Indian Journal of Fibre & Textile Research
Vol. 50, June 2025, pp. 160-163
DOI: 10.56042/ijftr.v50i2.9454

Effect of piecing index at comber on yarn quality

S Kumaresan, S Subramanian[a], A Mutumanickkam, S Deepika & M Senthamizhpaavai
Department of Textile Technology, Anna University, Chennai 600 025, India

Received 10 March 2024; revised received and accepted 12 September 2024

This study investigates the effect of varying piecing index at the comber on the yarn quality. Results show that yarns perform better in terms of evenness and imperfections when the comber is set at piecing index 0 for the fibres with a 2.5% span length of 30.3 mm. The incorrect selection of the piecing index at comber affects the evenness, imperfections, and classified fault of yarns, and there is no effect on tenacity and elongation-at-break of yarn. The findings underscore the importance of optimising the piecing index during combing to minimise short-term mass variation and enhance yarn quality.

Keywords: Comber, Piecing index, Sliver unevenness, Yarn quality

1 Introduction

The fibrous assemblies of sliver, roving, and yarn have irregularities mainly due to the drafting wave and other drafting-related irregularities. The primary causes of irregularities are poor raw material, improper selection of process parameters, and the condition of machinery. Comber machines inherently produce periodic mass variation due to the overlapping of fibres during the piecing of the web. The combed fibre fringes have a higher degree of fibre parallelisation with a lack of coherence. The piecing tends to form periodic variations in the web due to the intermittent nature of combing process. There are specific ways to reduce piecing irregularity after the generation of piecing wave; they are: off-centre location of sliver forming trumpet at each comber head, the adjustment of distance between sliver trumpet and draw box to make the arrival of pieced portion of adjacent slivers out of phase in draw box, resorting to sufficient number of post-comber drawing and doubling operations, and the use of post-comber draw frame with autoleveller. However, it is necessary to reduce the piecing wave at the generation stage itself.

The earlier studies show that the combing efficiency decreases, and the short fibre content in sliver increases with an increase in feed length per nip. The long thin faults in the yarn were found to increase with increasing depth of top comb penetration[1]. The yarn's thick places and neps were reduced by 25% while using combing segment with four partitions. The short and long thick faults were also found to be reduced significantly[2]. Chattopadhyay and Ghosh reported that the mass gets concentrated more at the leading edge of the fringe by changing the piecing index from zero to negative values[3]. Jayaram reported that the top comb having more needles per inch gave slivers with improved mean length, lower short fibre content, and better coefficient of variation (CV) of length distribution for the fibres. The top comb with more needles per inch had better cleaning capacity and less neps per gram in card sliver[4]. The research on the type of feed and combing parameters on comber performance has been studied earlier[5-7]. In the industry, much importance is not given to optimising the piecing index while changing the feed material to the comber and research on this aspect is also limited.

Therefore, the present study aims to investigate the effect of different piecing index values on the quality of yarn. By examining how the piecing index influences the regularity of slivers, and subsequently, the yarn properties, this research seeks to contribute valuable insights towards improving yarn uniformity through better control of the combing process.

2 Materials and Methods

2.1 Preparation of Yarn Samples

The 40 Ne yarn samples were produced from cotton with a 2.5% span length of 30.26 mm with different piecing indices at comber viz., -0.5, 0, +0.5, +1.0, +1.5. The E65 comber and RSB D-35 (Rieter) draw frame (with autolevelling), LF 1400A speed frame and

[a]Corresponding author.
E-mail:ssubbu.anna@gmail.com

LR9/AX ring frame (Lakshmi Machine Works) were used for producing yarn samples. The details of raw material and process parameters used at comber for producing samples are given in Tables 1 and 2, respectively.

Five samples of sliver and yarn were produced at different piecing index settings (-0.5, 0, +0.5, +1.0, +1.5) while keeping the material and all the other process parameters constant.

2.2 Testing Methods

The fibres from the comber lap were tested for 2.5% span length, 50% span length, and short fibre content using high-volume instruments (HVI, Uster). The length distribution curve of the fibres in the comber lap was obtained using an advanced fibre information system (AFIS, Uster). The unevenness of comber and post-comber draw frame slivers were evaluated using Uster evenness tester 5 with 50 m/min test speed and a testing time of 1 min. The mass spectrogram curve of comber and post-comer draw frame slivers was also obtained. The yarn unevenness and imperfections at different sensitivity levels were evaluated using Uster Tester 5 with 400 m/min test speed and testing time of 1 min. The mass spectrogram and variance-length curves were obtained by Uster Tester 5. The yarn samples were tested for classification of faults using Uster Classimat Tester 3. The tensile properties of the yarns were assessed using Uster Tensojet 5.

3 Results and Discussion

3.1 Fibre Properties

The 2.5% and 50% span length of fibres in the comber lap are found to be 28.78 mm and 14.9 mm, respectively. The short fibre content in the comber lap is 25.4%. The length distribution curve of fibres in the comber lap is shown in Fig. 1.

Table 1 — Raw material properties

Fibre property	Value
2.5% span length, mm	30.26
50% span length, mm	14.62
Uniformity ratio, %	48.3
Fineness, Micronaire	4.24
Bundle strength, g/tex	23.3
Maturity coefficient	0.87
Trash, %	2.61

Table 2 — Comber process parameters

Parameter	Value
Feed length per nip, mm	4.7
Type of feed	Forward
Detaching distance setting index	8
Top comb penetration index	+0.5
Total draft	84

3.2 Slivers

The 2.5% and 50% span length of fibres in the comber sliver are found to be 29.53 mm and 16.14 mm, respectively. The short fibre content in comber sliver is 14.4%. The unevenness parameters of comber sliver at different piecing indices are given in Table 3.

It is evident from Table 3 that the comber sliver unevenness (U_m and CV_m) values are lowest at piecing indices ***0*** and ***+0.5*** compared to other indices, indicating better uniformity at these settings. The unevenness of post-comber draw frame sliver for different piecing indices is shown in Table 4.

Similar to the comber sliver, the post-comber draw frame sliver shows minimum unevenness at

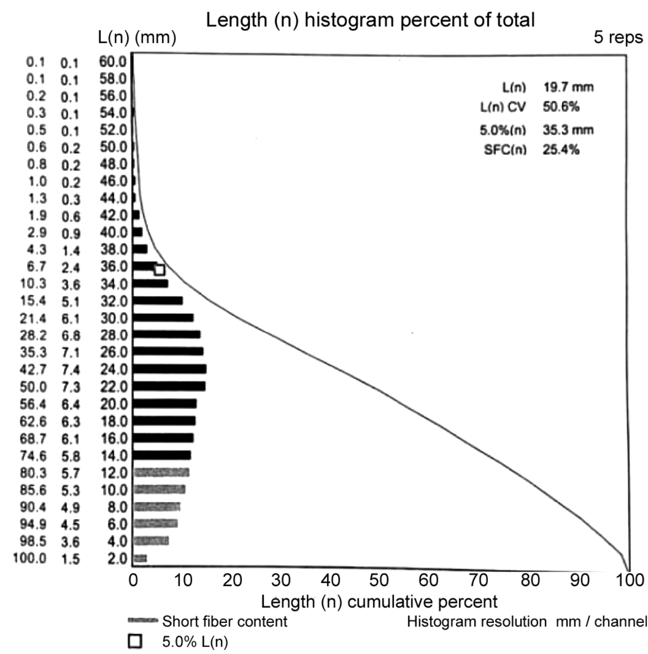

Fig. 1 — Length distribution curve of comber lap fibres

Table 3 — Unevenness of comber sliver

Parameter	Piecing index at comber				
	-0.5	0	+0.5	+1.0	+1.5
U_m, %	2.70	2.55	2.57	3.18	3.46
CV_m,%	3.41	3.25	3.23	3.98	4.32

Table 4 — Unevenness of post-comber draw frame sliver

Parameter	Piecing index at comber				
	-0.5	0	+0.5	+1.0	+1.5
U_m, %	1.75	1.55	1.54	1.70	1.99
CV_m, %	2.24	2.00	1.95	2.16	2.52

piecing indices ***0*** and ***+0.5***. The spectrograms of slivers, however, do not show any appreciable difference for different piecing indices. These results indicate that for the type of fibres used in this study, optimum piecing occurs at piecing indices of ***0*** and ***+0.5***.

3.3 Yarn Properties

The unevenness of yarn for different piecing indices at comber is shown in Table 5.

Table 5 shows that yarn evenness is better at piecing index ***0*** though the difference is marginal. Notably, the mass deviation rate 1.5 m (± 5% mass) is found to be minimum at the piecing index ***0*** compared to other piecing indices, suggesting better mass consistency. The imperfections of yarns at different sensitivity levels are shown in Table 6.

Although no significant variation in yarn imperfections for different piecing indices at comber is observed, piecing index ***0*** shows the lowest number of imperfections. The yarn faults for different piecing indices are shown in Table 7.

It is observed that the drafting, short thick and long thin faults are found to be lesser for piecing index **0** than the other indices. Spectrograms and variance-length curves of yarns do not show any appreciable difference across different piecing indices.

The single yarn and lea strength details of yarn for the different piecing indices are shown in Table 8.

No significant differences are observed in yarn strength and elongation-at-break across the various piecing indices.

From the above study, it is inferred that the piecing index setting at comber affects the quality of sliver as well as yarn. Incorrect selection of piecing index causes short-term mass variation in the comber web, which would result in mass variation in the comber sliver even if care is taken to distribute the piecing places while joining the sliver from different heads. It is normally expected that the unevenness due to the wrong selection of piecing index at the comber can be rectified at the post-comber draw frame autolevelling process. Since the comber slivers are doubled and drafted at the draw frame and further drafted at the roving frame and ring frame, the comber sliver variation is also expected to cause only long-term faults in the yarn. However, the result shows differences in imperfections level and classified faults due to different piecing indices. The reason could not be traced directly to the piecing, and it is felt that the wrong selection of overlapping may cause clustering of fibres and cause drafting-related problems in further processes. However, further elaborative study is required to confirm this argument for various length and length distributions of fibre mixings.

Table 5 — Unevenness of yarn

Parameter	Piecing indices at comber				
	-0.5	0	+0.5	+1.0	+1.5
U_m, %	9.71	9.51	9.67	9.78	9.73
CV_m, %	12.26	11.97	12.18	12.33	12.29
CV_m 1m, %	3.73	3.48	3.57	3.79	3.86
CV_m 3m, %	2.85	2.58	2.66	2.92	3.06
CV_m 10m, %	2.26	1.97	1.98	2.33	2.50
DR 1.5m 5%, %	13.2	10.7	13.4	15.4	17.4
H	3.23	3.12	3.46	3.40	3.46
Sh	0.71	0.69	0.78	0.75	0.76
Sh 1m	0.09	0.09	0.10	0.10	0.12

Table 6 — Yarn imperfections

Imperfections	Piecing indices at comber				
	-0.5	0	+0.5	+1.0	+1.5
Thin places					
-30%/km	1051	973	1042	1107	1034
-40%/km	60.9	59.7	57.5	54.1	49.7
-50%/km	1.6	0.6	0.9	0.6	1.6
-60%/km	0.0	0.0	0.0	0.0	0.0
Thick places					
+35%/km	201.3	175.6	207.5	215.6	201.6
+50%/km	17.2	14.7	20.6	18.8	17.8
+70%/km	3.4	1.6	3.8	2.2	4.1
+100%/km	1.3	0.3	1.3	0.6	1.3
Neps					
+140%/km	242.5	203.8	267.2	283.4	285.0
+200%/km	46.6	40.3	56.6	54.4	54.1
+280%/km	14.1	11.3	16.9	14.1	15.0
+400%/km	2.8	1.6	4.7	4.1	3.4
Total (normal sensitivity level)	65.4	55.6	78.1	73.8	73.5

Table 7 — Yarn classimat faults

Parameter	Piecing indices at comber				
	-0.5	0	+0.5	+1.0	+1.5
Objectionable faults (A4, B4, C3, C4, D3, D4)	4.0	5.0	11.0	8.0	6.0
Drafting faults (C1, C2, C3, C4, D1, D2, D3, D4)	12.0	8.0	10.0	11.0	17.0
Short thick faults (A1, A2, A3, A4, B1, B2, B3, B4, C1, C2, C3, C4, D1, D2, D3, D4)	174.8	100.0	135.0	155.2	132.0
Long thick faults (E, F, G)	5.0	4.0	5.0	4.0	3.0
Long thin faults (H1, H2, I1, I2)	4.0	3.0	7.0	7.0	19.0
Total faults	183.8	107.0	147.0	166.2	154.0

Table 8 — Strength properties of yarn

Parameter	Piecing indices at comber				
	-0.5	0	+0.5	+1.0	+1.50
	Single yarn				
B-Force, gF	328.3	334.9	319.6	322.9	316.2
Elongation, %	3.26	3.49	3.18	3.20	3.28
Tenacity, Rkm	22.24	22.69	21.65	21.87	21.42
B-Work, N.cm	3.105	3.378	2.936	2.990	3.016
Lea CSP	2877	2847	2875	2881	2869
Strength CV, %	4.66	3.66	4.37	2.51	4.64

4 Conclusion

The present study demonstrates that the piecing index setting at the comber significantly influences the quality of sliver and yarn. Among the piecing indices examined, indices 0 and +0.5 yielded the most favourable results across multiple quality parameters. These included lower unevenness in comber and post-comber draw frame slivers, reduced yarn mass variation, fewer imperfections, and a lower incidence of objectionable and drafting-related faults. Although the differences in strength and elongation properties of the yarn were not significant across the indices, a marginal improvement was observed at piecing index 0. The results show that the incorrect selection of the piecing index at comber affects the U%, imperfections and classimat fault of yarns, and there is no effect on the tensile properties of yarn for the chosen fibre mixing. However, further study needs to be conducted for various fibre mixings having different length distributions to get further insights on the effect of the piecing index.

Acknowledgement

The authors gratefully acknowledge KKP Textiles Pvt. Ltd., Namakkal, for their generous support and valuable assistance in the production and evaluation of the sliver and yarn samples utilised in this study.

References

1 Subramanian S & Gobi N, *Indian J Fiber Text Res*, 29 (2004) 196.
2 Chellamani K P, Chattopadhyay D & Thanabal V, *Indian J Fiber Text Res*, 28 (2003) 9.
3 Chattopadhyay R & Ghosh R, *Indian J Fiber Text Res*, 28 (2003) 393.
4 Jayaram V S, Proceedings of fifth joint technological conference of ATIRA, BTRA, SITRA & NITRA (SITRA, Coimbatore), (1963).
5 Grotiskii V S, *Technol Text Ind USSR*, 1 (1961) 68.
6 Gupte A A & Patel B A, Proceedings of twenty-seventh joint technological conference of ATIRA, BTRA, SITRA & NITRA (NITRA, Ghaziabad), (1986).
7 Owalekar R G, *Text Res J*, 39 (1969) 893.