performance fabrics are also durable which means your tennis clothes will last for a long time, and your sporty look will remain the same for longer one in different colors.

Today’s materials for tennis clothes retain their color and shape better than cotton. So you can always think big, even after an exhausting tennis match. Because performance materials are also durable, you can expect to take your clothes tennis for a long time and your athletic look even remain in the future.
Wear bright colors are the trend these days in the style of tennis, although the traditional tennis whites still offside.

**BRANDS**

Names like Lacoste and Ralph Lauren popularized the tennis shirt, and popular brands of tennis clothes today include Adidas, Diadora, Gamma, K-Swiss, Nike, Fila, Reebok and Wilson. Hats and visors, sweat bands for the forehead or wrist, socks, shorts, shirts, and sunglasses are all produced and heavily marketed.

**COLD WEATHER CLOTHING**

Playing in cold weather requires a few layers of clothing. Wear an undershirt, a T-shirt and a warm-up jacket or sweatshirt. In colder weather conditions it will take longer to get warmed up, so keep your body warm with extra layers until you've warmed up your muscles.

Tennis clothes should incorporate socks and apparel composed of materials and fabrics that absorb perspiration; allowing your skin to breathe is important so that heat and exhaustion don't become unbearable. Novel synthetic fabrics are engineered to wick or push the perspiration away from your body. Traditional cotton and acrylic are good for this anti-sweat purpose as well. Make sure the clothes are loose-fitting so that circulation is not impeded, accelerating exhaustion. Blisters, skin irritations, rashes can result from clothes that press down too tightly on any part of your body. You don't want clothes that pinch you because circulation shouldn't be inhibited in any way. Otherwise, you're more likely to get tired.

**MATERIALS AND METHOD**

**MICRO MODAL**

Modal is a cellulose fiber made by spinning reconstituted cellulose from beech trees. It is about 50% more hygroscopic (water-absorbent) per unit volume than cotton. It takes dye like cotton, and is color-fast when washed in warm water. Modal is essentially a variety of rayon.

Textiles made from Modal are resistant to shrinkage and fading, but prone to stretching and pilling. They are smooth and soft, more so than mercerized cotton, to the point where mineral deposits from hard water do not stick to the fabric surface. Modal fabrics should be washed at lower temperatures, and ironed after washing.

- Lenzing Modal is a registered trademark of Lenzing AG, an Austrian company specializing in textiles and fibers, particularly natural fibers made from cellulose. Modal has been used alone or with other fibers in household linens such as towels, bathrobes, and bedsheets, and the fabric has increased in popularity in the early 21st century.

**ADVANTAGES**

- Absorbs 50% more water than cotton.
- Takes dye as well as cotton.
- Lightweight fabric.
- Has the appearance of silk: luster/sheen/gloss.
- Holds colour when machine washed in warm water.
- Fabric isn’t stiff, doesn’t become rigid when machine washed.
- Can be repeatably washed and holds soft and smooth characteristics.
- Soft and smooth against the skin.
- Doesn’t pile as much as cotton.
- Resistant to fading.
- Resistant to shrinkage.
- Resistant to mineral build up when washed again and again e.g. lime from hard water. Blends are more crease resistant.
- Doesn’t age like cotton.

Modal fabric has softness, good drape and is comfortable for wearing Modal fabric has good moisture regain and air permeability which is often considered better than cotton fabric, it is a good material for exercise clothing and health suit, which can serve to benefit physiology circulation and health of the body. Modal fabric has level up surface, fine and smooth and velvet, which have the effect of natural silk. The yarn has the character of high strength. The fabric has good softness and brilliant luster. The effect of the finished Modal garment is very good, and the form is steady. The garment maintains anti-crease properties and has relatively easy care.

**PROPERTIES AND COMPARISON**

In brief, Modal possesses lower elongation and higher wet modulus as it has high rate of polymerization. Its exceptional similarity to cotton/silk in terms of texture (luster, sheen and gloss) results in a surface smoother than mercerized cotton.

A typical comparison of properties of High wet modulus viscose rayon with commonly used convectional fibers is as follows:

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>HIGH WET MODULUS (MODAL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DENSITY (g/cm³)</td>
<td>1.53</td>
</tr>
<tr>
<td>MOISTURE REGAIN (%)</td>
<td>11.8%</td>
</tr>
<tr>
<td>TENACITY (GPD)</td>
<td>2.2-4.0 dry</td>
</tr>
<tr>
<td></td>
<td>3.8-5.0 wet</td>
</tr>
<tr>
<td>BKNG ELONGATION</td>
<td>7.0% dry</td>
</tr>
<tr>
<td></td>
<td>8.5% wet</td>
</tr>
<tr>
<td>WORK OF RUPUTER (mN/tex)</td>
<td>11.5</td>
</tr>
<tr>
<td>INITIAL MODULES (mN/tex)</td>
<td>13300</td>
</tr>
</tbody>
</table>

**SUN TENCEL**

**THE NEW AGE FIBER**

TENCEL® heralds the beginning of a new age in fiber technology. Completely natural, TENCEL® is Lenzing Fibers' brand name for lyocell. A major break-through was made with the development of the unique nanofibril structure of this fiber. TENCEL®, made from wood pulp cellulose, offers a unique combination of the most desirable properties of man made and natural fibers: soft as silk, strong as polyester, cool as linen, warm as wool and as absorbent as cotton. Quite simply a "break-through" fiber.

TENCEL® - The "Break-Through-Fiber"

Nanofibrils are the key to the performance possibilities of TENCEL®. The unique technology of
nanofibrils allows the production of textiles, which, until now, could only be dreamed of. This is the first cellulose fiber to use this nano technology. Controlled and regular arrangement of nanofibrils in the TENCEL® fiber leads to new functional properties. The nanofibrils are hydrophilic and optimize absorption of moisture with excellent cooling properties.

* Natural cooling
* Nanofibrils
* Outstanding moisture management
* Inhibits bacteria growth

Moisture transport as a result of nano technology. In contrast to synthetic fibers, with reduced wicking properties, TENCEL® offers unique moisture transport. The completely new nano technology of TENCEL® supports this natural fiber property, guaranteeing optimum conditions for the skin. Synthetic fibers cannot absorb moisture into the inside of the fiber. The illustration shows that in contrast to cotton and polyester fibers, TENCEL® controls and regularly absorbs moisture. Also TENCEL® absorbs 50% more moisture than cotton.

MOISTURE (VAPOR) MANAGEMENT WITH EXTREME AIR HUMIDITY

Moisture transport is determined by climate. Depending upon climate conditions, TENCEL® either absorbs or releases moisture. Compared to other fibers, TENCEL® features the highest moisture absorption-rate: with air humidity at 65%, TENCEL® still has unused capacity to absorb moisture from the skin.

The graph shows the increase of moisture in a textile when the textile is moved from a relative humidity of 65% to a relative humidity of 100%. The moisture refers to the weight of the dry textile.

TENCEL® - THE SKIN SENSOR

The skin is the largest human respiratory organ. Human skin acts as a protective shell, regulates body temperature and maintains water balance. TENCEL® supports these body functions acting like a second skin.

A subjective feeling of well-being depends considerably on moisture absorption and on surface structure of the fibers. Rougher fibers can lead to skin irritation. The extremely smooth surface of TENCEL® feels soft and pleasant to the skin. The reason for the fine surface of the fiber is low fiber stiffness.
* Smooth fiber structure
* Temperature control
* Irritation free
* Suitable for sensitive skin

**REASSURING RESULTS FOR SENSITIVE SKIN**

TENCEL® is a godsend for anyone with sensitive skin. The combination of a smooth fiber surface and excellent moisture absorption creates a positive environment for healthy skin, making TENCEL® ideal for anyone with sensitive skin.

According to recent dermatological studies, wearing clothing made of TENCEL® significantly improves comfort and promotes a feeling of well being.* (Dermatological study of the textile compatibility of TENCEL®, 2004, Univ.-Prof. Dr. T.L. Diepgen, Heidelberg, Germany) Also, TENCEL® is chemical free, an important factor for sensitive skin and another asset in comparison to other fibers of a natural origin.

**POLYESTER**

Today over 70 to 75% of polyester is produced by CP (continuous polymerization) process using PTA (purified Terephthalic Acid) and MEG. The old process is called Batch process using DMT (Dimethy Terephthalate) and MEG( Mono Ethylene Glycol).

**CUT LENGTH:**

Cut lengths available are 32, 38, 44, 51 and 64mm for cotton type spinning and a blend of 76, 88 and 102 mm - average cut length of 88m for worsted spinning. The most common cut length is 38 mm.

**DRY HEAT SHRINKAGE:**

Normally measured at 180 degree C for 30 min. Values range from 5 to 8 %. With DHS around 5%, finished fabric realisation will be around 97% of grey fabric fed and with DHS around 8% this value goes down to 95%. Therefore it makes commercial sense to hold DHS around 5%. L and B colour: L colour for most fibres record values between 88 to 92. "b" colour is a measure of yellowness/blueness. B colour for semidull fibre fluctuates between 1 to 2.8 with different fibre producers. Lower the value, less is the chemicals degradation of the polymer. Optically brightened fibres give b colour values around 3 to 3.5. This with 180 ppm of optical brightener.

**DYE TAKE UP:**

Each fibre producer has limits of 100 +- 3 to 100+-8. Even with 100+3 dye limits streaks do occur in knitted fabrics. The only remedy is to blend bales from different days in a despatch and insist on spinning mills taking bales from more than one truck load.

**FUSED FIBRES:**

The right way to measure is to card 10 kgs of fibre. Collect all the flat strips(95% of fused fibres get collected in flat strips). Spread it out on a dark plush, pick up fused and undrawn fibres and weigh them. The upper acceptable limit is 30mgm/10kgs. The ideal limit should be around 15mgm/10kgs. DUPont calls fused/undrawn fibres as DDD or Deep Dyeing Defect.

**LUSTRE:**

Polyester fibres are available in
Bright: 0.05 to 0.10 % TiO2
Semi dull: 0.2 to 0.3 % TiO2
Dull: 0.5% TiO₂
Extra dull: 0.7% TiO₂ and
In optically brightened with normally 180 ppm of OB, OB is available in reddish, greenish and bluish shades. Semi dull is the most popular luster followed by OB (100% in USA) and bright.

PHYSICAL AND CHEMICAL PROPERTIES OF POLYESTER FIBRE:

Denier: 0.5 – 15
Tenacity: dry 3.5 - 7.0 : wet 3.5 - 7.0
% elongation at break: dry 15 - 45 : wet 15 45
% moisture regain: 0.4
Shrinkage in boiling water: 0 - 3
Crimps per inch: 12 -14
% dry heat shrinkage: 5 - 8 (at 180 c for 20 min)
Specific gravity: 1.36 - 1.41
% elastic recovery; @2% =98 : @5% = 65
Glass transition temp: 80 degree c
Softening temp : 230 - 240 degree c
Melting point: 260 - 270 degree c
Effect of sunlight: turns yellow, retains 70 - 80% tenacity at long exposure
Resistance to weathering: good
Rot resistance: high
Alkali resistance: damaged by con alkali
Acid resistance: excellent
Organic chemical resistance: good

NATURAL ANTI-BACTERIA

It's a common fact that Sun Tensel can thrive naturally without using any pesticide. It is seldom eaten by pests or infected by pathogen. Scientists have found that, the Sun tensel owns a unique anti-bacteria and bio-agent named "Tensel Kun". This substance combined with cellulose molecular tightly all along during the process of being produced into Sun Tensel fibre. Bamboo fibre has particular and natural functions of anti-bacteria, bacteriostasis and deodorization. It is validated by Japan Textile Inspection Association (JIA) that, even after fifty times of washing, Sun tensel fabric still possesses excellent function of anti-bacteria, bacteriostasis. Its test result shows over 70% death rate after bacteria being incubated on tensel fabric.

BREATHEABLE AND COOL

The notable feature of Tencel fibre is its unusual breathability and coolness. Because the cross-section of the Tencel fibre is filled with various micro-gaps and micro-holes, it has much better moisture absorption and ventilation. With this unparalleled micro-structure, Tencel apparel can absorb and evaporate humans sweat in a split second. Just like breathing, such garments make people feel extremely cool and comfortable in the hot summer. It is never sticking to skin even in hot summer. According to authoritative testing figures, Bamboo apparels are (1-2)°C lower than the normal apparels in hot summer. Tencel apparel is crowned as “Air Conditioning Dress”.

ENHANCED APPAREL VALUES

Comfort properties of textiles are extremely important. It is sometimes more important than the aesthetic properties when the garments are next to skin. Among all the comfort properties, good absorption and easy drying is one of the major requirements. When we do some physical work, we sweat. Garments, which are next to skin, should absorb this sweat quickly and transport it to the outer surface of
the garment. From the outer surface, sweat (or water to be precise) should be evaporated quickly to keep the body dry and cool. All these desired phenomena come under one technical term, called “moisture management”. It is clear that absorption of water and its transport to different parts of textiles followed by its evaporation is the major requirement. Transport of water to different parts of fabric is called ‘wicking’.

**WICKING AND MOISTURE MANAGEMENT IN TEXTILES**

In textile structures, the spaces between fibres effectively form capillaries. The closer fibres are packed together in yarns. It is evident from the basics of capillary action that, the smaller the apparent capillary diameter, the more readily wicking can occur. Hence, basic textile properties like, diameter, cross section, crimp etc. all plays a role in capillary transport. So, it is evident that wicking properties of different fabrics are bound to be different. Capillary action in textiles will attract water from places where it is abundant and transport it to the places where it is less abundant. When all parts of a garment are wet capillary action ceases.

**THERMAL BEHAVIOUR OF TEXTILE MATERIALS**

Thermal Properties of textiles have been investigated since 1930s; Heat flow through textile materials is studied into two segments named steady state and transient state. In the steady state heat transfer the value of the temperature at a place doesn't change with the time, but it changes with the position of that point, in easier words the temperature is variable with position but not variable with time. While in the transient state the temperature varies with both time as well as position.

**ASSESSMENT OF THE THERMAL BEHAVIOR**

Validation and Quantification of the results are one of the prime objectives of any testing. The same is true with Thermal Behaviour also, there are many test methods and instruments have been developed with an objective of real assessment of the performance and at the same time it should be practical, simple to operate.

**THERMAL TESTING METHOD**

Thermal balance of the human body and its responses to the dynamic interactions with the clothing and environment systems is responsible for the thermal comfort. Most of the researchers consider heat and the moisture transmission behaviour of a fabric as vital factors deciding the thermo physiological comfort.

**MEASUREMENT OF THERMAL CONDUCTIVITY**

The transmission of heat through clothing may involve conduction process, which is heat flow through fibre/textile material and the entrapped air and radiation process. So, while referring thermal conductivity, heat flow by all the possible means has to be considered and measured.

**METHODOLOGY**

To procure raw materials (Fiber).

To produce Air vertex yarn.

To produce knitted fabrics

Testing comfort properties
3.2 SAMPLE PREPARATION

FIBRE

Sun Tencel, micro model fibres with polyester fibres are blended and processed in air vertex yarn.

Yarn composition Are

50% Micro Modal + 50% Polyester

50% Sun Tencel + 50% Polyester

KNITTING OF FABRIC

GSM - 130
Loop length - 0.27mm
Structure - Single Jersey
Gauge - 24

TESTING

PHYSICAL / GEOMETRICAL PROPERTIES.

- Loop length
- Course/inch, wales/inch, Gsm, stitch density.

MECHANICAL PROPERTIES.

- Bursting strength

COMFORT PROPERTIES

- Thermal property
- Moisture vapour & Air permeability,
- Low stress mechanical properties

FINISHING

- Anti-bacterial and UV protection
CONCLUSION

Design, fabrication and testing of Functional yarn and polyester blended fabrics are having better comport compare to other combination like cotton and polyester, micro model and lycra combination Functional fibres (modal, Tencel, polyester) yarn are having high moisture management and low weight. Sweating will be observe and releasing cycle vary effective ,so player feel the better comfort and polyester having high elastic property so it’s easy to expand and recover in this property gives the good fit and smart appearance to the player now a day’s color full shirts are available in market.

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