Influence of Fibre Length on Ring Spun Yarn Quality

R. D. Parsi[1], Madhuri V. Kakde[2], Kuldip Pawar[3], R. S. Police Patil[4]

[1,2,3]*Centre for Textile Functions, SVKM'S, NMIMS, MPSTME, Shirpur, India*

[4]*Spentex Industries Pvt. Ltd. Baramati, India*

Abstract **- Fibre length is an important factor in determining the quality of ring spun yarn. Various parameters have been developed to characterize cotton fibre length in the past decades. This study was carried out to investigate the effects of these parameters and their combinations on yarn properties. The present work in which the fibre length varied, keeping all the other parameters same, has revealed the existence of an optimum fibre length for achieving the best yarn quality. For this study trials have been conducted to justify the yarn quality by changing the fiber length, yarn were evaluated by checking the sample on AFIS tester and UT3 tester and to make comparison between them, the trials have given results i.e. the RKM in yarn increased 5% in relation with previous yarn quality which have been channelized up to yarn stage.**

Key word- **Fibre length, Yarn quality, AFIS Tester, UT3 tester, RKM.**

I. INTRODUCTION

Fibre length is one of the most important technological properties of cotton fibres in both marketing and processing. To some extent it is true, as other factors being equal, longer cottons give better spinning performance than shorter ones. But the length of cotton is an indefinite quantity, as the fibers, even in a small random bunch of cotton. The average length of all fibres in a sample or the average length of a given percentage is related to other cotton fibre characteristics such as strength, fineness, maturity and uniformity

Fibre to yarn conversion process has been affected by several factors which include properties of raw material, level of technology, machinery and skill of machine operators. In cotton fibre spinning, the cost of raw material plays an important role, since it accounts for over 50% of the total cost of the ring spun yarn. Yarn imperfections on the other hand are an important yarn parameter which affects yarn and fabric processing, and quality parameter. In this study, the relationship between fibre properties and yarn quality has been investigated. The main emphasis of this project work is to find out the effect of fiber length on yarn quality for achieving the good yarn strength, and the trials have been conducted to justify the yarn quality by changing the fiber length.

II. LITERATURE REVIEW

The influence of fiber length on yarn tenacity has been commented upon by many researchers. While some of them have reported increase in yarn strength with increase in fiber length, others have reported the reverse correlation.

Yiyun Cai et.al. studied a comparative study of the effects of the cotton fiber length parameters on modeling yarn properties. The results of this study show that the variations in fiber length distributions play important roles in predicting yarn properties, such as strength and irregularity. D. Thibodeaux et.al. showed in research work that short fibers within a process mix of cotton cannot wrap around each other and contribute little or nothing to yarn strength. Short fibers indirectly cause product defaults and directly contribute to higher waste and lower manufacturing efficiency. Eric Hequet et.al in his research predict that for the carded ring spun yarns, the shortest fibers and the longest fibers exhibit the highest correlation with the yarn CV%, the no. of thin and thick places. For the combed ring spun yarns, the longest fibers exhibit the highest correlation with the yarn CV%, the no. of thin and thick places. The correlation coefficients between different length categories and the number of neps are generally low. The shortest and the longest fibers are highly correlated with the hairiness for all the types of yarns. The shortest fibers increase hairiness and the longest fibers decrease hairiness.

Mishu Zeidman et.al. studied on fiber length distribution and its ultimate effect on the yarn strength. In this study, they pointed out an important issue of friction among adjacent fibres in a yarn structure and also introduce and derive a new parameter called the strength efficiency of fibers in a yarn, which may contribute to an understanding of the yarn failure mechanism.

III. MATERIAL AND METHODS

In this research work cotton fiber of mixing length 29.74 mm and 31.34 mm of MS-01 mixing were proceeds through blow room, carding, breaker draw frame, unilap, comber, finisher draw frame, speed frame, and ring frame. The cotton fiber tested for micronaire (mic), maturity (mat), trash content, length and short fiber index (sfi). These fiber properties were tested on HVI. Machine setting and yarn parameters considered included, yarn count and yarn twist. Fiber properties in the mixing are given in Table 1.

Table No. 01: HVI Test data

2.5 % Span Length in mm	30.70
50 % Span Length in mm	13.70

Raw Material Trash %	3.3 %
Short Fibre Content by (w)	10.3 %
Bundle Strength at 3 mm Gauge	23.5 gms / Tex
Fibre Micronaire	3.8 µgs / Inch
Short Fibre Content by (n)	27.8 %
Maturity Ratio	0.88

IV. EXPERIMENTAL WORK

In order to study the influence of cotton fiber length on quality of ring spun yarn, the collected yarn samples were tested under the standard testing conditions. The actual experiments to be carried out with following process variables are laid down in following Table 2.

Table No. 02: Process Variables

Count	30 Ne
TPI	20.73
TPM	816
Machine Speed	17,757 rpm
Top Arm Load Gauge	14 kg
Ring Size Diameter	38 mm
Traveller	3/o

V. RESULTS AND DISCUSSION

Ring spun yarn made from different cotton fibre lengths i.e 29.74 mm and 31.34 mm were collected and testing for strength on Tenso-rapid and for unevenness on Uster Tester 5.

A. Effect of fiber length on RKM

Table No. 04: Effect of fiber length on RKM

Uster Tensorapid 3 Results		
Mixing length	**29.74 mm**	**31.34 mm**
RKM	17.23	17.55
CV%	6.54	7.61
Elongation	4.33	4.30
CV%	7.93	9.96

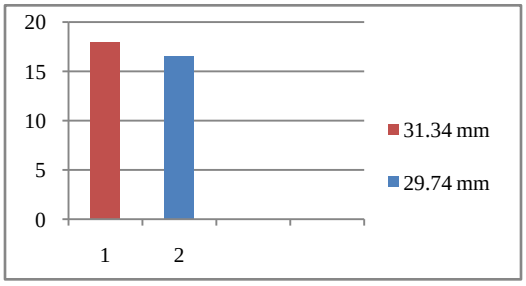

Figure No. 01: Effect of fiber length on RKM

Fibre length is one of the most important fibre characteristics influences ring spun yarn strength. Figure 1 shows that increasing the fibre length increases RKM. As the fibre length increases, the fibres have greater chance to contribute in twist zone and longer fibres have more mass than short fibres and therefore have a greater effect on yarn strength. The yarn strength is very dependent on the wrapping twist.

B. Effect of fibre length on Hairiness

Table No. 5: Effect of fibre length on Hairiness

Mixing length (mm)	**29.74**	**31.34**
Hairiness	4.94	4.89

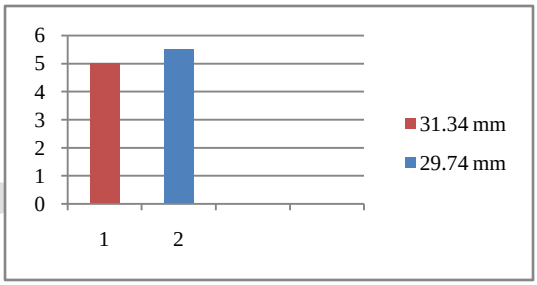

Fig 2: Effect of fibre length on Hairiness

The study of the effect of fibre length on yarn hairiness indicated that short fibres were negatively correlated with yarn hairiness. This implies that as short fibre index increased yarn hairiness increased as shown in above figure 4. The shorter the fibre the higher the number of fibre ends in a given length of yarn. More fibre ends will lead to higher hairiness. While using the longer fibres, the fibres tend to overlap on the yarn surface in a better manner and hence improve the compactness of yarn which results less hairiness. Many researchers have revealed that fibre length uniformity has a positive correlation with yarn hairiness since; an increase in length uniformity is equivalent to increase in effective fibre length.

C. Effect of fiber length on U% and Imperfections:

Table No. 6: Effect of fiber length on U% and Imperfections

Mixing length (mm)	**29.74**	**31.34**
Count	29.73	29.59
Count CV%	0.98	1.04
UT5 Results		
U%	8.97	9.55
CV%	97.3	116.0
CVm%	11.07	12.09
CVm 10%	1.83	1.92
Thin -30%	503.3	875.5
Thik +35%	156.3	318.5
Neps +140%	310.0	348.8
Total Sensitivity	**969.6**	**1484.8**
Thin-50%	0.3	0.5
Thik+50%	20.8	32.8
Neps +200%	76.0	78.4
Total IPI	**97.1/km**	**116.1/km**

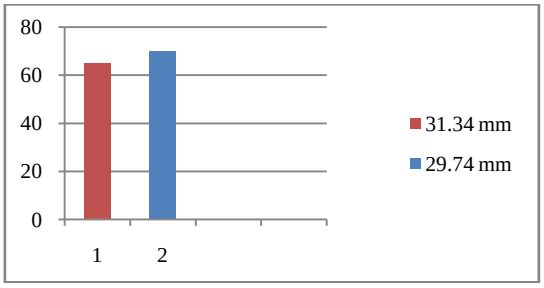

Fig 3: Effect of fibre length on U%

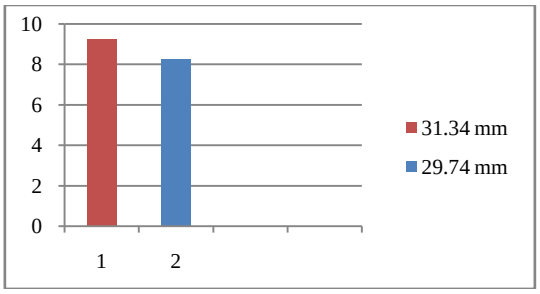

Fig 4: Effect of fibre length on neps

From the above table 6 it is clear that for the combed ring spun yarn, the longest fibers exhibits the highest correlation with the yarn CV%, the thin places and the thick places. The correlation coefficients between the different length categories and the number of neps are generally low.

Fig (4) shows the relationship between fiber length and neps count. It can be noticed that yarn nep count is positively and significantly correlated with slenderness of fibers. The slenderness is the ratio of fibre length to fibre fineness. As the slenderness of the fibers increases yarn nep count increases. Whereas slenderness of the fibers increases, for the same fiber substance, fibre stiffness increases and fibres which are not stiff enough have too little springiness. They do not return to shape after deformation. They have no longitudinal resistance. This leads to the formation of neps.

VI. CONCLUSION

The tensile and tear strengths and hence durability of a cotton fabric are greatly influenced by the length and strength of cotton fibres in addition to the fabric structure. This is so because fibre length to a large extent determines yarn strength, which ultimately contributes to fabric strength. Also, fibre length and its distribution affect fibre processing and hence yarn performance during subsequent mechanical processing, including weaving and knitting.

From the experimental results, it should be born in mind that yarn quality declines alongside staple length of the fiber; this affects yarn tenacity, hairiness and yarn imperfections in particular. Yarn produced from shorter fibers has negative effect on yarn tenacity, hairiness and yarn imperfections.

REFERENCES

[1]. S.P.Mishra, (2005); Fiber Science and technology; New age international ltd publishers.
[2]. Yiyun Cai et.al. A Comparative Study of the Effects of the Cotton Fibre Length Parameters on Modeling Yarn Properties, Textile Research Journal, June 2013, Vol.83, no.9, p 961-970.
[3]. Mishu Zeidman et.al, Influence of Fibre Length Distribution on Strength Efficiency of Fibers in Yarn, Textile Research Journal, March2002, Vol.72, no.3 , p216-220.
[4]. Ochola, J. et.al. Study on the Influence of Fiber Properties on Yarn Imperfections in Ring Spun Yarns, Asian Journal of Textile; September 2012, Vol. 2 Issue 3, p32
[5]. Fawkia F. Et.al. Effect of Egyptian cotton Fiber Length Distribution on Yarn Properties, June 2007.
[6]. Lord, E., (1961),), The Characteristics of Raw Cotton, Manual of Cotton Spinning, A. F. W. Coulson and M. Tordoff, Eds. Vol. 2, Part 1, The Textile Institute and Butterworth &Co .. Manchester, UK.
[7]. http://www.rieter.com/cn/rikipedia/articles/rotor-spinning/applications-engineering/fiber-properties/fiber-length/
[8]. Arindam Basu, yarn structure – properties relationship, Indian journal of fibre & Textile research, September 2009, Vol. 34, p287-294.