



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 13, Issue 4, April 2024

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 8.423

9940 572 462

6381 907 438

[ijirset@gmail.com](mailto:ijirset@gmail.com)

[www.ijirset.com](http://www.ijirset.com)

# Development of Sports Textiles with Enhanced Comfort Properties for Thermal and Moisture Transport

Preetika R, Subiksa S, Divesh S, Dr. Bhaarathi Dhurai, Mr. Sathish Kumar

U.G. Student, Department of Fashion Technology, Kumaraguru College of Technology, Coimbatore,  
Tamil Nadu, India

Professor, Department of Fashion Technology, Kumaraguru College of Technology, Coimbatore,  
Tamil Nadu, India

Managing Director, Innotex Private Materials, Tirupur, Tamil Nadu, India

**ABSTRACT:** The pursuit of high-performance sportswear has driven advancements in textile innovation, aiming at enhancing comfort during physical activities. This project focuses on the design and construction of four specialized garments – a women's trail running shirt, a women's tennis one-piece, a men's triathlon suit, and a packable windbreaker jacket for women. The central objective is to optimize thermal and moisture transport properties in each garment. Rigorous research and lab testing led to the selection of textiles with superior moisture-wicking and breathability. The Trail Running Shirt incorporates a lightweight, breathable fabric to facilitate rapid moisture evaporation, preventing overheating during intense Trail runs. The Tennis one-piece integrates high-stretch and moisture wicking fabrics, providing unrestricted movement, and preventing sweat accumulation during rigorous Tennis matches. The Triathlon suit combines compressive and breathable fabrics to support muscles, promote blood flow, and enhance moisture management throughout demanding Triathlon competitions. Lastly, the Packable Wind Breaker Jacket is lightweight, durable, and wind resistant. It also offers limited water resistance, repelling dirt, and stains. Prototypes underwent in-field evaluation to meet comfort and performance standards. It represents a dedication to advancing sportswear for a better athlete experience.

**KEYWORDS:** High-performance sportswear, Textile Innovation, Comfort, Thermal, Moisture transport, Breathability, Compressive fabrics, In-field evaluation.

## I. INTRODUCTION

Athletes rely heavily on the clothes they wear to perform at their best. In the world of sports textiles, there's been a significant shift in how athletes experience comfort, manage their body temperature, and deal with sweat during physical activity. The goal is to make sure athletes feel comfortable, stay at the right temperature, and stay dry. This has led to big improvements in how fabrics are made and how clothes are designed for sports. This report looks closely at sports textiles, exploring how sports clothing has evolved to meet athletes' needs and improve their performance. These clothes not only help athletes physically but also make sure they perform better overall. Sports clothes now offer support, protection, and ways to manage sweat effectively so that athletes can stay cool and dry. Researchers are constantly working on making even better sports textiles. One way they do this is by using fabrics that stretch and breathe well, thanks to special weaves and clever ventilation systems. This means air can flow better through the clothes, helping athletes stay comfortable even when they're working hard. Another approach is to use fabrics that feel soft and smooth on the skin. These often have special stitching techniques to reduce rubbing and irritation, especially in areas where athletes move a lot, so they can move freely without discomfort. We aim to create a top-tier line of sports attire tailored to elevate athlete comfort and boost performance. Our focus is on crafting shirts, dresses, suits, and jackets that prioritize comfort, efficient temperature regulation, and sweat-wicking abilities. We meticulously refine every aspect through continuous adjustments informed by user input and rigorous laboratory testing. Our aim is to establish a benchmark in comfort and excellence, ensuring each garment reaches its full potential.

## II. LITERATURE REVIEW

Comfort is a state of pleasant psychological, physiological, and physical harmony between individuals and their surroundings [1]. Human comfort involves various processes, including physical, thermo-physiological, neuro-physiological, and psychological factors [2]. Thermo-physiological comfort specifically relates to maintaining the

body's thermal balance, aiming to sustain a core temperature of approximately 37°C. Even a slight deviation of around  $\pm 5^{\circ}\text{C}$  from this optimal temperature range can lead to severe consequences such as hypothermia or hyperthermia, which can impair work performance significantly [3]. Under normal atmospheric conditions and during typical activity levels, the body regulates its temperature through mechanisms like conduction, convection, radiation, and perspiration. However, during higher levels of activity or in elevated temperatures, the body generates more heat, requiring increased perspiration to dissipate it effectively [4]. Perspiration occurs in two forms: insensible vapor and sensible liquid. Both forms aid in heat dissipation, with the latter directly carrying heat away from the body. For efficient cooling, clothing should facilitate the transfer of perspiration. Inadequate moisture transfer through clothing can lead to discomfort, especially during physical activity, as it impedes sweat evaporation. This can elevate humidity levels within the clothing microclimate, raising skin and rectal temperatures and ultimately causing heat stress [5]. Creating clothing tailored for specific purposes requires careful consideration of fiber, yarn, and fabric construction parameters. Optimal clothing comfort is achieved by selecting materials and designs that offer high thermal resistance to protect against cold, moderate resistance to water vapor transfer in mild thermal conditions, and efficient transfer of both vapor and liquid moisture in high thermal stress situations [6]. Ensuring thermal comfort is essential for overall physical and psychological well-being. Maintaining an optimal temperature and humidity level in the skin's microclimate is crucial, with the ideal skin temperature range being around  $33.4 \pm 3^{\circ}\text{C}$ . However, traditional textiles often struggle to adapt to changing environmental conditions, such as varying weather patterns and extreme situations like strong winds or heavy rainfall. This limitation leads to ineffective thermal regulation, ultimately compromising wearer comfort and protection. Hence, there is a pressing need for the advancement of intelligent textiles designed to adjust to fluctuating environmental conditions. These innovative textiles would ensure optimal comfort for wearers in both warmer and cooler climates [7].

The mechanism by which moisture moves through textiles mirrors the capillary action seen in liquid wicking. This action in porous materials depends on two key factors: pore diameter and surface energy. Smaller pores or higher surface energy enhance capillary action. In textiles, the spaces between fibres in yarn form effective capillaries. The addition of micro-size fibers helps create narrower capillaries, aiding efficient moisture transport. The surface energy of textile material is mainly influenced by the chemical makeup of the fibre and the surface texture of the fabric. Managing moisture effectively in textiles during intense physical activity presents a significant challenge for ensuring athlete comfort. Fabrics create a microclimate between the body and the environment, facilitating heat and vapor exchange. Moisture transmission through the fabric involves diffusion, sorption-desorption, and forced convection through moving air near the skin. In hot and humid conditions, it's crucial for clothing to quickly absorb moisture and transport it efficiently to the environment, utilizing wetting and wicking actions for player comfort. Wetting action spreads fluid on textiles, replacing the fiber-air interface. Wicking action, influenced by surface tension, capillary pathways, and pore distribution, involves molecular attraction between fibers and liquid at the fabric surface [8]. Physical comfort is closely linked to skin temperature and moisture content in the environment, both affected by physical exertion. The fabric type plays a crucial role in regulating skin moisture. Comfort is significantly influenced by fabric wetness or dryness and the thermal conditions within the microclimate. Therefore, sports garments worn close to the skin should exhibit effective sweat absorption, transmission, and desorption properties.

Regarding moisture management, some textile manufacturers advocate for absorbent fibres like cotton or viscose, emphasizing their ability to absorb liquid moisture readily. Conversely, others argue that fibres for sports should facilitate rapid wicking through capillary action, favouring synthetic fibres over natural ones like cotton, ramie, and flax. Synthetic fibres do not retain moisture, keeping the garment dry and lighter in wet conditions. Additionally, wet synthetic fibres tend to dry faster due to their lower liquid absorbency [9].

### III. METHODOLOGY

#### CONCEPT AND RESEARCH

- Identify sport, geography, demographics.
- Research athlete and consumer needs.
- Brainstorm sport-specific features.
- Establish design concepts for each sportswear

#### DESIGN AND MATERIAL

- Create sketches, technical drawings.
- Select materials, construction methods.
- Consider fit, ergonomics.



**PROTOTYPING**

- Pattern making
- Cutting
- Sew the prototype, make adjustments.

**MATERIAL TESTING**

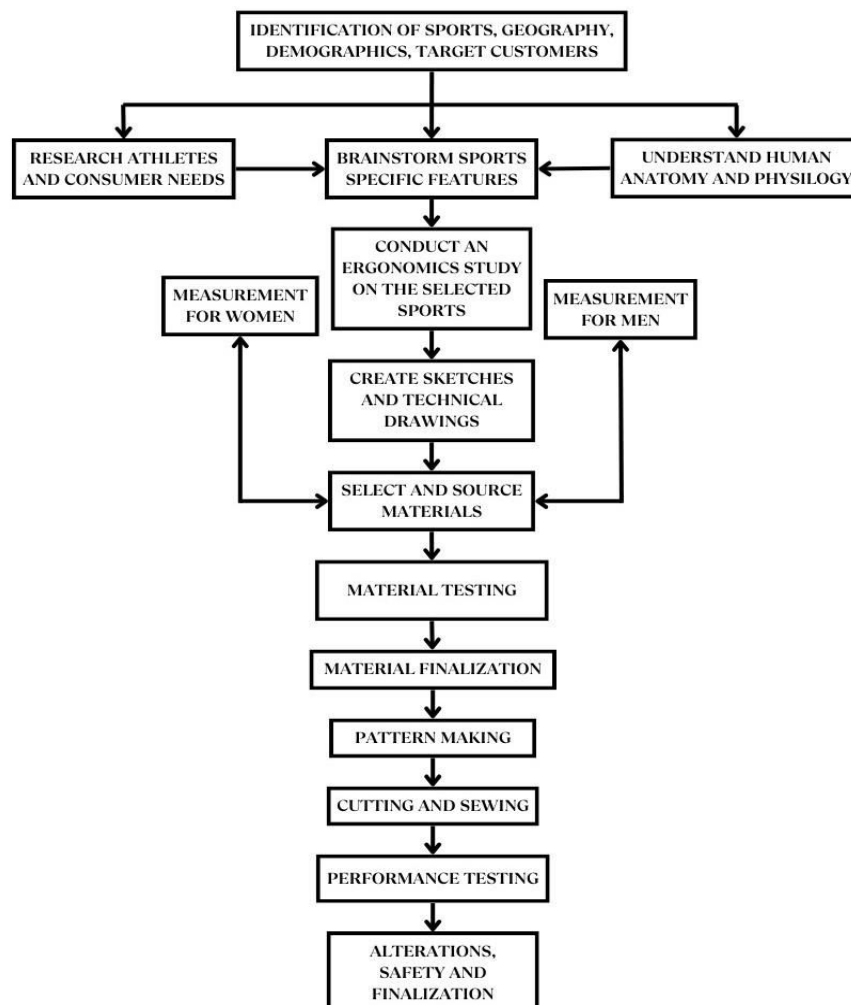
- Conduct lab tests, evaluate performance.
- Assess moisture-wicking, insulation, breathability.
- Evaluate durability, washability.

**PERFORMANCE TESTING**

- Test fit and comfort.
- Assess moisture transport, comfort.
- Gather feedback, make adjustments.

**SAFETY AND FINALIZATION**

- Ensure garments meet safety standards.
- Address safety concerns, if any.
- Finalize design, incorporating improvements.
- Prepare for cost-effective mass production.





#### IV. TRAIL RUNNING SHIRT

Trail running shirts tailored for India's diverse regions provide versatile performance in varying climates and terrains. From the rugged trails of the Western Ghats to the picturesque landscapes of the Himalayas, these shirts are designed to keep runners comfortable and dry. With moisture-wicking fabrics and breathable designs, they offer optimal performance in summer heat, fall foliage, winter chill, and spring bloom. Whether navigating coastal trails in the south or scaling mountain paths in the north, these shirts ensure runners can focus on their stride and enjoy the beauty of India's diverse landscapes. In females, when considering the anterior/front of the body, there is a slightly higher sweat amount observed on the upper arms. Moving to the posterior/back of the body, there are higher sweat amounts detected at the spinal column of the upper back (thoracic region), as well as slightly higher sweat amounts on the upper arms, particularly in the triceps area. Interestingly, the sweat amount observed on the lower lateral aspect, above the hips, is the same as that in males. Furthermore, it was noted that the mid-central back (spine) exhibited the highest sweat rate in both males and females. Consequently, the entire back region tends to produce more sweat compared to the chest area.

Which is the preferable option: loose or close-fitting? These shirts aren't skin-tight, but they do offer a snugger fit compared to many others. A woven mesh back enhances breathability without compromising the overall silhouette. The mesh panels at upper back facilitate direct airflow, promoting excellent breathability. It's worth mentioning that this shirt emerged as the fastest-drying option in the review.

The trail running shirt is a crucial piece of gear designed to meet the specific demands of trail runners. It is engineered to provide comfort, performance, and durability in rugged outdoor environments. Features commonly found in trail running shirts include moisture-wicking fabrics to keep runners dry and comfortable, breathable mesh panels for enhanced ventilation to minimize chafing and irritation during long runs. Additionally, trail running shirts often feature lightweight and quick-drying materials to ensure optimal performance in various weather conditions. Reflective elements is incorporated for increased visibility during low-light conditions. Overall, the trail running shirt is essential equipment for runners tackling challenging terrain and varying climates.



Fig. 2 – (a) Final Front Sketch of Trail Running Shirt; (b) Final Back Sketch of Trail Running Shirt



Fig. 3 –(a) CLO-3D Front Sketch of Trail Running Shirt; –(b) CLO-3D Back Sketch of Trail Running Shirt



Developments in Trail Running Shirt for Women

- **Raglan Short Sleeves:** Trail running T-shirts often incorporate raglan short sleeves, which are designed for a comfortable and unrestricted fit. This sleeve style allows for enhanced freedom of movement, particularly in the shoulder area, ensuring that runners can maintain their natural range of motion throughout their run.
- **Round Neck Design:** The round neck design of these T-shirts offers a classic and versatile look while ensuring a comfortable fit around the neckline. This design choice helps prevent irritation or discomfort during prolonged wear, allowing runners to focus solely on their performance.
- **Hem Lower at the Back:** Many trail running T-shirts feature a hem that is lower at the back than at the front. This design provides added coverage and protection, particularly when runners are navigating uneven terrain. The extended coverage at the back helps prevent the shirt from riding up during movement, ensuring that runners stay covered and comfortable throughout their run.
- **Back Ventilation:** To enhance breathability and regulate body temperature during intense workouts, trail running T-shirts often incorporate back ventilation features. These vents allow for optimal airflow and ventilation, helping to dissipate heat and moisture to keep runners cool and comfortable, even in hot and humid conditions.
- **Reflective Element:** Safety is paramount during trail running, especially in low-light conditions or when running near roadways. Many trail running T-shirts include reflective elements at the back, which enhance visibility and ensure that runners remain seen by motorists and other runners during early morning or evening runs.

**Fabrics Used in Trail Running T shirt.**

Fabric Reference Name	Composition	GSM
MICRODOT	100% POLYESTER	180 GSM
HYDRA MESH	92% POLYESTER, 8% ELASTANE	160 GSM

**V.TENNIS ONE PIECE DRESS**

An analysis of the Women’s Tennis Apparel market based on product type, which includes:

- Skort
- Tennis Dress
- Tennis Skirt
- Other

Furthermore, the report focuses on the status and outlook for major applications/end users in India, detailing sales volume, market share, and growth rate for Women’s Tennis Apparel across different segments, such as:

- Professional Tennis Player
- Amateur Tennis Player

Regarding geography, the report provides insights into consumption patterns within India and neighboring countries, offering data for the year 2023, including: India, Southeast Asia (including Malaysia, Singapore, Philippines, Indonesia, Thailand, Vietnam), Other Regions.



Fig. 4 – (a) Final Front Sketch of Tennis dress; (b) Final Back Sketch of Tennis dress



Fig. 5 – (a) CLO-3D Front Sketch of Tennis dress; (b) CLO-3D Back Sketch of Tennis dress

#### Developments in Tennis dress

- Knife Pleated Skirt: The dress incorporates a knife pleated skirt design, adding a touch of elegance and movement to the outfit. The pleats not only enhance the aesthetic appeal but also provide freedom of movement during intense rallies on the tennis court.
- Top Attached with Skirt: The top portion of the dress is attached to the skirt, creating a cohesive and streamlined look. This one-piece design ensures ease of wear and eliminates the need for separate pieces, allowing players to focus solely on their game.
- Scoop Neckline: The dress features a scoop neckline in the front, providing a flattering and comfortable fit. This neckline style offers unrestricted movement for the arms and shoulders, allowing players to swing and serve with ease.
- Racer Back: At the back, the dress incorporates a racerback design, which enhances mobility and flexibility during gameplay. The racerback style allows for a full range of motion in the shoulders and upper back, enabling players to move freely on the court.
- Mesh Panels: Strategically placed mesh panels are incorporated into the design to enhance ventilation and breathability. These panels are positioned at the upper front neckline and arm regions, as well as the upper back, allowing for optimal airflow and moisture management during intense matches.



- Attached Skirt: The dress includes an attached skirt, which adds a stylish and feminine touch to the overall design. The skirt provides coverage and modesty while allowing for unrestricted movement on the court.
- Separate Shorts: tennis one-piece dresses may also come with separate shorts or built-in compression shorts underneath the skirt. These shorts offer added coverage and support, helping players feel confident and comfortable during gameplay.

Fabrics Used in Tennis dress

Fabric Reference Name	Composition	GSM
ZURICH	92% POLYESTER, 8% ELASTANE	220 GSM
HYDRA MESH	92% POLYESTER, 8% ELASTANE	160 M

### VI.TRIATHLON SUIT

It is characterized by its snug fit, engineered to streamline performance. Constructed from moisture-wicking fabric, it ensures efficient sweat management throughout the race. Designed as a one-piece ensemble, it offers a streamlined fit to minimize drag and maximize aerodynamics across swimming, cycling, and running segments. Engineered with moisture-wicking fabrics, it efficiently manages sweat to keep athletes dry and comfortable throughout the race. The triathlon suit exemplifies the fusion of performance, comfort, and functionality, making it indispensable for athletes aiming for peak performance in multisport competitions. Triathlon suits are essential apparel for multisport athletes, designed to streamline performance across swimming, cycling, and running segments. In cold climates like the northern regions of India, they offer added insulation and coverage, while in hot and humid environments such as southern India or desert regions like Rajasthan, breathability and moisture-wicking properties are prioritized. For variable climates like those found in the Western Ghats, adaptable suits with removable sleeves or legs are favored. Coastal areas like Goa require suits optimized for open-water swims, while urban races in cities like Mumbai demand suits suitable for well-paved roads. In mountainous regions like the Himalayas, suits must accommodate challenging terrains and varying elevations.

Triathlon includes-

**Swimming:** The triathlon typically begins with a swimming segment, which can take place in open water (such as lakes, rivers, or oceans) or in a pool, depending on the event. Triathletes swim varying distances, ranging from sprint distances of around 750 meters to Ironman distances of 3.8 kilometers (2.4 miles). Participants wear swim caps and goggles for safety and performance.

**Cycling:** After completing the swim, triathletes transition to the cycling segment. They ride bicycles of various types, including road bikes, time trial bikes, or triathlon-specific bikes, depending on personal preference and the nature of the course. Cycling distances vary by event, with sprint distances typically around 20 kilometers (12.4 miles) and Ironman distances around 180 kilometers (112 miles).

**Running:** Following the cycling leg, triathletes transition to the final segment: running. Participants run varying distances, with sprint distances typically around 5 kilometers (3.1 miles) and Ironman distances around 42.2 kilometers (26.2 miles). The run concludes the triathlon, with participants crossing the finish line to complete the event.



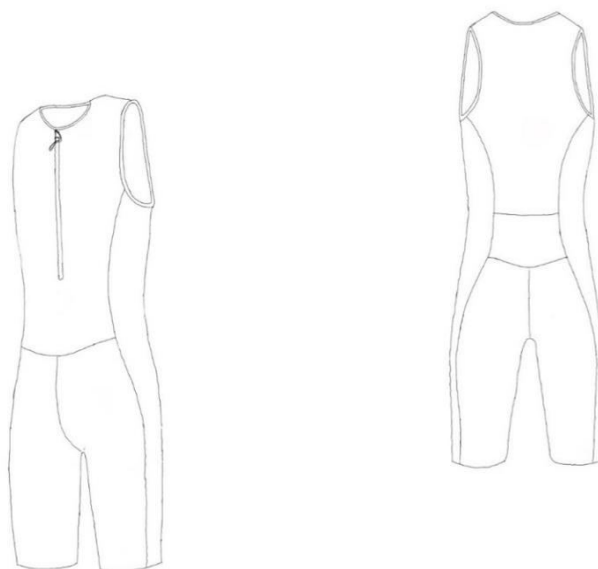


Fig. 7 – (a) Front Flat Sketch of Triathlon Suit; (b) Back Flat Sketch of Triathlon Suit



Fig. 8 –(a) CLO-3D Front Sketch of Triathlon Suit ;(b) CLO-3D Back Sketch of Triathlon Suit

#### Developments in Triathlon Suit

- Closed Round Neckline: The suit features a closed round neckline, providing a comfortable and secure fit around the neck. This neckline design ensures minimal water resistance during the swim portion of the triathlon and reduces chafing or discomfort during extended wear.



- **Front Zipper:** A front zipper is incorporated into the suit for easy wear and removal. This zipper allows athletes to quickly put on or take off the suit, saving valuable time during transitions between swim, bike, and run segments of the triathlon.
- **Raglan Sleeves:** Raglan sleeves are included in the suit's design to facilitate comfortable movement of the arms and shoulders. This sleeve style ensures unrestricted range of motion, allowing athletes to maintain their natural swimming, cycling, and running motions without feeling constricted.
- **Snug Fit:** The suit is designed to offer a snug fit that hugs the body closely without being too tight or restrictive. This snug fit enhances comfort and performance by minimizing drag in the water and reducing wind resistance during the cycling portion of the triathlon.
- **Cut and Side Panels:** The suit may feature strategically placed cut and side panels to enhance ventilation and airflow. These panels allow for optimal breathability, helping to regulate body temperature and keep athletes cool and comfortable throughout the race.

Fabrics Used in Triathlon suit

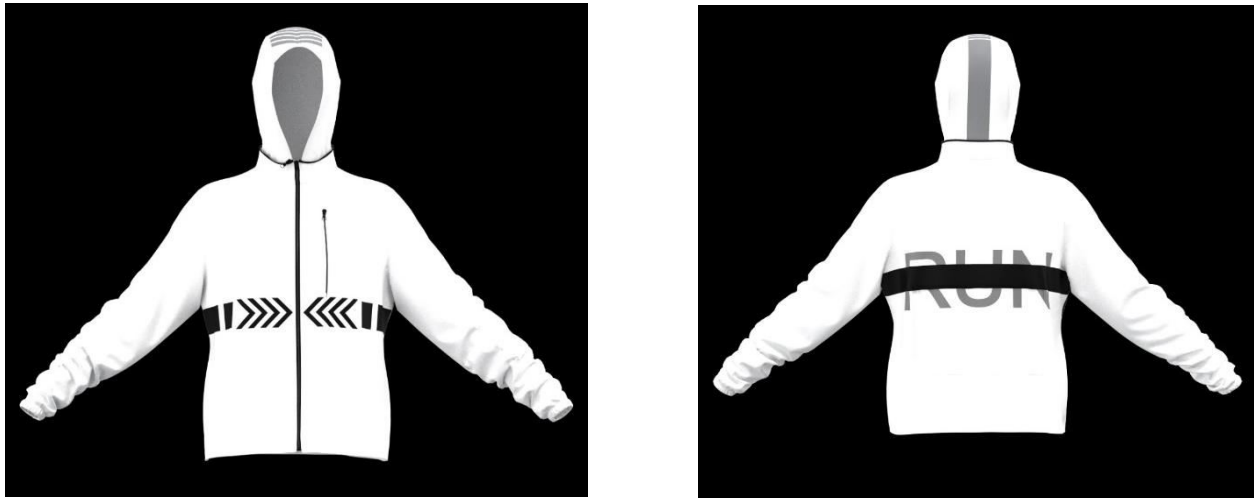
Fabric Reference Name	Composition	GSM
TRICOT 4 WAY	80% POLYESTER, ELASTANE	20% 200 GSM

VII.WIND BREAKER JACKET

The Ripstop windbreaker jacket embodies a blend of cutting-edge design and advanced materials tailored to meet the needs of outdoor enthusiasts. Constructed from Ripstop fabric renowned for its durability, the jacket features an interwoven grid pattern that prevents tears and abrasions, ensuring long-lasting performance in rugged conditions. Providing reliable windproof protection, it shields wearers from harsh winds while offering water-resistant properties that repel moisture, keeping them dry in light rain or drizzle. Despite its robust construction, the jacket remains lightweight and packable, making it convenient for travel and outdoor excursions. Its breathable design promotes airflow and ventilation, preventing overheating during strenuous activities. With versatile performance suited for hiking, camping, or urban exploration, the Ripstop windbreaker jacket combines functionality with style, boasting a sleek and modern design with thoughtful details for enhanced comfort and usability. Overall, it stands as a dependable outerwear choice for those seeking protection from the elements without compromising on performance or aesthetics.

In the realm of insulated jackets, several factors differentiate synthetic options from their down counterparts. Firstly, synthetic insulated jackets excel in moisture resistance, maintaining their insulation properties even when exposed to moisture. They dry quickly and continue to provide warmth when wet, making them ideal for activities in wet or variable conditions. Secondly, affordability is a notable advantage of synthetic insulated jackets. They often come at a lower price point compared to high-quality down jackets, offering a budget-friendly option for those seeking reliable insulation. Moreover, synthetic insulation addresses ethical concerns for individuals who prefer cruelty-free alternatives. It provides a guilt-free option for those who have reservations about using animal products. Lastly, synthetic insulation is hypoallergenic, making it suitable for individuals with allergies to down feathers. This characteristic ensures comfort and safety for a broader range of use.

The Ripstop windbreaker jacket is a versatile outerwear option suitable for various regions in India, offering protection against wind and light rain. Its durable Ripstop fabric ensures resilience against rough terrain, while its water-resistant properties make it ideal for outdoor activities such as hiking, trekking, and urban exploration. With its sleek design and packable features, the Ripstop windbreaker provides comfort and functionality for adventurers and urban dwellers across diverse climates and terrains in India.



**Fig. 9 –CLO-3D Sketch of Wind Breaker Jacket (100% Polyester); (b) CLO-3D Back Sketch of Wind Breaker Jacket (100% Polyester)**

Development in Wind breaker jacket

- **Foldable Hood:** The jacket incorporates a foldable hood that offers adjustable warmth and protection against the elements. This feature provides added versatility, allowing users to adapt to changing weather conditions by easily deploying or stowing the hood as needed.
- **Packable Design:** Designed for on-the-go convenience, the jacket is packable, meaning it can be folded into a portable pouch for easy storage and transport. This packable feature makes the jacket ideal for travel, outdoor adventures, and activities where space is limited.
- **Ripstop Woven Fabric:** The jacket utilizes ripstop woven fabric, known for its lightweight, durable, and water-resistant properties. This fabric is engineered with reinforced grid patterns that prevent tears and rips, ensuring long-lasting performance in rugged outdoor environments. Additionally, the fabric's water-resistant treatment repels moisture, dirt, and stains, keeping users dry and comfortable.
- **Key Qualities:** The jacket prioritizes water resistance and durability, making it suitable for a wide range of outdoor activities and environments. Whether hiking through unpredictable weather or exploring rough terrain, users can rely on the jacket's protective features to stay comfortable and protected.
- **Tailored Fit:** The jacket is designed with a tailored fit that allows for movement without restriction. This tailored silhouette ensures that users can move freely and comfortably during various activities, from hiking and climbing to cycling and camping.
- **Adjustable Features:** To further enhance comfort and functionality, the jacket features adjustable cuffs and drawstrings at the hem. These adjustable elements allow users to customize the fit and seal out drafts, ensuring optimal warmth and protection in challenging conditions.

Fabrics Used in Wind breaker jacket

Fabric Reference Name	Composition	GSM
RIPSTOP	100 %POLYESTER	140 GSM



**VIII. RESLUTS AND DISCUSSION**

**TRAIL RUNNING SHIRT**

TEST	MICRODOT POLYESTER	XL220
Composition	100 % Polyester	100 % Polyester
Gram per square meter	180	220
Wicking(mm/sec)	0.09	0.09
Drying time (g/hr)	0.2	0.3
Air Permeability(cm <sup>3</sup> /sec/cm <sup>2</sup> )	184.72	80.55
Tensile Strength(kg/lbs)	26.2	21.2
Tear strength(kg/lbs)	2.05	2.126
Pilling (Grade)	5	4
Abrasion Resistance	100.774	116.507

Both shirts are made of 100% polyester fabric, known for its moisture-wicking and quick-drying properties, perfect for trail running. The second shirt has a higher GSM (220 vs. 180), indicating potentially better durability and insulation. Both shirts exhibit effective moisture-wicking capabilities (0.09 mm/sec) and similar tear strength values. The first shirt dries slightly faster (0.2 g/hr vs. 0.3 g/hr), while also boasting higher air permeability (184.72 cm<sup>3</sup>/sec/cm<sup>2</sup> vs. 80.55 cm<sup>3</sup>/sec/cm<sup>2</sup>), providing better breathability. Additionally, the first shirt has higher tensile strength (26.2 kg/lbs) and a higher pilling grade (5), while the second shirt offers slightly better abrasion resistance (116.507) against friction and wear.

In conclusion, both Microdot Polyester trail running shirts offer excellent performance characteristics suitable for trail running.

**TENNIS ONE PIECE DRESS**

TEST	ZURICH	4 WAY
Composition	92 % Polyester, 8% Elastane	94 % Polyester, 6% Elastane
Gram per square meter	220	220
Wicking(mm/sec)	0.02	0.006
Drying time (g/hr)	0.04	0.02
Air Permeability(cm <sup>3</sup> /sec/cm <sup>2</sup> )	31.94	10.41
Tensile Strength(kg/lbs)	21.55	16.275
Tear strength(kg/lbs)	1.97	3.025
Pilling (Grade)	5	5
Abrasion Resistance	102.5	100.953

Both have a GSM of 220, indicating similar fabric weight and density. Performance wise Zurich demonstrates better moisture-wicking, faster drying, higher air permeability, and greater tensile strength. However, 4 Way has superior tear strength. Pilling and abrasion resistance wise Both dresses have the same pilling grade (5), but Zurich has slightly better abrasion resistance. Zurich offers superior moisture-wicking, faster drying, higher air permeability, and greater tensile strength, while 4 Way excels in tear strength. Overall, Zurich excels in moisture management and durability, making it a preferred choice for those prioritizing these features.

**TRIATHLON SUIT**

TEST	TRICOT 4 WAY	4 WAY
Composition	92 % Polyester, 8% Elastane	94 % Polyester, 6% Elastane
Gram per square meter	220	220
Wicking(mm/sec)	0.0004	0.006
Drying time (g/hr)	0.01	0.02
Air Permeability(cm <sup>3</sup> /sec/cm <sup>2</sup> )	10.416	10.41
Tensile Strength(kg/lbs)	10.375	16.275
Tear strength(kg/lbs)	1.35	3.025



Pilling (Grade)	5	5
Abrasion Resistance	108.704	100.953

Tricot 4 Way consists of 92% Polyester and 8% Elastane, while 4 Way comprises 94% Polyester and 6% Elastane. GSM wise Both fabrics have a GSM of 220, indicating similar fabric weight and density. Performance wise Tricot 4 Way shows lower wicking capability, slower drying time, lower tensile strength, and lower tear strength compared to 4 Way. However, both fabrics have the same pilling grade and similar air permeability. Abrasion Resistance wise Tricot 4 Way exhibits slightly higher abrasion resistance compared to 4 Way. In conclusion, while Tricot 4 Way may offer some advantages in abrasion resistance, 4 Way fabric generally performs better in terms of wicking, drying time, tensile strength, and tear strength.

**PACKABLE WIND BREAKER JACKET**

TEST	RIPSTOP(POLYESTER)	COTTON LAMINATED
Composition	100 % Polyester	100% Cotton laminated
Gram per square meter	120	380
Air Permeability(cm <sup>3</sup> /sec/cm <sup>2</sup> )	20.22	11.3
Tensile Strength(kg/lbs)	5.575	13.95
Tear strength(kg/lbs)	1.825	2.05
Pilling (grade)	5	5
Overall Moisture Management Capacity	0.5408	0
Abrasion Resistance	106.755	103.509

Firstly, in terms of composition, RIPSTOP Polyester is made entirely of polyester, while Cotton Laminated consists of 100% cotton laminated material. Secondly, when considering weight, RIPSTOP Polyester is lighter at 120 grams per square meter compared to the heavier Cotton Laminated fabric, which weighs 380 grams per square meter. Air permeability, a crucial factor for breathability, favors RIPSTOP Polyester with a value of 20.22 cm<sup>3</sup>/sec/cm<sup>2</sup> compared to 11.3 cm<sup>3</sup>/sec/cm<sup>2</sup> for Cotton Laminated. In terms of strength, Cotton Laminated outperforms RIPSTOP Polyester. Cotton Laminated boasts higher tensile strength at 13.95 kg/lbs compared to 5.575 kg/lbs for RIPSTOP Polyester. Similarly, its tear strength is also superior at 2.05 kg/lbs compared to 1.825 kg/lbs for RIPSTOP Polyester. Moisture management capacity, however, varies significantly. RIPSTOP Polyester demonstrates better moisture management with a capacity of 0.5408 compared to 0 for Cotton Laminated. Finally, in terms of abrasion resistance, both fabrics perform well, with RIPSTOP Polyester slightly edging out Cotton Laminated with a value of 106.755 compared to 103.509. In summary, while Cotton Laminated excels in strength, RIPSTOP Polyester offers advantages in weight, air permeability, and moisture management. Both fabrics have their strengths and are suited to different purposes depending on the specific requirements of the application.

**MESH**

TEST	HYDRA MESH	CRYSTA MESH
Composition	92 % Polyester, 8% Elastane	92 % Polyester, 8% Elastane
Gram per square meter	160	140
Wicking(mm/sec)	0.05	0.08
Drying Time(g/hr)	0.2	0.3



The provided data compares two types of mesh fabrics: Hydra Mesh and Crysta Mesh, both composed of 92% polyester and 8% elastane. Hydra Mesh weighs 160 grams per square meter, slightly heavier than Crysta Mesh which weighs 140 grams per square meter. In terms of moisture management, Hydra Mesh exhibits a higher wicking rate of 0.05 mm/sec compared to Crysta Mesh's 0.08 mm/sec, implying its ability to draw moisture away from the body more efficiently. Additionally, Hydra Mesh boasts a faster drying time of 0.2 g/hr compared to Crysta Mesh's 0.3 g/hr. These characteristics make Hydra Mesh a preferable choice for applications where moisture-wicking and quick drying properties are essential, such as sportswear and activewear.

## IX. CONCLUSION

This project has laid a strong foundation for a next-generation sportswear collection that prioritizes athlete comfort and performance. Here are the key achievements.

- **Enhanced Athlete Experience:** Developed garments deliver superior thermal regulation and moisture management, promoting drier, cooler conditions for athletes during activity.
- **Improved Performance:** Optimized fabric properties potentially contribute to enhanced athletic performance by reducing fatigue and discomfort associated with sweat and overheating.
- **Data-Driven Design:** Combining user feedback with scientific testing ensured the garments effectively meet the needs of athletes across various disciplines.

This project paves the way for further advancements in sportswear design, driven by a commitment to create best-in-class apparel that empowers athletes to achieve their full potential.

## REFERENCES

- [1] li, y. (2001), "the science of clothing comfort", textile progress, 1(2), 31.
- [2] kothari, v. k. ,2000,"quality control: fabric comfort", indian ins. of tech., delhi, india.
- [3]saville, b. p. ,1999, "physical testing of textiles", woodhead publishing ltd.
- [4]parsons, k. c. ,1993 "human thermal environments", taylor & francis publishers, united kingdom.
- [5] zhang, p., watanabe, y., kim, s. h., tokura, h. and gong, r. h. (2001), thermoregulatory responses to different moisture-transfer rates of clothing materials during exercise, j. text. inst., 92 (1), 372-378 .
- [6] y jhanji, deepthi gupta , vk kothari. vol 49 no 1 (2024) role of fibre, yarn and fabric variables in engineering clothing with required thermo-physiological properties, indian journal of fibre and textile research.
- [7] y.c. peng et al. ,(2020) advanced textiles for personal thermal management and energy, joule.
- [8] ] coull, n.a., west, a.m., hodder, s.g.,wheeler, p., and havenith, g. (2021), bodymapping of regional sweat distribution in young and older males. eur. j. appl. physiol.121, 109–125. <https://doi.org/10.1007/s00421-020-04503-5>.
- [9] dr. c b sentil kumar 1, dr. b senthil kumar , d.anita rachel.(2020), aspects of sportswear base fabrics: a review .



INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  [ijirset@gmail.com](mailto:ijirset@gmail.com)



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details