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Comfort and Moisture Management Performance of Interlock Knits Made from Poly Viscose and Poly Modal Blends

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Abstract

This study presents a comparison of the performance characteristics of interlock knitted Poly Viscose–Lycra and Poly Modal–Lycra fabrics produced under identical structural conditions. Physical and comfort-related tests including GSM, thickness, bursting strength, air permeability, thermal insulation, wicking, and moisture management were conducted using standardized methods. The results revealed that Poly Viscose fabric exhibits superior thermal retention, air permeability, and mechanical strength, while Poly Modal demonstrates enhanced moisture transport and faster wicking behavior. These findings are intended to support fiber selection based on climate-specific and function-specific requirements in knitwear design.

Keywords: Poly Viscose, Poly Modal, Interlock Knit, Comfort Performance, Moisture Management, Lycra Blend, Thermal Conductivity, Air Permeability

1. Introduction

The performance and comfort properties of knitted fabrics are strongly influenced by fiber composition, yarn structure, and fabric construction. In recent years, there has been a growing demand for high-performance fabrics that not only meet functional requirements but also enhance wearer comfort under diverse environmental and activity conditions. Among the various functional characteristics, thermal regulation, moisture management, air permeability, and mechanical durability play a critical role in determining fabric suitability for applications such as innerwear, sportswear, and casual outerwear.

Regenerated cellulosic fibers such as viscose and modal have gained prominence due to their biodegradable nature, softness, and improved moisture management compared to conventional cotton and synthetic fibers. Poly Viscose, a blend of polyester and viscose, offers durability, drape, and moderate moisture absorption. On the other hand, Poly Modal, a polyester-modal blend, is known for its excellent wet strength, dimensional stability, and superior moisture transport behavior. When combined with Lycra (spandex), these fabrics provide stretchability, which further enhances fit and comfort.

Although several studies have evaluated the individual performance characteristics of viscose and modal-based fabrics, limited literature is available on their comparative assessment under identical knitting conditions, particularly for interlock structures commonly used in medium-weight knitwear. Such comparative evaluation is essential for informed fabric selection in function-specific applications.

This study aims to investigate and compare the thermo-physiological comfort and moisture management properties of Poly Viscose and Poly Modal interlock knit fabrics with identical structural parameters and Lycra content. The performance metrics examined include GSM, thickness, bursting strength, air permeability, thermal insulation, wicking, and moisture transport behavior. The outcomes are intended to assist designers and manufacturers in optimizing material selection for performance-oriented apparel.

2. Materials and Methods

Two interlock knitted fabric samples were produced: one with a 65/35 Poly Viscose–Lycra blend (6% Lycra), and the other with a 65/35 Poly Modal–Lycra blend (6% Lycra). Both fabrics were knitted using identical machine settings (loop length: 28.5 mm, gauge: 28, dia: 34") on a Pai lung Double Knit Interlock machine equipped with spacer technology. Physical and comfort properties were assessed using standard test methods including:

- GSM (ASTM D3776)
- Thickness (ISO 5084)
- Bursting strength (IS 1966-1)
- Air permeability (IS 11056-1984)
- Thermal conductivity (GB/T 11048)
- Moisture management (AATCC 195)
- Wicking behavior (Vertical Wicking Test)

3. Results and Discussion

3.1 GSM (Grams per Square Meter)

GSM is a critical indicator of fabric mass per unit area. It influences characteristics such as thickness, durability, and drape. The measurements for both fabric samples are provided in Table 1.

Sample	GSM
Sample 1 (Poly Viscose)	372 g/m²
Sample 2 (Poly Modal)	370 g/m²

The GSM values for both fabrics are closely aligned, thereby indicating consistent loop length and knitting parameters. Poly Viscose displayed a slightly higher GSM, which is likely to contribute to enhanced thermal insulation and durability.

3.2 Air Permeability

Air permeability denotes the airflow through fabric and is essential for thermal comfort. The test results have been summarized in Table 2.

Sample	Air Permeability
Sample 1 (Poly Viscose)	36.69 cc/sec/cm²
Sample 2 (Poly Modal)	25.11 cc/sec/cm²

The air permeability test measures the rate at which air passes through a fabric under a specified pressure differential. Higher values indicate greater breathability and enhanced thermal comfort in warmer conditions or during physical activity. The results indicated that Poly Viscose offers superior ventilation, making it more appropriate for garments intended for enhanced comfort, breathability, and thermal regulation—such as sweatshirts, outerwear, or casual activewear. Conversely, Poly Modal, with lower air

permeability, may retain more warmth and is thus more suited for moderate environments where insulation is prioritized over ventilation.

3.3 Fabric Thickness

Fabric thickness affects the fabric's thermal insulation, softness, and drape. Table 3 shows the thickness of both fabric samples measured under standardized pressure.

Sample	Thickness (mm)
Sample 1 (Poly Viscose)	1.08 mm
Sample 2 (Poly Modal)	1.05 mm

Poly Viscose displayed a slightly higher thickness, which may result in marginally better insulation. However, both fabrics fall within the medium-thickness range suitable for outer garments.

3.4 Bursting Strength Test

Bursting strength evaluates the resistance of knitted fabric to rupture when force is applied in multiple directions. The test results are shown in Table 7.

Sample	Bursting Strength (kg/cm²)
Sample 1 (Poly Viscose)	11.03 kg/cm²
Sample 2 (Poly Modal)	10.93 kg/cm²

Both samples demonstrated comparable bursting strength, with Sample 1 performing slightly better. Thus, both fabrics are considered suitable for applications requiring mechanical durability, such as outerwear and activewear.

3.5 Absorbency

Absorbency assesses how quickly a fabric can absorb moisture. The drop absorbency test results are presented in Table 4.

Sample	Absorbency
Sample 1 (Poly Viscose)	Good
Sample 2 (Poly Modal)	Good

The absorbency test was carried out to assess the ability of the fabric to absorb moisture, which is critical for wear comfort, especially in close-to-skin applications. Both samples, Poly Viscose and Poly Modal demonstrated qualitatively good absorbency under standardized testing conditions. This finding aligns with the intrinsic hydrophilic nature of regenerated cellulosic fibers. Modal fibers, though chemically similar to viscose, possess a more uniform and crystalline structure, which typically improves wet strength and absorption consistency. However, in this study, both fabric variants demonstrated comparable moisture uptake performance, thereby indicating their suitability for innerwear, loungewear, and active casual garments where basic moisture absorption is essential.

3.6 Thermal Conductivity

Thermal tests evaluate heat retention and insulation capability. Table 5 summarizes the thermal performance of the samples.

Parameter	Sample 1 (Poly Viscose)	Sample 2 (Poly Modal)
Warmth Retention (%)	37.40	35.54
Thermal Transmittance (W/m²·°C)	20.15	22.99
CLO Value	0.3201	0.2817
Thermal Resistance (m²·K/W)	0.0496	0.0437

Sample 1 (Poly Viscose) demonstrated superior thermal insulation, as indicated by higher warmth retention, greater thermal resistance, and a higher CLO value. Warmth retention was observed to be 37.40% for Sample 1 compared to 35.54% for Sample 2 (Poly Modal), representing a 4.97% improvement. Similarly, the thermal resistance of Sample 1 (0.0496 $m^2 \cdot K/W$) exceeded that of Sample 2 (0.0437 $m^2 \cdot K/W$), thereby indicating enhanced ability to resist heat flow. The CLO value, which measures insulation equivalent to standard clothing at 21 °C, was 0.3201 for Sample 1 and 0.2817 for Sample 2.

Conversely, Sample 2 demonstrated a higher thermal transmittance (22.99 $W/m^2 \cdot °C$) than Sample 1 (20.15 $W/m^2 \cdot °C$), suggesting that the Poly Modal fabric allows more heat to pass through, making it suitable for garments intended for mild or transitional climates.

3.7 Wicking Test

Wicking performance is crucial for moisture management. The measured lengthwise and widthwise capillary action is shown in Table 6.

Parameter	Sample 1 (Poly Viscose)	Sample 2 (Poly Modal)
Lengthwise Wicking (mm)	5.8	11.4
Widthwise Wicking (mm)	5.4	10.7

The wicking performance of the fabric samples was assessed in both longitudinal and transverse directions to determine their moisture transport efficiency. Sample 2 (Poly Modal) demonstrated substantially higher wicking rates—11.4 mm/sec lengthwise and 10.7 mm/sec widthwise—compared to Sample 1 (Poly Viscose), which recorded 5.8 mm/sec and 5.4 mm/sec, respectively.

Conversely, Poly Viscose, while showing moderate wicking behavior, may retain moisture longer and is better suited for garments intended for casual or low-activity wear where slower moisture transport is acceptable.

3.8 Moisture Management Test (MMT)

The MMT evaluates real-time liquid moisture transport behavior. Critical parameters including wetting time, absorption rate, and one-way transport index are summarized in Table 8.

Parameter	Sample 1 (Poly Viscose)	Sample 2 (Poly Modal)
Wetting Time (Top) [s]	4.34	4.44
Wetting Time (Bottom) [s]	3.07	4.56
Absorption Rate (Top) [%/s]	21.74	23.78
Absorption Rate (Bottom)[%/s]	24.85	27.54
Spreading Speed (Top) [mm/s]	2.67	2.74
Spreading peed(Bottom)[mm/s]	2.57	2.63
Max Wetted Radius (Top) [mm]	23.0	20.0
Max Wetted Radius (Bottom) [mm]	22.3	20.0
One-Way Transport Index	+20.34	-23.41

The Moisture Management Test (MMT) provides a comprehensive evaluation of the fabric's dynamic liquid transport properties, capturing multiple parameters related to absorption, wetting, spreading, and directional moisture movement.

Poly Modal (Sample 2) demonstrated superior absorption rates (23.78%/s top, 27.54%/s bottom) and slightly faster spreading speeds compared to Poly Viscose (Sample 1). Additionally, Sample 2 had a marginally faster wetting time on the top surface (4.44 s) but a slower bottom wetting time (4.56 s vs. 3.07 s), thereby indicating delayed moisture passage through the fabric thickness.

Poly Viscose (Sample 1) demonstrated higher maximum wetted radius values and, most notably, a positive one-way transport index (+20.34). Conversely, Sample 2 recorded a negative value (–23.41), thereby indicating poorer directional transfer of moisture from the skin-contact side to the outer layer.

4. Conclusion

The comparative evaluation of Poly Viscose and Poly Modal interlock knit fabrics blended with Lycra revealed distinct performance characteristics relevant to their end-use applications. Both samples demonstrated comparable GSM and thickness, reflecting uniform construction. Poly Viscose demonstrated higher air permeability, better thermal resistance, and slightly superior bursting strength, thereby indicating its suitability for cooler climates and outerwear. Conversely, Poly Modal demonstrated enhanced wicking ability and faster moisture absorption, thereby making it preferable for activewear and warmer environments. Notably, Poly Viscose demonstrated a positive one-way moisture transport index, favoring long-term comfort. Thus, fabric selection should be guided by specific functional requirements—thermal insulation and durability versus rapid moisture management.

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