International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 13 Issue: 07 | July 2026 www.irjet.net p-ISSN: 2395-0072

Cause Analysis of Barre Defects in Manmade Cellulosic Fabrics: An Industrial Investigation

Ravi Patidar[1], Shweta Tandyekkal [2], Anshu Chaurasiya[3], Manasi Naik[4]

[1]Lead Technologist, Grasim Industries ltd., Pulp & Fibre Innovation Centre, Mumbai, India
[2]Senior Research Associate, Grasim Industries ltd., Pulp & Fibre Innovation Centre, Mumbai, India
[3]Intern, Grasim Industries ltd., Pulp & Fibre Innovation Centre, Mumbai, India
[4] Research Associate, Grasim Industries ltd., Pulp & Fibre Innovation Centre, Mumbai, India

---***---

Abstract – *Barre is a major appearance defect that reduces the aesthetic and commercial value of textile fabrics. This study investigates the causes of barre defects in woven and knitted fabrics produced from viscose, modal, lyocell, and their blends using industrial customer complaint samples. The results identified yarn compactness, twist, diameter, loop length, fibre splitting, surface contamination, and processing variations as the primary causes of barre. The findings can be help in making an effective methodology for industrial troubleshooting and quality improvement.*

Key Words: Fabric appearance, Barre, Yarn Count, Hairiness, twist, Compactness, Diameter, loop length, PPI.

1. INTRODUCTION

The textile in one of the largest manufacturing sectors in the world, supplying a wide range of products like apparel, home furnishing, medical, technical and industrial applications. The increasing demand for high-quality textile products has placed considerable attention on fabric appearance, comfort, durability and sustainability [1,2]. In today's highly competitive market, consumers not only expect fabrics to provide functional performance but also to exhibit superior aesthetic characteristics. Therefore, the fabric quality has become a critical factor influencing customer satisfaction, brand reputation and commercial success [2].

Textile products undergo a range of manufacturing stages including fibre production, spinning, fabric manufacturing, dyeing, finishing and garment manufacturing. Defects may be introduced at any stage of this complex production chain and can significantly affect the quality and value of the final product. The occurrence of defects often leads to increased manufacturing costs, material wastage, reprocessing, delayed deliveries and customer complaints. Therefore, the identification and control of defects remain important objectives for textile manufacturers [3,4].

Among the various quality characteristics of textiles, fabric appearance is one of the most important attributes determining consumer acceptance. Many defects become particularly visible after dyeing and finishing operations, when the fabric has already undergone substantial value addition [5]. Appearance-related defects such as shade variation, streakiness, patchiness, mottling, crease marks and barre can adversely affect the visual uniformity of the fabric and reduce its commercial value [3-6]. Since these defects directly influence the perceived quality of textile products, they frequently become a source of rejection by fabric manufacturers, garment producers, retailers and end consumers [4,6].

Among the appearance defects observed in dyed and finished fabrics, barre is considered one of the most objectionable because of its distinct stripe-like appearance and its tendency to become more pronounced after coloration. The term "barre" is derived from the French word meaning "barred" or "striped" and is used in textile engineering to describe unintended stripes or bands appearing in fabrics due to variations in fibre, yarn, fabric structure or dyeing behaviour. Hunter defined barre as a repetitive visual barred pattern or stripiness parallel to the yarn direction in knit or woven fabric caused by differences in the physical, structural or dyeing characteristics acting either singly or combination may produce the barred pattern [6].

The barre in the fabric may be originated from the one or more combination of following three reasons: -

1. Barre due to fiber: - Mixing of different grades of fibers, variation in fiber fineness, variation in fiber crimp, morphological difference etc.

2. Barre due to yarn: - Mixing of yarns with different blend levels, different counts, different twist level/twist direction, different degrees of hairiness, different texture, different amounts of wax, unevenness of yarn, mercerization differences etc.

3. Barre due to fabric: - In knitted fabric- difference in loop length in a feed, tension variation of feed yarn, variation in fabric take-up, variation in oil content, uneven cylinder height needles etc. In woven fabric- uneven warp tension, tension on weft, take-up motion, let-off motion, variation in beat-up etc [3].

Nowadays, the sales of yarn are generally carried out under an agreement between the spinners and fabric manufacturer that the produced yarn should be free of variation which can lead to barre defect [7]. Therefore, yarn manufacturers frequently receive complaints about barre marks from the subsequent processing zone. However, barre issues are not limited to the yarn manufacturing zone, they may also result from fabric manufacturing zone as discussed earlier or uneven dye fixation on the fabric surface [8].

Previous studies have demonstrated that the barre is influenced by many factors related to fibre, yarn, fabric manufacturing, and dyeing [3-9]. Fiber mixing, fiber structure, variation in the count of yarns, difference in yarn diameters, hairiness, yarn construction, fabric construction, and dye affinity have all been suggested as factors contributing to the development of barre. In addition, differences in processing conditions in spinning, fabric manufacturing, dyeing, and finishing could amplify these differences and cause of barre to be more visible in the finished fabric. Due to the complexity of the defect, locating the causes of barre can be quite difficult.

Although extensive investigations have been conducted on barre defects in cotton, polyester, nylon and textured yarn fabrics [3–9], comparatively limited attention has been given to barre defect in fabrics produced from regenerated cellulosic fibres. Furthermore, most published studies have focused on laboratory investigations, while relatively few studies have utilized industrial complaint data to identify the practical causes of barre in commercial production environments. The combined influence of fibre characteristics, yarn properties, fabric structure and dyeing behaviour on barre defect in viscose, modal and lyocell fabrics remains insufficiently understood.

Therefore, our objective of this investigation is to conduct the cause analysis of barre defects in fabrics produced from Manmade cellulosic fiber (viscose, modal and lyocell). In this study, the attention is placed to identify the cause of barre through conducting the various test analysis using the fabric of customer complaint. The findings of this study are expected to provide a better understanding of the mechanisms responsible for barre defects and contribute to the development of effective strategies for improving fabric appearance quality and reducing defect-related losses within the textile industry.

2. MATERIAL AND METHODS

2.1 Material

This investigation has been carried out using industrial customer complaint associated with barre defects in finished fabrics (woven or knitted) produced from manmade cellulosic fiber (viscose, modal and lyocell) received from various customers. Fabric samples containing visible barre defect were collected from industrial complaint cases. For each sample, both the defective (barre) region and the adjacent normal region were identified and marked for further investigation.

2.2 Methodology

Initially, customer observations and complaint reports have been reviewed to understand the nature and appearance of the barre defect. Based on the visual characteristics of the defect, the suspected causes were categorized as fibre-related, yarn-related, fabric-related or dyeing-related.

To identify the origin of the barre, comparative analyses has been performed between the defective portion and the adjacent normal portion of the same fabric. The objective is to determine whether significant differences existed in fibre, yarn, fabric or dyeing characteristics which may contribute to the observed barre formation. Depending on the suspected cause, a series of analytical and characterization techniques have employed.

A series of fibre, yarn, fabric and colour characterization tests (SEM, Optical Microscopy, Electronic Twist Tester, Reflectance Spectrophotometer K/S, etc.) have been subsequently performed to identify variations between the defective and non-defective regions. The analyses included evaluation of fibre morphology, blend composition, yarn structure, yarn diameter, yarn twist, fabric surface characteristics and dye uptake behaviour. In selected cases, chemical dissolution techniques have been employed to verify the contribution of specific fibre components to the observed barre.

The results obtained from the different characterization techniques have been compared and correlated with the customer observations. Based on the observed differences between the normal and defective regions, the most probable root cause responsible for barre defect has been identified for each complaint case.

2.3 Characterization Techniques

2.3.1 Scanning Electron Microscopy (SEM)

Analysis of the morphology of fibres was done by the Phenom XL scanning electron microscope (SEM Phenom Prox, Netherlands). Images were taken at 15 kV with magnification (350-5000x). SEM was used to examine fibre cross-sections, yarn cross-sections and fabric surface characteristics. The technique was used to evaluate fibre distribution, fibrillation behaviour and structural differences between the barre and non-barre regions. SEM provides high-resolution imaging of fibre and yarn structures and is widely used for the characterization of textile materials [10].

2.3.2 Colour intensity measurement

The colour measurement was carried out using Konica Minolta spectrophotometer (C-3600A). The colour measurement data was tabulated in the results section, where K indicates the absorption coefficient and S is the scattering coefficient; $K/S=(1-R)2\ /2R$, where R is reflectance. The CM-3600A employs di: 8°, de: 8° (diffuse illumination, 8° viewing) geometry for reflectance measurements, which conforms to ISO, CIE, ASTM, DIN, and JIS standards with SCI (specific component included), mask used MAV: 8 mm. Additionally, L*, a*, and b* values help measure the colour differences between different shades. The L* value represents the depth in relation to the shade of dyed fibre. The redness and greenness values of the dyed fibres increase according to the positive and negative values of a*, respectively. Similarly, the yellowness and blueness values of the dyed fibre increase according to the positive and negative values of b*, respectively.

2.3.3 Optical microscopy

Zeiss Axioscope A1 microscope was used to capture an optical microscopic image of the fibres to observe fibre longitudinal morphology and to measure yarn diameter. Comparative observations were performed on yarns extracted from the defective and normal regions to identify structural irregularities that could contribute to barre formation.

2.3.4 Twist Measurement

Electronic twist tester (TT-MCT) used to measure twist of yarn. Twist levels of yarns extracted from both barre and non-barre regions were compared to determine the influence of twist variation on fabric appearance and dyeing behaviour.

3. RESULTS AND DISCUSSION

Case-1: Barre caused by yarn hairiness and splitting of fiber in viscose blend woven fabric.

Figure 1 (Viscose/Polyester/Spandex woven fabric with barre effect)

The longitudinal SEM images of defective(barre) regions of yarn, which are lighter, and the adjacent normal regions of yarn, which are darker, are shown in Figure 1.

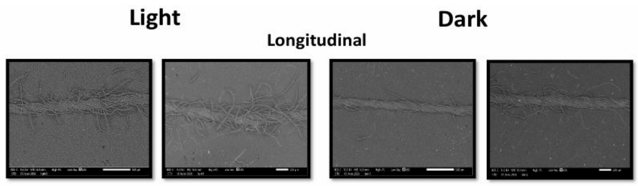


Figure 2 (SEM images of longitudinal view of yarns)

It can be seen from Figure 1 that the lighter yarns (defective regions) have more hairiness than the darker yarn, this may be caused by variation in the twist per length.

The cross-sectional SEM image of yarn is shown in Figure 2, where we can see the fibers of the lighter portion of the yarn get split into smaller fibrils at the surface of the yarn. This splitting of fiber could occur due to chemical treatment during dyeing [11]. The splitting of fiber is seen only in lighter regions of the yarn, splitting of fiber may be also a reason of lighter appearance of fabric. Therefore, increased yarn hairiness and fiber splitting may both contribute to the observed variation in light shade in the fabric.

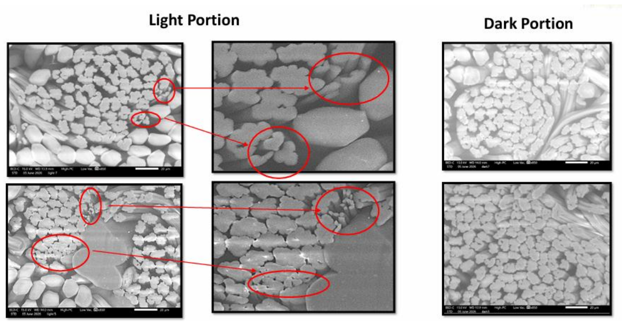


Figure 3(SEM images of cross-section of yarns)

Case-2: Barre caused by loop length variation in 100% modal knitted fabric.

Figure 4 (100% Modal knitted fabric)

The observations of loop length of both defective(barre) regions, which are lighter, and the normal regions, which are dark, are represented in

Table 1 (Loop length)

Sample	Light Blue	Dark Blue
Diameter (μm)	306.71	254.98
Maximum (μm)	326.22	292.57
Minimum (μm)	282.29	234.95
Standard Deviation (μm)	12.15	16.35
CV (%)	3.96	6.41

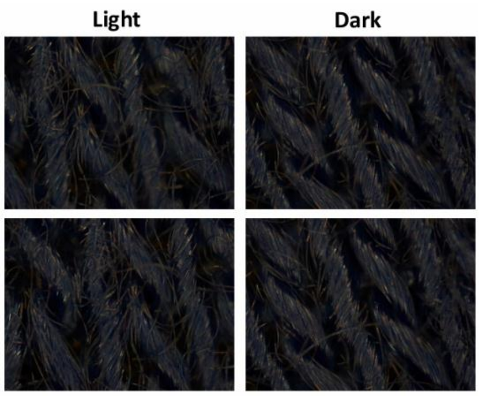


Figure 5 (Optical Microscopic view)

From the table it can be seen the lighter regions of the knitted fabric shows higher loop length than the darker regions of the fabric, these may cause by tension variation of feed yarn in knitting [6] and there may be one more reason for barre that the yarns of lighter regions have slightly more hairiness or abrasion than the darker regions of fabric (shown in Figure 5). The colour brightness decreases with increasing abrasion in fabric [12].

Case-3: Barre caused by yarn diameter variation in 100% viscose knitted fabric.

Figure 6 (100% viscose woven fabric)

The observations of diameter variation of both defective(barre) regions, which are lighter, and the normal regions, which are dark, are represented in Table 2.

Table 2 (Yarn diameters)

Parameter (N = 20)	Light	Dark
Average Loop Length (mm)	**3.70**	**3.47**
CV (%)	9.83	10.31

From the table, it can be seen that the lighter yarns have the higher diameter than the darker yarns and that the lighter yarns have less compactness than darker yarns. The fabric made from compact yarn shows higher K/S values or brightness than less compact yarn [13].

Case-4: Barre caused by weft yarn density (PPI) variation in polyester/viscose blend woven fabric.

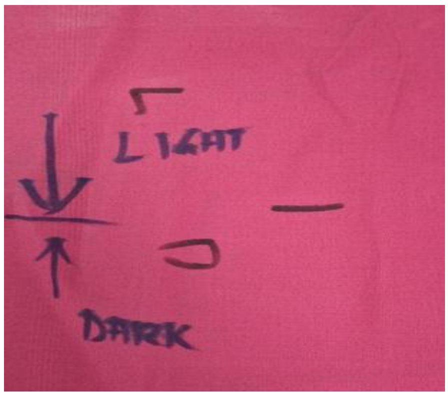


Figure 7 (Polyester/Viscose blend woven fabric)

The small samples have been taken from the barre line, which is darker, and normal fabric, which is lighter, as shown in Figure 9 for GSM measurement.

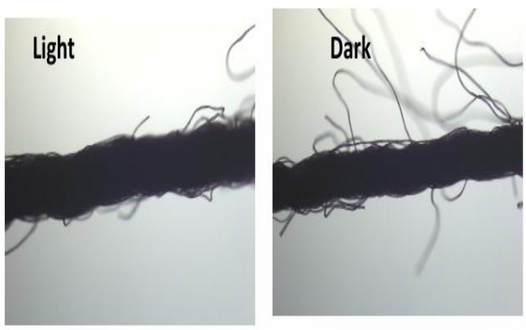


Figure 8 (Optical Microscopic view)

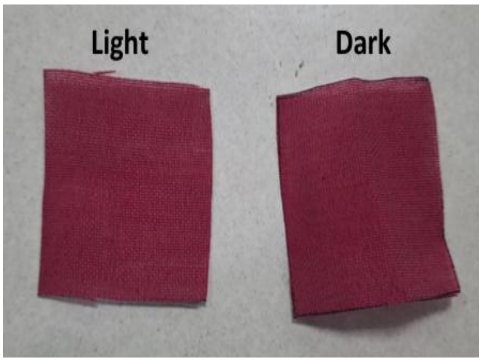


Figure 9 (Light and Dark Portion)

The GSM found for the light portion was 74 g/m2, and the dark portion was 80 g/m2, which means the lighter portion has a lower GSM than the darker portion. The PPI (Picks Per Inch) found for the lighter portion was 60, and the darker portion was 65. Therefore, in this case, the barre significantly caused by the yarn density difference.

Case-5: Barre caused by flatten/melted yarn in polyester/viscose blend woven fabric

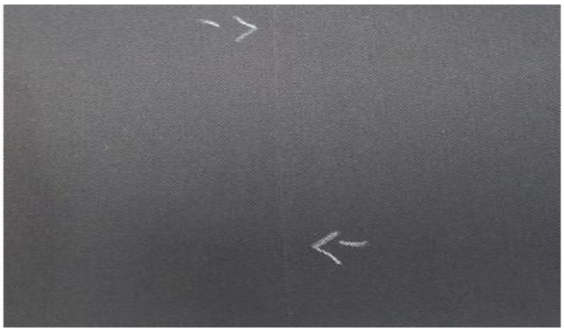


Figure 10 (Woven fabric with a white line barre)

The small sample has been taken, and SEM analysis has been done for the fabric sample as well as the defective white line yarn. SEM image shows (figure 11) at the affected line, it is seen like a flattened/melted yarn exactly at the defective white or barre line, and the yarn SEM shows (Figure 12) like some polyester fibers are fused and make a flattened fiber.

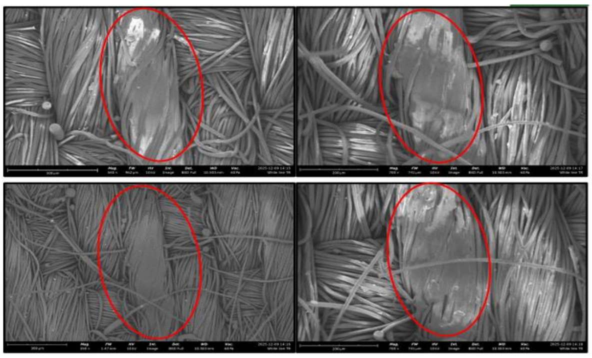


Figure 11 (SEM image of fabric)

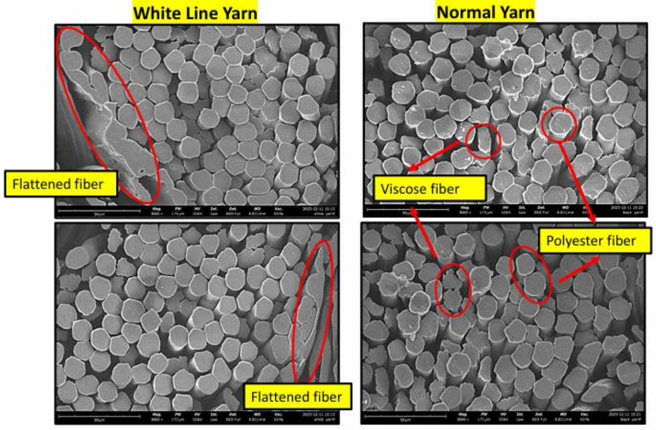


Figure 12 (SEM image of yarn)

The chemical dissolution has been done to verify which fiber causes white line appearance, as shown in Figure 13.

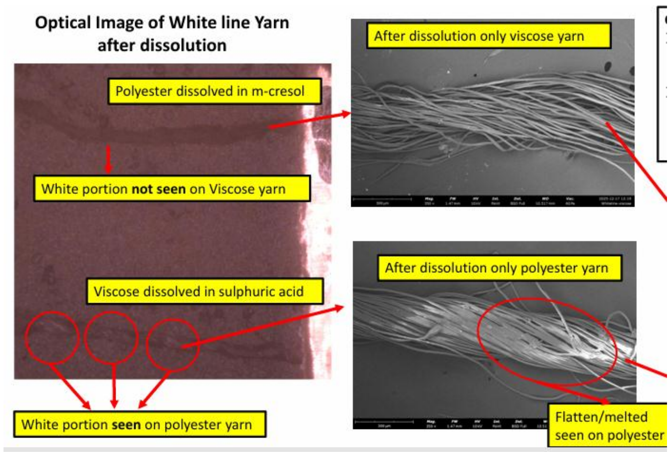


Figure 13 (Optical Microscopic image after chemical dissolution)

After the polyester dissolution in m-cresol, there was no white portion seen on the viscose yarn, and after viscose dissolution in sulphuric acid, the white portion was seen on the polyester yarn and flatten/melted portion was seen in the SEM image on the surface of the yarn.

Case-6: Barre caused by uncontrolled singeing of polyester/viscose blend woven fabric.

Figure 14 (Woven fabric with warp wise streaks/barre)

After the dissolution of polyester and viscose, the SEM images have been taken of the fabric sample as well as yarns from both portion streaks and normal of all three sets of fabrics (Original PV, Viscose portion, and Polyester portion) as shown in Figure 15.

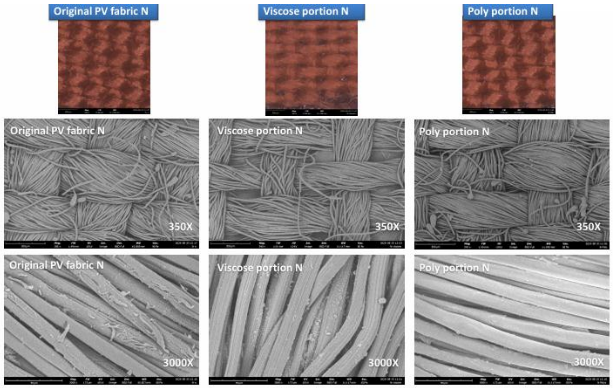


Figure 15 (SEM images of fabrics and yarns)

It can be seen from Figure 15 that the external deposition on the viscose part, both in the original and viscose portion of fabrics, is prominent; this could be the reason for streaks and dye variation. In SEM Imaging of light and dark yarns separated from viscose fabrics, it is seen that dark yarns had slightly more deposition of particles on the surface of yarn, as shown in Figure 16, and the observations of colour strength are represented in Table 3.

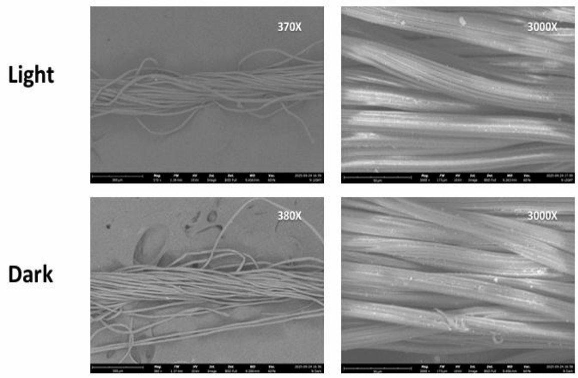


Figure 16 (SEM images of yarns)

Table 3 (Colour Strength value, K/S)

Sample	Yarn	L* (D65)	a* (D65)	b* (D65)	dE*ab (D65)	K/S St.(Max)
Viscose N	Dark	50.54	26.85	56.50	—	100.00
Viscose N	Light	50.42	27.29	56.14	0.58	99.06

From Table 3, it can be seen that the dark regions (streak regions) have more colour strength(K/S) value than the light regions (normal regions). Therefore, the significant reason for these streaks or barre may be variation in external depositions of particles on the surface of the fabric caused by uncontrolled singeing.

Case-7: Barre caused by debris (contaminants) present on polyester/viscose blend woven fabric.

Figure 17 (PV woven fabric with a glow line/barre defect)

The SEM images of the affected or glow line region shown in Figure 18, it can be seen the presence of protruding polyester fibres and particulate debris on the surface of the fabric. These contaminants create localised variations in surface morphology, causing the affected area to appear lighter than the surrounding fabric. The results suggest that polyester fibre contamination or surface debris are the primary contributors to the observed glow line defect, highlighting the importance of contamination control during processing.

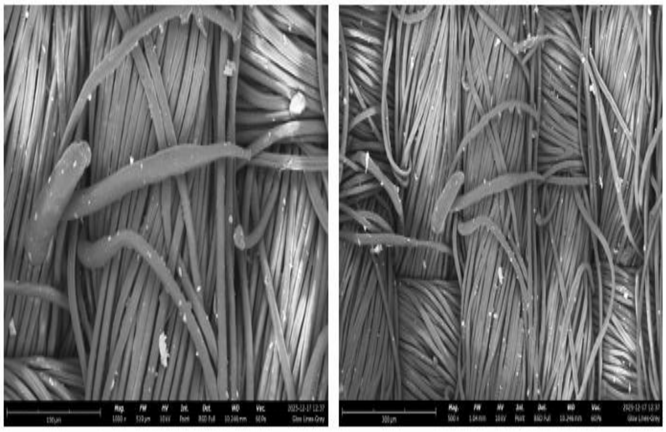


Figure 18 (SEM images of affected area)

Case-8: Barre caused by twist variation of yarn in the 100% viscose knitted fabric.

Figure 19 (100% viscose knitted fabric with periodic light line or barre)

The SEM analysis of yarns has been done on both the defective or light portion and the surrounding portion of the fabric. The longitudinal images of the light and dark yarns are shown in Figure 20.

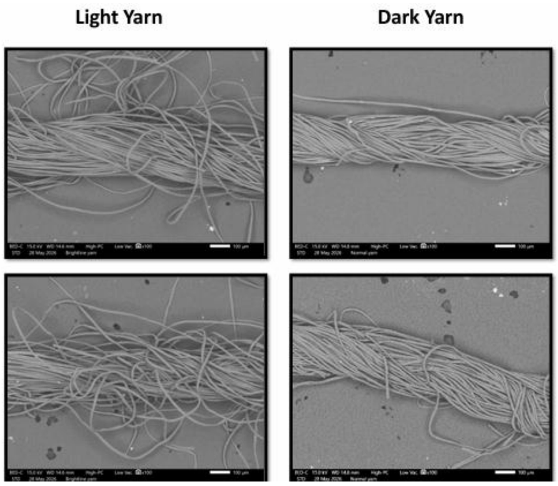


Figure 20 (longitudinal view of SEM)

From Figure 20, it can be seen that the lighter yarns have a looser structure and more hairiness than the darker yarns. The twist testing of both yarns has been done and found that the darker yarns show higher TPM (556.66) compared to the light yarn (500.83), which leads to more compactness in darker yarns, which significantly affects the dyeing pickup as well as colour variation in both yarns.

Case-9: Barre caused by a combination of yarn diameter and loop length variation in 100% viscose knitted fabric.

Figure 21 (100% viscose knitted fabric with strips or barre defect)

The measured yarn diameter and loop length values are presented in Table 5, while the corresponding SEM images are shown in Figure 22. It can be observed that both parameters are different in the light and dark regions of the fabric The lighter yarns exhibit a larger average diameter than the darker yarns, indicating lower yarn compactness, which may influence dye uptake and colour development. In addition, the lighter region shows a higher loop length compared to the darker region. A smaller loop length results in a tighter and more compact fabric structure with lower porosity and higher cover factor, which contributes to a darker appearance of the fabric [14].

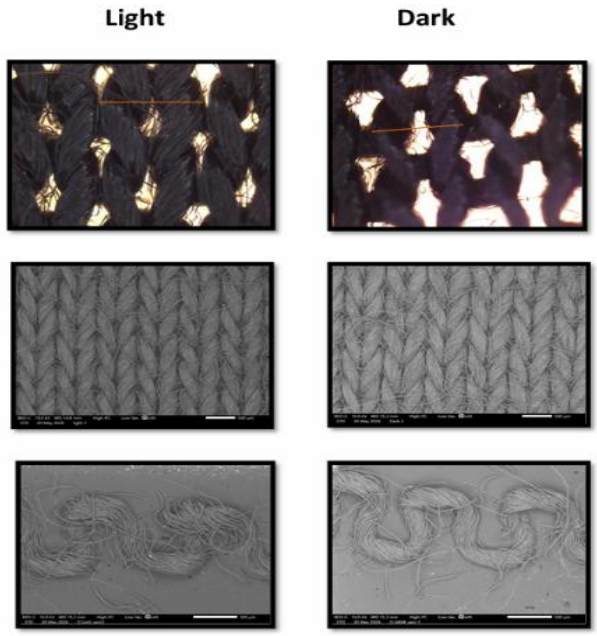


Figure 22 (SEM images of fabrics and yarns of both region)

Table 4

Parameter (N = 20)	Light	Dark
Average Loop Length (mm)	3.44	3.37
Average Diameter (µm)	272.92	229.74

Case-10: Barre caused by yarn count and diameter variation in the lyocell/linen blend woven fabric.

Figure 23 (Woven fabric with barre in warp yarn)

The yarn count and diameter results for the defective and normal regions are presented in Table 5, and the longitudinal SEM images of yarns are shown in Figure 24. The defective yarn exhibited a lower linear density (174.6 denier; 32.7 Ne) than the normal yarn (187.7 denier; 28.2 Ne), indicating that the defective yarn was finer. However, despite its lower linear density, the defective yarn showed a significantly larger average diameter (291.3 µm) compared to the normal yarn (198 µm).

4. Summary of industrial barre complaint cases investigated in this study

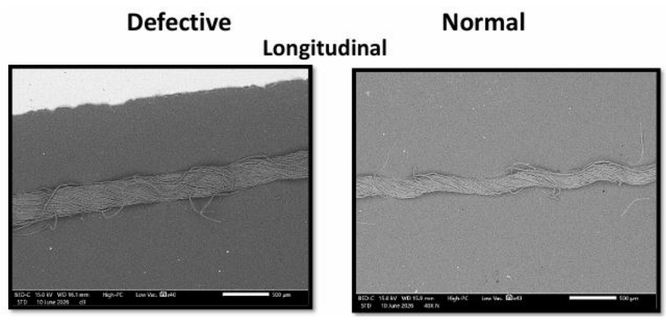
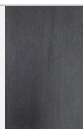
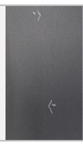


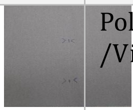
Figure 24 (SEM images of yarns)

Under normal circumstances, a finer yarn is expected to exhibit a smaller diameter. In the present case, the opposite trend was observed, where the finer yarn possessed a larger diameter. This behaviour suggests a lower packing density or reduced compactness of the defective yarn structure. Such structural differences can alter light reflection and dye penetration characteristics, resulting in visible shade variation between the defective and normal regions. Although the difference in yarn count was relatively small, the substantial difference in yarn diameter indicates that yarn structural variation is likely a major contributor to the observed barre defect.

Table 5 (Yarn count and diameter)

Parameter	Defective	Normal
Average Denier	174.6	187.7
Count (Ne)	32.7	28.2
Average Diameter (µm)	291.3	198.0

Case No.	Fabric Image	Fibre Composition	Fabric Type	Barre Appearance	Suspected Cause
Case 1		Viscose/ Polyester /Spandex	Woven	Light shade stripe	Yarn hairiness / fibre splitting
Case 2		100% Modal	Knitted	Light and dark bands	Loop length variation
Case 3		100% Viscose	Knitted	Shade variation	Yarn diameter variation
Case 4		Polyester /Viscose	Woven	Dark barre line	PPI variation
Case 5		Polyester /Viscose	Woven	White barre line	Flattened / melted yarn

Case No.	Fabric Image	Fibre Composition	Fabric Type	Barre Appearance	Suspected Cause
Case 6		Polyester /Viscose	Woven	Warp-wise streaks	Uncontrolled singeing
Case 7		Polyester /Viscose	Woven	Glow line	Surface contamination / debris
Case 8		100% Viscose	Knitted	Periodic light barre	Yarn twist variation
Case 9		100% Viscose	Knitted	Stripe barre	Combined effect of yarn diameter and loop length variation
Case 10		Lyocell/ Linen	Woven	Warp-wise barre	Effect of yarn count and yarn diameter variation

5. CONCLUSION

In this investigation, the results demonstrated that barre defects can originate from variations at multiple stages of textile manufacturing. Fibre-related causes included fibre splitting and fibrillation, while yarn-related causes included differences in hairiness, twist, diameter, count and compactness. Fabric structural parameters such as loop length and weft density (PPI) were also found to significantly influence fabric appearance. In addition, processing-related factors such as uncontrolled singeing, fibre melting and surface contamination were identified as major contributors to barre formation.

Among the investigated cases, yarn structural variations, particularly differences in yarn compactness arising from changes in diameter, twist and loop length, were the most frequently observed causes of barre. These variations altered light reflection, dye uptake and colour development, resulting in visible shade differences in the finished fabric. The findings confirm that barre is a multifactorial defect and that its successful diagnosis requires a systematic comparison between defective and non-defective regions. The methodology adopted in this work provides a practical framework for industrial troubleshooting and can assist textile manufacturers in reducing customer complaints, minimizing quality losses and improving fabric appearance consistency.

REFERENCES

1) Blackburn, R.S., Biodegradable and Sustainable Fibres, Woodhead Publishing, Cambridge, UK, 2005.
2) Woodings, C., Regenerated Cellulose Fibres, Woodhead Publishing, Cambridge, UK, 2001.
3) Cotton Incorporated, Barre, Technical Reference No. TRI-1002, Cotton Incorporated, Cary, NC, USA, 2002.
4) Yankey, J.M., "The Solutions for Controlling Fabric Barre" Proceedings of the Beltwide Cotton Conferences, National Cotton Council of America, Memphis, TN, USA, 1997, pp. 1714–1718.
5) A. K. M. M. Hossain and M. I. Islam, "Exploring weft knit fabric defects based on their presence and quality impact: A case study," Communications in Development and Assembling of Textile Products, vol. 1, no. 1, pp. 57–64, 2020, DOI :10.25367/cdatp.2020.1.p57-64.
6) Hunter, L. The Causes and Measurement of Knitted Fabric Barre. South African Wool and Textile Research Institute (SAWTRI), Port Elizabeth, South Africa, 1976.
7) Mahmood, N., Jamil, N.A., Ahmad, I., Iqbal, R. and Khan, R.M., "Enhancing the Quality of Single Jersey Knitted Fabric by Preventing Barre Caused by Yarn Parameters" Pakistan Journal of Agricultural Sciences, vol. 44, no. 4, pp. 704–708, 2007.
8) Rashid, M.S., "Impact of Consistent Fibre Properties on Optimization of Fabric Barre" Daffodil International University Journal of Science and Technology, vol. 4, no. 2, pp. 53–57, 2009.
9) A. B. Talele, M. V. S. Rao, and R. S. Gandhi, "Dye non-uniformity in textured yarn fabrics-A diagnostic approach," Indian Journal of Textile Research, vol. 13, no. 3, pp. 128–132, Sep. 1988.
10) J. I. Goldstein, D.E. Newbury, J.R. Michael, Nicholas W.M., John Henry J.S. and David C. Joy, Scanning Electron Microscopy and X-Ray Microanalysis, 4th ed., Springer, New York, 2018. DOI: 10.1007/978-1-4939-6676-9.
11) Öztürk , H. B., & Bechtold, T. Splitting tendency of cellulosic fibers. Part 3: splitting tendency of viscose and modal fibers. Cellulose, 15(1), 101-109, 2008.
12) H. G. Ortlek, M. Tutak & G. Yolacan. Assessing colour differences of viscose fabrics knitted from vortex-, ring- and open-end rotor-spun yarns after abrasion, The Journal of The Textile Institute, 101:4, 310-314, 2010. DOI: 10.1080/00405000802399528.
13) Tyagi, G.K., Sharma, D., & Salhotra, K.R. Properties and Processibility of Compact Yarns. Indian Journal of Fibre & Textile Research, 27(4), 362–368, 2002.
14) Eltahan EA, Sultan M and Mito AB. Determination of loop length, tightness factor and porosity of single jersey knitted fabric. Alexandria Engineering Journal, 55(2) (2016) 851–856. DOI: 10.1016/j.aej.2016.01.034.