IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology
Impact Factor 8.066 ⋇ Peer-reviewed & Refereed journal ⋇ Vol. 12, Issue 3, March 2025
DOI: 10.17148/IARJSET.2025.12314

Exploring the Handle and Thermal Behaviour of Plain, Twill, and Sateen Wet Reeled Tasar Silk Woven Fabrics

G Thimmareddy[1], Sumit Kumar[2], Rahul Ranjan Ghosh[3], Abhishek Kumar[4]

Scientist, Central Silk Technological Research Institute, Bengaluru-560068, India[1]

Senior Technical Assistant, Central Silk Technological Research Institute, Bengaluru-560068, India[2]

Scientist, Central Silk Technological Research Institute, Bengaluru-560068, India[3]

Senior Technical Assistant, Central Silk Technological Research Institute, Bengaluru-560068, India[4]

Abstract: The Tasar silk industry plays a vital role in rural employment, particularly among tribal and female populations. It is widely used for sarees, dress materials, and furnishings, with several GI-tagged varieties. Clothing comfort, influenced by tactile sensations, depends on the fabric's mechanical and thermal properties. Despite advancements, no research exists on the tactile comfort of Tasar silk. This study aims to fill that gap by evaluating the handle properties of plain, twill, and satin Tasar fabrics for women's apparel.This study evaluates the low-stress mechanical and thermal properties of power loom-woven Tasar silk fabrics with three weave structures—Plain (T-P), Twill (T-T), and Sateen (T-S)—using the Kawabata Evaluation System. The Kawabata Evaluation System provides objective analysis, distinguishing different silk weaves based on stiffness, softness, and flexibility.The T-S weave exhibits superior stiffness and compression resistance, making it suitable for rigid applications. T-P offers excellent shear properties and grip, while T-T demonstrates the highest tensile strength, ideal for high-stress applications. T-T also provides the best balance of softness, smoothness, and thermal insulation, whereas T-S enhances stiffness but reduces pliability. Thermal analysis shows T-P excels in heat dissipation, while T-T is best for warmth retention. These findings guide fabric selection for tailored textile applications, with future research focusing on advanced finishing techniques.

Keywords: Handle Value, Kawabata, Plain Weave, Sateen Weave, Tasar Silk, Twill Weave, Thermal Value

I. INTRODUCTION

India is the second largest producer of Tasar silk in the world next to China. Tasar cocoons are produced in the tropical zoneof the Indian subcontinent by *antheraea mylitta D*. It feeds mostly on the leaves of Asan, Arjuna, and Sal trees and, once grown, wraps its body in a protective cocoon of silk strands. These layers of silk strands are significant since they are the raw material for the most desired Tasar silk fabrics, but the insect within the shell must be killed first before it can be retrieved during the reeling procedure [1]. However, filament extraction is never simple since the presence of sericin, tannin, and calcium oxalate in the filament makes the shell hard and abrasive, which must be softened during cooking process [2].

Tasar reeling can be categorized into two methods: wet and dry. The dry reeling process is conducted without water in the reeling basin, whereas wet reeling involves the use of water. Among the two, wet-reeled Tasar silk exhibits superior qualities in terms of strength, cohesiveness, and luster [3]. Previous research has examined both traditional and advanced techniques for cooking Tasar cocoons, followed by reeling on conventional devices and reeling machines using both wet and dry methods. Findings indicated that the improved peroxide-based (open pan) cooking technique, when used in wet reeling, resulted in higher silk recovery rates [4].

Additionally, studies have explored an enzymatic method (Biopril 50) for dry reeling of Tasar silk, which demonstrated better cooking efficiency, productivity, and silk recovery. However, the extended two-day treatment duration made it less practical. More recent investigations introduced an innovative approach where cocoons were first boiled under pressure, then treated with a combination of hydrogen peroxide, sodium carbonate, and sodium silicate solution. This method significantly enhanced silk recovery compared to conventional processes. Among the techniques studied, the permeation cooking method proved to be the most effective, achieving a 90% cooking efficiency and a silk recovery rate of 56.6%. Furthermore, cocoons processed through permeation cooking exhibited superior reeling performance, with a reelability rate of 28.2%—approximately 20% higher than traditional and open pan methods [5].

DOI: 10.17148/IARJSET.2025.12314

The Tasar silk Industry employs many rural residents across many states in India. This industry is known for its distinctive silk quality and shining surface, as well as its environmentally friendly culture. It also offers a traditional livelihood for many tribal and female populations in India. Post cocoon sector (PCS) is one of the major sections of the Tasar silk industry, which not only provides the product but also delivers direct measurable employment, primarily to rural women [6]. Tasar silks are mostly used to make sarees, dress materials for women, dhotis, and other garments. It is also utilized as a base material for handicrafts, furnishings, and upholstery fabrics. Some of the Tasar silk sarees like Bhagalpur Silk, Champa Silk, Kotpad Handloom Fabric, Gopalpur Tussar Fabrics, Sambalpuri Bandha Saree & Fabrics, Bomkai Saree & Fabrics, Santipore Saree, Baluchari Saree are Geographical Indications (GI) tagged by Govt. of India [7].

Clothing comfort is mainly reliant on tactile sensations. Tactile comfort in clothing is governed by the human sensory reaction to garment materials, which is impacted by physiological, mechanical and thermal aspects. Clothing materials come into contact with the skin, which has various receptors, causing the user to experience a range of emotions. Touch and tactile properties are key considerations for materials that come into close contact with human skin. The tactile comfort is strongly tied to the cloth handling properties. Fabric handles rely on intricate interactions of bending, tensile, compressive deformation and shear at low stress [8]. Traditionally, handle qualities are subjectively examined by sliding the fabric between fingers and thumb, providing insight into its stiffness, softness, stiffness, bulkiness, smoothness and crispiness. The Kawabata Evaluation System has revolutionized fabric handle evaluation by measuring low-stress mechanical characteristics and objectively predicting their value for suitable application [9].

Research on the mechanical properties of various silk weaves under low-stress conditions has highlighted distinct characteristics among different types of silk fabrics. Silk Habutae is recognized for its high stiffness and pronounced scroop, whereas silk Dechine exhibits significant flexibility with minimal anti-drape stiffness. Silk Georgette, while offering good flexibility, lacks anti-drape stiffness and fullness. On the other hand, silk Fujiginu is noted for its strong scroop but possesses low crispness. Silk Chirimen is characterized by its high stiffness and anti-drape stiffness, yet it maintains a soft texture despite its limited flexibility. Silk Shantung, in contrast, has even greater stiffness and anti-drape stiffness [10].

Matsudaira and Kawabata observed that woven silk fabrics tend to demonstrate softness and ease of deformation in compression, leading to increased extensibility and enhanced FUKURAMI values. This softness results from the fiber crimp present in silk fibers, which enhances their ability to deform under compressional and tensile forces. Additionally, the spacing between warp and weft threads at crossover points contributes to reduced shear stiffness and lower hysteresis of shear force in woven silk fabrics [11].

Comparative studies on the mechanical properties of spun silk sarees versus reeled silk sarees have shown that spun silk sarees outperform in bending and shear properties, as confirmed through Primary and Total Hand Value tests. This suggests a qualitative advantage in their performance. Further research indicates that woven fabrics made from mulberry silk waste blended with wool are well-suited for lightweight winter apparel for women, while union-blended fabrics serve as suitable materials for men's winter suits. In another study, Chopra and Chattopadhyay examined the handle properties of degummed mulberry silk fabrics processed using five different techniques—acid, alkali, triethylamine (TEA), soap, and enzyme treatments. Their findings suggest that soap, alkali, and TEA treatments yielded the most favourable results [12].

The Central Silk Board, a government body in India has consistently prioritized quality and productivity enhancement and reduced drudgery in Tasar silk sector. Lately, projects have been initiated to focus on product development and consumer requirements.There is currently no research on the tactile comfort of Tasar silk fabrics, which will determine their end uses.The purpose of this research is to investigate the tactile comfort and handling features of plain, Twill, and Satin Tasar woven fabrics for use in women's thin dresses and suiting fabrics.

II. MATERIALS & METHODS

2.1 Materials

20 kg of A graded Wet reeled Tasar Silk Yarns have been sourced from Vanya Silk Reeling Division, Central Silk Technological Research Institute (CSTRI), Central Silk Board, Bangalore. The detailed specifications are presented in the Table 1.

ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⪿ Peer-reviewed & Refereed journal ⪿ Vol. 12, Issue 3, March 2025

DOI: 10.17148/IARJSET.2025.12314

Table 1: Detailed Specifications of the procured Wet reeled Tasar Silk Yarns

Parameters	Standard	Value
Mean	IS 17618 (Part 4)	97.423
SD	IS 17618 (Part 4)	5.422
CV%	IS 17618 (Part 4)	5.565
Tenacity (gm/den)	IS 17618 (Part 5)	2.58
Elongation %	IS 17618 (Part 5)	28.6
Winding Breaks	IS 17618 (Part 3)	3
Cohesion (No of Stokes)	IS 17618 (Part 6)	28
Overall Grade		A

2.2 Development of Power loom Tasar Silk woven fabrics

Three distinct Tasar woven samples have been prepared using Plain (1/1), Twill (4/4), and Sateen (8/5) weave structures. Each sample is woven with a single fold of wet-reeled yarn as the warp and two folds of wet-reeled yarn as the weft. The weaving structures of these samples are illustrated in Fig 1. All fabrics have been produced on a power loom, with specifications detailed in Table 2.

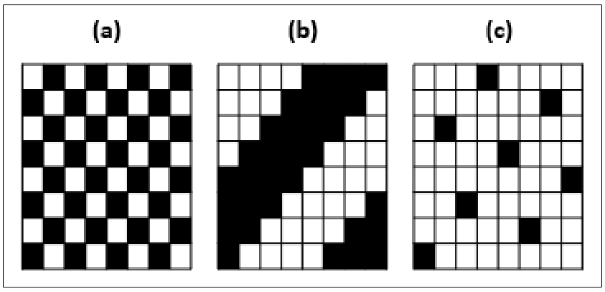

Fig. 1: Weave structure (a) 1/1 Plain (b) 4/4 Twill (c) 8 end with 5 move Sateen

Table 2: Construction parameters of Tasar woven silk fabrics

Sample Code	Sample Details	EPI	Warp Denier	PPI	Weft Denier	Cover Factor	GSM
T-P	Tasar Plain Fabric	80	97	86	216	21.45	125.2
T-T	Tasar Twill Fabric	80	97	110	178	23.16	124.3
T-S	Tasar Sateen fabric	80	97	116	174	23.69	123.6

2.3 Evaluation of Low-stress Mechanical Properties

The Kawabata Evaluation System (KES) is employed to analyse the low-stress mechanical properties of fabrics, including bending, tensile behaviour, shear, compression, surface friction, and roughness. Prior to testing, the Tasar silk woven fabrics are conditioned under standardized atmospheric conditions (65 ± 2% relative humidity and 20 ± 2 °C temperature) for 24 hours to ensure consistency in results. The KES-F system comprises four specialized instruments: KES-FB1 (Automatic Tensile & Shear Tester), KES-FB2 (Pure Bending Tester), KES-FB3 (Automatic Compression Tester), and KES-FB4 (Automatic Surface Tester). Table 3 provides a comprehensive overview of the evaluated parameters, along with their corresponding units [13-15].

2.4 Assessment of Thermal Properties

The sensation of "coldness and warmth" refers to the perceived thermal response when the skin comes into contact with an object. This perception varies depending on the rate of heat transfer between the skin and the object. It can be quantified by determining the "Q-max" value, which represents the peak heat flux, as well as the thermal insulation properties of the material. These parameters are evaluated at CIRCOT's Textile Testing Laboratory in Mumbai using the Kawabata Evaluation System-F7 THERMO LABO II, a specialized instrument designed for precise thermal analysis.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⪻ Peer-reviewed & Refereed journal ⪻ Vol. 12, Issue 3, March 2025

DOI: 10.17148/IARJSET.2025.12314

Table 3: Parameters of the Kawabata Evaluation System (KES)

Properties	**Module**	**Parameter**	**Description**	**Unit**
Tensile Properties	KES-FB1	LT	A measure that defines the extent of non-linearity of the stress/strain curve. LT values below 1.0 indicate that the stress/strain curve falls below a 45-degree straight line while LT values greater than 1.0 indicate that the stress/strain curve falls above 45-degree straight line	-
		WT	Tensile energy or work done in tensile deformation represented by the area under the stress-strain curve	gf.cm/ cm^2
		RT	Tensile resilience, which is the ratio of work recovered to the work done in tensile deformation	%
		EMT	Percentage tensile elongation which is the ratio of the actual extension to the original sample length	%
Shear Properties	KES-FB1	G	Shear rigidity, which is the slope of the shear curve	gf/ cm.deg
		2HG	Hysteresis of Shear force at 0.5-degree shear angle	gf/ cm
		2HG5	Hysteresis of Shear force at 5-degree shear angle	gf/ cm
Bending Properties	KES-FB2	B	Bending Rigidity which is the slope of the bending curve that lies between the radius of curvatures 0.5 cm^{-1} and 1.5 cm^{-1} (μnm)	$gf.cm^2$ / cm
		2HB	Hysteresis of bending momenta bending curvature of ±0.5 cm^{-1}	$gf.cm^2$ / cm
Compression Properties	KES-FB3	LC	Linearity of Compression- thickness Curve	
		WC	Compressional energy, represented by the area under the compression curve	gf.cm/ cm^2
		RC	Compressional resilience, which is the ratio of work recovered to work done	%
Surface Properties	KES-FB4	MIU	Co-efficient of friction, as measured over three-cm length of fabric	-
		MMD	Mean deviation of MIU	-
		SMD	Index of surface roughness (mean deviation of surface peaks representing thick and thin places, μm)	μm
Thickness		T_0	Fabric thickness at a very low compressive load (0.5 g/sq.cm)	mm
		T_m	Fabric thickness at the maximum compressive load (50.0 g/sq.cm)	mm
Weight		W	Fabric Weight	mg/cm^2

III. RESULTS AND DISCUSSION

3.1 Low- Stress Mechanical properties

The given dataset of Kawabata Evaluation System (KES) parameters mentioned in the Table 4 has been meticulously analysed to understand the low stress mechanical properties of three different fabric weave structures: T-P, T-T, and T-S, in both warp and weft directions. The properties have been categorized into tensile, shear, bending, compression, and surface characteristics, along with thickness and weight measurements. The findings have been interpreted in detail to highlight the structural behavior and performance differences among the fabric types.

In the tensile properties, LT (linear tensile strength) has been observed to be highest in the T-P fabric (warp: 0.902, weft: 0.963), indicating that this structure has been designed to withstand greater tensile forces in both directions.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588
International Advanced Research Journal in Science, Engineering and Technology
Impact Factor 8.066 ⪤ Peer-reviewed & Refereed journal ⪤ Vol. 12, Issue 3, March 2025
DOI: 10.17148/IARJSET.2025.12314

However, the highest WT (widthwise tensile strength) has been recorded in the T-T structure (warp: 7.650, weft: 3.750), signifying that this fabric has been manufactured with a tighter weave or stronger yarns, leading to enhanced resistance to tensile deformation. The RT (residual tensile strength) has been found to be highest in the T-S structure (warp: 59.600, weft: 60.850), suggesting that this fabric has been engineered to retain a greater portion of its tensile strength after deformation. The EMT (extension at maximum load) has been noted to be highest in the T-P fabric in the warp direction (1.980), indicating that this fabric has been constructed with more elasticity, allowing greater elongation before rupture.

Table 4: Results of Kawabata Evaluation System (KES)

Properties	Parameter	T-P		T-T		T-S	
		Warp	Weft	Warp	Weft	Warp	Weft
Tensile Properties	LT	0.902	0.963	0.803	0.772	0.778	0.933
	WT	1.780	2.780	7.650	3.750	6.020	2.670
	RT	57.800	53.680	49.900	54.450	59.600	60.850
	EMT	1.980	1.520	3.810	1.940	3.070	1.150
Shear Properties	G	0.560	0.530	0.300	0.380	0.350	0.380
	2HG	1.480	1.130	0.820	0.710	1.170	0.790
	2HG5	2.170	1.760	1.090	0.980	1.570	1.130
Bending Properties	B	0.103	0.432	0.118	0.946	0.147	2.261
	2HB	0.082	0.157	0.074	0.278	0.081	0.585
Compression Properties	LC	0.325		0.421		0.484	
	WC	0.168		0.199		0.294	
	RC	68.930		79.640		68.740	
Surface Properties	MIU	0.118	0.138	0.172	0.352	0.549	0.656
	MMD	0.039	0.035	0.018	0.018	0.053	0.018
	SMD	10.502	12.167	5.363	5.488	11.335	3.740
Thickness	T_0	1.411		1.463		1.812	
	T_m	1.203		1.274		1.567	
Weight	W	12.500		12.300		12.400	

For shear properties, the shear rigidity (G) has been found to be relatively similar across all fabric structures, though slightly lower in the T-T weave (warp: 0.380). This suggests that the inter-yarn friction in T-T has been reduced, making it more flexible under shear forces. The 2HG (shear hysteresis) and 2HG5 (shear hysteresis over a larger displacement) values have indicated that T-P possesses higher resistance to shearing deformation, with values of 1.480 and 2.170, respectively, in the warp direction. This resistance has been attributed to a tighter yarn interlocking or a stiffer yarn composition.

The bending properties have been significantly influenced by the weave structure, with the highest bending rigidity (B) being detected in the T-S fabric, particularly in the weft direction (2.261). This suggests that the fabric has been woven with a structure that resists bending forces more effectively, making it stiffer compared to the other structures. Similarly, 2HB (hysteresis of bending moment) has been observed to be highest in T-S (weft: 0.585), indicating that this fabric retains more of its original shape after bending deformation, demonstrating superior stiffness.

In terms of compression properties, LC (linear compression) has been measured to be highest in the T-S fabric (0.484), followed by T-T (0.421). This indicates that T-S requires more force to be compressed, suggesting that it has been woven with a denser or more resilient yarn structure. WC (work of compression) has also been found to be the highest in T-S (0.294), signifying that more energy is needed to compress this fabric, which has been linked to its compact weave and material composition. The RC (resilience compression) values have remained relatively consistent across the three fabrics, suggesting that their ability to recover from compression has not been significantly affected by weave structure.

For surface properties, MIU (coefficient of friction) has been observed to be highest in the T-S weft direction (0.656), indicating that this fabric has been finished with a rougher or more textured surface, contributing to higher friction. MMD (mean deviation of MIU) values have been recorded with minor variations, implying that the uniformity of friction across the surface has been maintained. SMD (surface roughness) has been identified as highest in the T-P fabric (warp: 10.502, weft: 12.167), revealing that this fabric has been produced with a rougher texture, possibly due to fiber composition or finishing treatments.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⋇ Peer-reviewed & Refereed journal ⋇ Vol. 12, Issue 3, March 2025

DOI: 10.17148/IARJSET.2025.12314

The thickness of the fabrics has been noted to vary slightly, with T-S being the thickest (T_o: 1.812, T_m: 1.567). This suggests that the T-S weave has been designed to provide higher bulk or insulation, making it potentially more suitable for applications requiring enhanced thermal resistance. The weight has been observed to be relatively similar across all fabric types (T-P: 12.500, T-T: 12.300, T-S: 12.400), implying that despite differences in weave structure and thickness, the mass per unit area has been maintained within a close range.

3.2 Primary Hand Value (PHV) and Total Hand Value (THV)

The Table 5 reflects the primary and total hand values of developed fabrics in terms of Koshi, Fukurami, Numeri, and Sofutosa, with PHV scales ranging from 10-strongest to 1-weakest and THV scales from 5-excellent to 1-poor.

Table 5: Primary and Total Hand Value for Tasar Fabrics

Properties		T-P	T-T	T-S
KN-203-LDY- Women's Thin Dress Fabrics	Koshi (Stiffness)	7.16	7.23	7.83
	Numeri (Smoothness)	5.48	6.92	3.93
	Fukurami (Fullness & Softness)	8.46	9.98	8.43
	KN-302 Winter-THV	3.38	4.28	2.44
KN-203-MDY- Women's Suiting Fabrics	Koshi (Stiffness)	6.15	6.21	7.13
	Numeri (Smoothness)	2.41	4.36	1.11
	Fukurami (Fullness & Softness)	2.76	4.76	3.29
	Sofutosa (Softness)	1.96	3.72	-0.53
	KN-301 Winter-THV	2.10	3.05	2.20

The Kawabata Evaluation System (KES) has been used to assess the handle properties of women's fabrics, providing valuable insights into their tactile and mechanical performance. The data have been analysed for two fabric categories: KN-203-LDY (Thin Dress Fabrics) and KN-203-MDY (Suiting Fabrics), with three different weave structures—Plain, Twill, and Sateen.

For KN-203-LDY (Thin Dress Fabrics), Koshi (stiffness) has shown an increasing trend from Plain (7.16) to Sateen (7.83), indicating that the Sateen weave has imparted a stiffer structure. This increase in stiffness has likely resulted from the higher yarn floatation in Sateen, which has reduced inter-yarn friction and allowed the fabric to resist bending more effectively. Numeri (smoothness) has been observed as highest in Twill (6.92), suggesting that this weave has promoted a smoother surface. The tighter and more regular interlacing pattern of Twill has likely contributed to a uniform texture, whereas Sateen (3.93) has exhibited the lowest smoothness, possibly due to the increased yarn slippage causing surface irregularities. Fukuarami (fullness and softness) has reached its peak in Twill (9.98), implying that this weave has enhanced the fabric's voluminous and cushion-like feel. This effect has likely occurred due to the moderate interlacement, which has allowed more air to be trapped within the fabric structure. The KN-302 Winter-THV values have demonstrated that Twill (4.28) has provided better thermal insulation than Plain (3.38) and Sateen (2.44), which may have been attributed to the structural arrangement of Twill that has permitted more air entrapment, thereby enhancing heat retention.

For KN-203-MDY (Suiting Fabrics), Koshi (stiffness) has again increased with the transition from Plain (6.15) to Sateen (7.13), reinforcing the notion that the Sateen weave has imparted greater rigidity. The higher stiffness in Sateen has potentially arisen from the longer floats restricting flexibility and making the fabric more resistant to deformation. Numeri (smoothness) has displayed a peak in Twill (4.36), suggesting that this weave has optimized surface regularity. Meanwhile, Sateen (1.11) has shown the lowest smoothness, likely due to the lower number of interlacing points making the fabric surface more prone to unevenness. Fukuarami (fullness and softness) has been maximized in Twill (4.76), highlighting that this weave has contributed to a more substantial and cushioned hand feel. This could have been due to the ability of the Twill weave to balance structure and flexibility, allowing a higher degree of drapability. Interestingly, Softosa (softness) has presented a negative value (-0.53) in Sateen, indicating an extremely firm and possibly harsh texture. This negative value has likely been caused by the weave structure reducing pliability and creating a denser, less yielding fabric. The KN-301 Winter-THV values have indicated that Twill (3.05) has offered the best thermal retention, reinforcing its effectiveness in providing warmth through its structural configuration.

3.3 Thermal Properties

The data presented in the Table 6 has been analysed to understand the variation in maximum heat flux Q- max and Thermal Insulation Value (TIV%) for different sample codes.

The highest Q-max value of 0.092 W/cm² has been observed for the T-P sample, followed by 0.085 W/cm² for the T-T sample and 0.084 W/cm² for the T-S sample. These variations in heat flux may have resulted from differences in material composition, structural configuration, or thermal conductivity properties of the samples. Furthermore, the TIV% values have exhibited a distinct trend, with the T-T sample showing the highest thermal improvement (24.6%), followed by the T-P sample (24.4%) and the T-S sample (21.6%). The lower TIV% of the T-S sample may have been due to reduced thermal efficiency, potentially caused by material limitations or increased thermal resistance. The observed variations in both parameters have indicated that the thermal performance of the samples has been significantly influenced by their inherent thermal properties and design characteristics.

Table 6: Q max ad Thermal Insulation Value of Tasar Fabrics

Sample Code	Q- Max (W/cm^2)	TIV %
T-P	0.092	24.4
T-T	0.085	24.6
T-S	0.084	21.6

IV. CONCLUSION

This study presents a comprehensive evaluation of the low-stress mechanical and thermal properties of power loom-woven Tasar silk fabrics, incorporating three distinct weave structures—Plain (T-P), Twill (T-T), and Sateen (T-S)—utilizing the Kawabata Evaluation System (KES). The findings offer critical insights into the structural mechanics and functional performance of these fabrics, facilitating their informed selection for diverse textile applications.

The analysis has elucidated that the T-S weave structure exhibits superior bending stiffness and enhanced compression resistance, rendering it particularly suitable for applications necessitating rigidity and resilience. Conversely, the T-P fabric demonstrates outstanding shear properties and pronounced surface roughness, making it a viable choice for applications demanding enhanced grip and friction. Meanwhile, the T-T fabric exhibits the highest tensile strength, especially along the warp direction, positioning it as the preferred option for applications requiring elevated tensile performance. These variations in mechanical responses underscore the role of weave structure in engineering fabrics to meet specific functional and performance requirements in textile applications.

Furthermore, the study has delineated the influence of weave structure on fabric handle characteristics. The Twill weave has consistently exhibited a harmonious balance between smoothness, softness, and thermal insulation, rendering it an optimal selection for comfort-oriented applications. In contrast, the Sateen weave has been observed to enhance fabric stiffness while concurrently reducing smoothness and fullness, indicating its suitability for applications that demand a more structured and less pliable textile. These findings furnish essential guidelines for fabric selection in women's apparel, ensuring that appropriate weave structures are chosen to satisfy distinct functional and aesthetic criteria.

Thermal analysis further reveals that the T-P weave possesses the highest heat flux (Q-max), thereby making it advantageous for applications necessitating efficient heat dissipation. Conversely, the T-T weave exhibits the highest thermal insulation value (TIV%), positioning it as the most suitable choice for warmth retention. Collectively, these findings underscore the functional differentiation among weave structures: T-S is optimized for stiffness and durability, T-P is preferred for elasticity and enhanced grip, and T-T is ideal for applications prioritizing comfort and thermal insulation.

The outcomes of this study serve as a valuable reference for textile engineers and designers in the strategic selection of Tasar silk fabrics for specialized applications. Future research may explore advanced finishing treatments and innovative processing techniques to further augment the mechanical and thermal performance of Tasar silk fabrics, thereby expanding their applicability across diverse industrial and apparel sectors.

ACKNOWLEDGMENT

This study is being conducted as part of the approved research project CFW 07023 SI, titled "Investigation of Thermo-Physiological Characteristics of Plain, Twill, and Sateen Woven Tasar Fabric." The research has received funding from the Central Silk Board, Ministry of Textiles, Government of India, for which the authors express their sincere gratitude. They also extend their appreciation to the Director of the Central Silk Technological Research Institute, Central Silk Board, for his valuable support in facilitating the project.

DOI: 10.17148/IARJSET.2025.12314

REFERENCES

[1]. Dr. Kariyappa and Dr. Subhas V. Naik, “Book on Tasar Silk- Some advances in post-cocoon aspects”, *Central Silk Technological Research Institute, Bengaluru*, 2022.
[2]. Kiran B Malali, Uday C Javali, Naveen V Padaki and Subhas V Naik. Influence of slug catcher on quality of tasar silk yarn. Procedia Engineering. 2017; 200: 33-38
[3]. Kariyappa and Subhas V. Naik, “Influence of method of tasar cocoon drying on reeling performance and quality of tasar silk”, *Sericologia,* vol. 61, issue. 3 & 4, pp. 87-95, 2021.
[4]. U.C. Javali, D. Ravi Kumar and S. Roy, “A comparative study on tasar cocoon cooking-pressurized v/s improved method*”, Man Made Textiles in India*, vo1. 53, issue. 3, pp. 100, 2010.
[5]. Uday C. Javali, Kiran B. Malali, H. G. Ramya, Subhas V. Naik and Naveen V. Padaki, “Studies on Tasar Cocoon Cooking Using Permeation Method”, *Journal of The Institution of Engineers (India): Series E* , vol. 99, pp. 55-62, 2018. https://doi.org/10.1007/s40034-018-0112-9
[6]. R. R. Ghosh, Y. C. Radhalakshmi, L. N, S. Periyasamy, “Optimization of Process Parameters for Wet Reeled Tasar Silk Yarn”, *International Advanced Research Journal in Science, Engineering and Technology*, vol. 11, issue. 1, pp. 93-107, 2024. 10.17148/IARJSET.2024.11111
[7]. R. R. Ghosh, Y. C. Radhalakshmi, L. N, S. Periyasamy, “Investigation of the fastness properties and color strength of dry and wet reeled Tasar silk yarns”, *International Journal of Science and Research Archive*, vol. 1, issue, pp. 1275-1286, 2024.https://doi.org/10.30574/ijsra.2024.11.2.0585
[8]. Katpadi Mohammed AK, Naik SV, “A study on the Low Stress Mechanical properties of spun silk sarees woven on Handloom”,*Textile & Leather Review*,vol. 5, pp. 525-539, 20222. https://doi.org/10.31881/TLR.2022.63
[9]. Mitsuo M, Matsui M, “Features of Mechanical Properties and Fabric Handle of Silk Weaves”, *The Journal of the Textile Institute*, Vol. 83m, issue. 1, pp. 133-143, 1992 https://doi.org/10.1080/00405009208631183
[10]. Verma N, Grewal N, Bains S, “Evaluation of Comfort and Handle Behavior of Mulberry Silk Waste/Wool Blended Fabrics for End Use”, vol. 13, issue. 3, pp. 277-288, 2016. https://doi.org/10.1080/15440478.2015.1029187
[11]. Matsudaira M, Kawabata S, “A Study of the Mechanical Properties of Woven Silk Fabrics. Part II: Analysis of the Shearing Properties of Woven Silk Fabrics”, *The Journal of the Textile Institute*, vol. 79, issue. 3, pp. 133-143, 1988. https://doi.org/10.1080/00405008808658281
[12]. S. Chopra , R. Chattopadhyay & M. L. Gulrajani, Low Stress Mechanical Properties of Silk Fabric Degummed by Different Methods, *The Journal of The Textile Institute*, vol. 87, issue. 3, pp. 542-553, 1996. 10.1080/00405009608631356
[13]. D. Atalie, R. K. Gideon, A. Ferede, P. Tesinova, and I. Lenfeldova, “Tactile Comfort and Low-Stress Mechanical Properties of Half-Bleached Knitted Fabrics Made from Cotton Yarns with Different Parameters,” *Journal of Natural Fibers*, vol. 18, no. 11, pp. 1699–1711, 2021. 10.1080/15440478.2019.1697989.
[14]. S. Chopra, R. Chattopadhyay, and M. L. Gulrajani, “Low stress mechanical properties of silk fabric degummed by different methods,” *Journal of the Textile Institute*, vol. 87, no. 3, pp. 542–553, 1996. 10.1080/00405009608631356.
[15]. A. K. Samanta, A. Mukhopadhyay, M. M. Bhagwat, and T. R. Kar, “Study on the Effect of Different Woven Structures on Physical Properties of Cotton Muslin Fabric,” *Journal of Natural Fibers*, vol. 12, no. 5, pp. 444–456, Sep. 2015. 10.1080/15440478.2014.958646.