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Application Of Moisture Management And Uv Protection Finish For Sportswear

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Abstract:

This research focuses on the development of a bilayer interlock knitted fabric explicitly designed for sportswear applications using a combination of modal and polyester yarns. Two different structures are used in the study to explore the influence of fabric structure on key performance characteristics, such as moisture management and UV resistance. The bilayer fabric was produced using circular knitting technology and evaluated using standard textile testing protocols. The fabric has been dyed using dark colours which imparted UV protection properties and moisture management properties has also been imparted in the dyeing process, making the fabric suitable for activewear in varying environmental conditions. Further analysis revealed the specific arrangement of yarn within Structure 1 has better moisture management and UV protection properties when compared to structure 2.

Index Terms: Bilayer interlock knitted fabric, modal, polyester, moisture management, UV protection.

1. Introduction:

Double approach yarn

Introduces a sportswear-specific double-layered interlock knit fabric made from a modal and polyester yarn blend. The study investigates how two different knit structures affect key performance characteristics such as moisture resistance and UV ray resistance.

Blend Brilliance

Blending modal with polyester yields a fabric that marries the best of both fibers: the modal's smooth, breathable hand feels luxurious against the skin and absorbs moisture, while polyester contributes strength, quick-drying performance, and wrinkle resistance. Together, they create a durable, shape-retaining textile that manages sweat efficiently, holds its colour and form through repeated washes, and offers enhanced comfort and ease of care—making it ideal for high-performance sportswear.

The definition used by the authoritative Textile Terms and Definitions, issued by the Textile Institute1, of technical textiles is 'textile materials and products made mainly for their technical and performance attributes rather than for their aesthetic or decorative features [1]

Sports textile improve athletic performance with features such as moisture-wicking and breathability, designed for various sports to enhance efficiency and decrease the risk of injury. The performance features of active sportswear directly affect comfort level and athletic performance in sports activities. Various categories of sportswear products need various performance characteristics.[2]

In active high sports, sweat rate production is extremely high because of a large amount of metabolic heat production [3] In such situations, Liquid moisture transmission property is one of the key parameters to define the high active comfort sportswear [4] Moisture management in sportswear is effective to keep athletes dry and comfortable and improves performance, minimizing the chance of skin irritation.

Ultraviolet radiations are very small portion of the sun's spectrum which harms all forms of life and their metabolisms. These kinds of radiations have the capability to induce all types of symptoms ranging from simple tanning to highly malignant skin cancers, correct design specification of fabrics, absorbers, and finishing techniques, can become very crucial as a protective system against the harmful effects of Ultraviolet rays[5]

2. Materials and Methods

2.1 Materials Used

Two types of yarns were selected for this study:

- **Modal Yarn**: Used for the inner layer, with a count of 30s Ne
- **Polyester Yarn**: Used for the outer layer, with 120 micro denier
- Both the yarns were sourced from M/S Ganapathi Chettiyar Pvt Ltd, Tirupur and Go Green Fabrics, Chennai, Tamil Nadu, India

2.2 Fabric Formation

- The bilayer knitted fabric was manufactured using a circular knitting machine, jacquard interlock knitting creating a double sided fabric where modal is used as the face side of the fabric and polyester

is used as the back side. The fabrics thus produced are of two different structures with differing properties.

- Stitch density and machine speed were optimized to maintain fabric uniformity and avoid layer blending.

2.3 Finishing Treatment

- No chemical finishes were applied in the initial phase to isolate the effects of the fiber structure.
- A second set of samples received a **UV-protective finish** and moisture management finish by dyeing with deeper shades for comparative analysis.

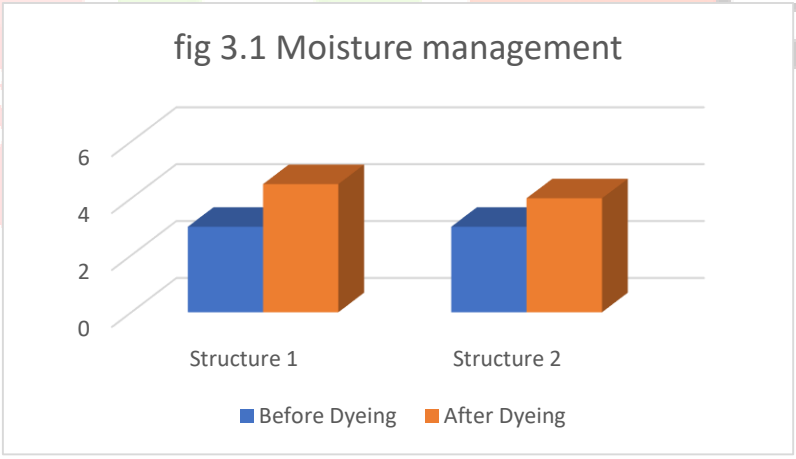
3. Testing standards, Methods, Result and Discussion:

3.1 Moisture Management test

Table 3.1 Moisture management test

	OMMT
Structure 1	3
Structure 1 Dyed	4.5
Structure 2	3
Structure 2 Dyed	4

fig 3.1 Moisture management

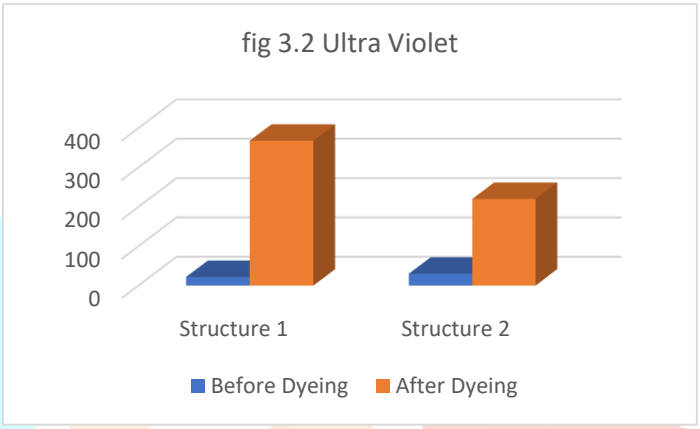


According to the test results, it is evident that both Sample 1 and Sample 2 acquired moisture management properties upon dyeing. This improvement in moisture management properties enhances quick drying and wicks sweat from the skin, leaving the wearer feeling comfortable. Sample 1 performed better in terms of moisture management than Sample 2. This is especially true in high-intensity sportswear, where the ability to keep the body dry reduces discomfort while increasing athletic performance.

3.2 Ultra Violet protection test:

Table 3.2 Ultra Violet protection test

SAMPLE	UVA-BLOCKING	UVB-BLOCKING	UPF RATING
Structure 1	90.5	96.26	22
Structure 2	90.8	97.47	30
Structure 1 dyed	99.24	99.86	368
Structure 2 dyed	98.96	99.70	220



According to the test results, it is clear that both structure 1 and structure 2 experience a sudden rise in UV protecting properties after dyeing. This improvement guards the sportsmen and also active individuals who spend long hours outdoors against the deforming UV radiation emitted by the sun. The process of dyeing have stronger influence on structure 1 compared to structure 2, and hence sample 1 provide better competitiveness in clothes that are for outdoor use.

3.3 Water absorbency test:

An absorption test typically involves dropping a liquid droplet onto a material to determine its absorbency. The methods helps ascertain how effectively the material soaks up the liquid

Procedure:

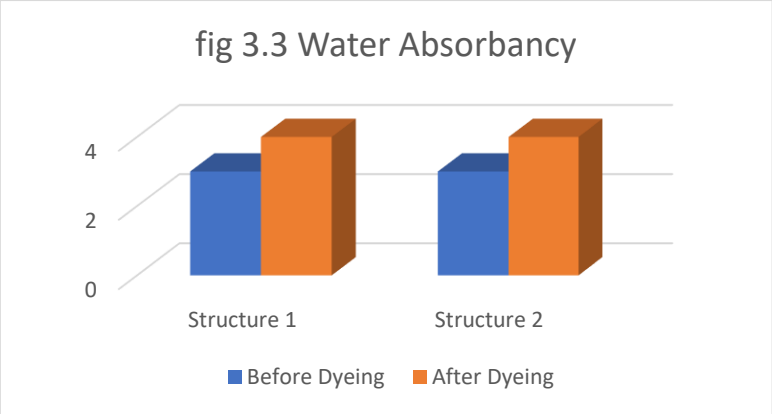
The test sample (e.g., cloth, paper) is put on a level, flat area.

A specific quantity of water is released onto the surface of the material by drop tester

The test can be timed to actually observe how fast the liquid is absorbed by the material.

Table 3.3 Water absorbency test

	Time	ASTM Rating
Sample 1	12-15 seconds	3
Sample 2	20-15 seconds	4
Sample 1 Dyed	10-12 seconds	3
Sample 2 Dyed	15-18 seconds	4



According to the findings, it is possible to say that both structures exhibit enhanced absorption characteristics following dyeing, that is, they absorb moisture better. This is especially crucial in sportswear, as fabrics with enhanced sweat-absorbing ability keep the wearer dry and comfortable during sports. With enhanced moisture absorption, the fabric is able to wick sweat from the body, thereby minimizing discomfort and chafing. This renders the materials highly suitable for sportswear, particularly for high-intensity sports where moisture management is critical to performance and comfort.

3.4 Colour fastness:

3.4.1 Colour fastness to rubbing- crockmeter

Colour Fastness to Rubbing: The Crockmeter Method

Color fastness to rubbing, also known as crocking, determines how well a fabric's color adheres when rubbed. This test is conducted using a crockmeter. It rubs a dry and a wet white cotton cloth against the colored fabric sample. This is done with a set amount of pressure and strokes. The amount of color that rubs off onto the white cloths is then checked using a gray scale. This gives a rating of the fabric's color fastness. This test is necessary to determine whether fabrics are suitable for different applications. It ensures that colors do not bleed or rub off onto other surfaces when worn or used.

ASTM D2054 — *Standard Test Method for Colour fastness to Crocking*

Purpose: Evaluate the colour transfer from the surface of dyed fabric to other surfaces through rubbing.

Apparatus: Crockmeter, an instrument designed to simulate rubbing action.

Procedure:

Cut the sample to be tested at 50mmx130mm

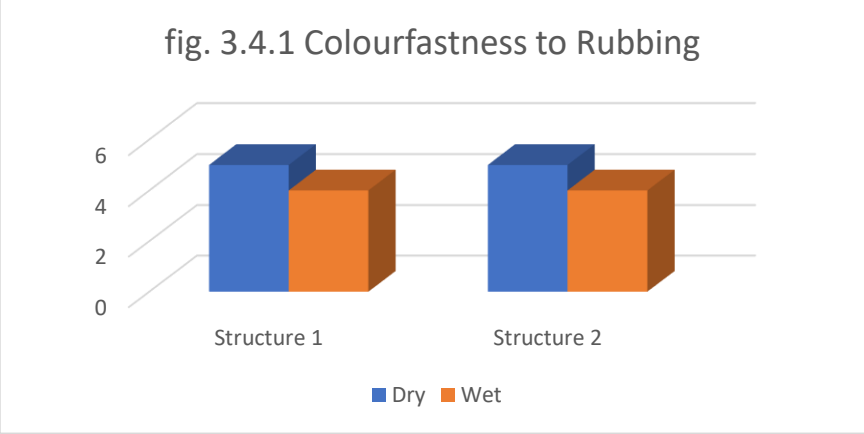
Clamp the sample into the base of the crock meter.

Attach a dry white cotton rubbing cloth to the crock meters rubbing head, for wet testing wet the rubbing cloth for wet rubbing. Lower the rubbing head onto the specimen

Perform 100 rubbing cycles and check the colour adhered to the rubbing clothNow compare the sample with greyscale to rate the colour fastness.

Table 3.4.1 Colour fastness to rubbing

	Dry	Wet
Structure 1 dyed	5	4
Structure 2 dyed	5	4



3.4.2 Colourfastness to washing- Laundrimeter

Colour fastness to washing describes how well a fabric keeps its color during washing. It determines how much the color fades or bleeds. A laundrometer is used in a laboratory to test this. During the test, a fabric sample is immersed in a container containing detergent and steel balls. This happens for a set time and temperature. After washing, the sample's color change and any stains on nearby white fabric are examined. We use grey scales to determine how well the color has held up. This test is important for checking the quality and how long dyed fabrics will last.

ASTM D2054 – *Standard Test Method for Colourfastness of Textile (Prints) to Laundering*

Apparatus: Laundrometer

Procedure:

Prepare a Fabric sample (4×10 cm) sewn to multifiber fabric.

Select washing conditions according to AATCC 61,Test no 2A

Place specimen in canister with detergent and run the laundrometer

Rinse thoroughly and dry

Use Grey scale to determine the colour change.

Table 3.4.2 Colour fastness to washing-Laundrometer

	ASTM rating
Structure 1 dyed	5
Structure 2 dyed	5

According to the findings, it is possible to conclude that both fabrics possess outstanding colour fastness to washing and rubbing, therefore the colour remains bright and doesn't change over time. This is particularly vital for sports apparel, since sports clothing usually suffers from sweating, washing, and sun exposure, which eventually results in colour change. Cloths that have good colour fastness will retain their colour and appear as new, even after multiple usages and washing. This is why such fabrics are suitable for sportswear, as they will keep the clothes looking fine and functioning as required during their lifespan.

4. Conclusion

The study concluded that bilayer interlock knitted fabrics made from modal and polyester yarns are potentially well-suited for sportswear. Specifically, Structure 1 exhibited superior performance compared to the other two fabric structures tested, particularly in moisture management and UV ray blocking. This highlights the significant impact of fabric construction on overall performance. Furthermore, the application of dark dyes enhanced the fabric's functionality, making it appropriate for activewear across a range of weather conditions.

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