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Evaluation & Analysis of Splice Strength of Ring Spun Yarn Produced from Different Types of Cotton Fibers

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Abstract

Raw materials & their quality are known to be the most important factors which determine the quality of yarn. There are various properties which determine the quality of yarn; some of them are known to be the prominent properties of ring spun yarn. In this study some prominent properties of Ring spun yarn produced from different types of cotton fiber including splice strength, Imperfection Index, Yarn hairiness, yarn unevenness, yarn RKM, Elongation, CSP were investigated in detailed. For this purpose, yarns from three different cotton types like Ivory Coast, Mali & Cameron of having same count were undergo various tests to find out the better-quality yarn. Result showed that there was significant difference between the ring spun yarns with respect to various properties.

Keywords: Splice Strength • Unevenness • Hairiness• PI • Elongation

Introduction

Cotton (Gossypium spp.) fiber is the most significant natural fiber in the textile industry. Physical properties like splice strength, hairiness, imperfection index, elongation and so on determine the value and quality of cotton fibers and the yarn spun from them [1,2]. Apparently, Fiber properties determine performance during processing and spinning. To produce high-quality ring spun textiles, fibers must be fine and have sufficient strength to endure processing [3]. Among the measurable properties splice strength receive the least attention from spinning technology. However the value of splice strength can never be omitted, as it influences the performances of spun yarn during winding warping & weaving [4]. Knotting is the conventional method of joining the yarn ends. But in many bout knotting causes serious defects on fabric surface. So various types of knots free yarn joining process have been established, on that matter splicing is the best method among knots free yarn joining process [5]. Splicing is a technique of joining two yarn ends by intermingling the constituent fibers so that the joint is not significantly different in appearance and mechanical properties with respect to the parent yarn. Splicing is the most widely used for agreeable knots free joining. There has several types of splicing techniques like electrostatic splicing, mechanical splicing, pneumatics splicing [6]. Among these techniques pneumatic splicing is the best technique of all because of its better performance, creating better fabric surface weather woven or knit fabric. The usefulness of splicing is primarily dependent on the tensile strength and physical appearance. A high degree of yarn quality is not possible through knot, as the knot itself is objectionable due to its physical dimension, appearance and problems during downstream processes [7]. The knots are indebted for 30 to 60% of stoppages in weaving [8]. Apparently for yielding good quality yarn splicing has played a vital role and also enhances the speed of yarn production by eliminating major faults. Splicing effects on yarn properties badly which has come from different types of fibers such as it has great effects on yarn splice strength. In accordance with, in this present study an endeavor has been made to test three different types of cotton fiber in order to visualize the different fibers properties from HVI and AFIS machine. Afterwards in this study we have added different properties of yarn like Unevenness, Imperfection Index, Rkm, Elongation, CSP and Hairiness which made from three different types of cotton fibers. Splicing is an important part in winding machine because after cutting the fault in yarn according to the NSLT setting, it is required to join the ends of yarn efficiently so that the joint does not seem different in terms of appearance and tensile properties. In this study we have evaluated splice strength of parent and spliced yarn of the three different yarns.

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Materials and Methodology

Three cotton fibers were taken for this test such as Mali, Cameroon & Ivory Coast as a raw material for the production of same count of yarn. The count of all the cotton yarn is 24 Ne. After that different fiber properties were tested by using the High Volume Instrument (HVI) & Advanced Fiber Information System (AFIS) [9,10]. These two machines are the crucial for testing all the fiber properties because all the testing result depends on this tests report. Moreover, all the analysis and evaluations of fiber properties including splice strength properties depends on the HVI & AFIS machines. After that tests all the fibers were converted to yarn. The yarn was produced in ring spinning system of LMW ring machine which is used to produce yarn in short staple spinning. The count of the yarn is 24 Ne CH (Combed Hosiery) was produced from three different cotton fibers. Roving count of 0.70 Ne was kept during the processing of these three yarns of same count. The same roving was fed to each spindle of ring frame so that the variation can remain less. Moreover, all the parameters for those three samples are kept same such as traveller no, draft, spindle speed, No of twist per inch. Ring frame parameters are given below Table 1.

After producing yarn from ring frame machine, the ring cops are collected; it was then wound on the winding machine. Then yarn was passed through winding machine where the brand name of this machine is MURATEC MURATA MACHINERY LTD where the model number is Process Coner II QPRO Plus and the smart cleaning device name is USTER QUANTAM 3. The speed of the winding was 1300 m/min. Moreover, different properties of yarn such as evenness properties and hairiness were carried out in PREMIER iQ2 LX. Other important properties of yarn like elongation, Count Strength product (CSP) were resulted from the machine called ELE Stretch XT, which has the capacity of

Table 1. Processing parameters of Ring frame.

Parameter	Mali	Cameroon	Ivory Coast
Count	24 Ne	24 Ne	24 Ne
Break Draft	1.14	1.14	1.14
Total Draft	36.23	36.23	36.23
Spindle Speed	15000	15000	15000
TPI	18.54	18.54	18.54
Traveler No.	2/0	2/0	2/0

5000 lbs. The value of Rkm is also performed by PREMIER TENSOMAXX 7000. Furthermore, the splicer yarn strength & normal yarn strength are measured using the Push-Pull Tension Gauge (TECLOCK). The Model no of this machine is PPN- 70510. Also, the measuring range of strength is 0.5~10 N. Afterwards, all these things were used to evaluate the statistically significant difference between three yarns of different types of cotton fiber.

Result and Discussion

To analyze and evaluate the splice strength of ring spun yarn, at first, we have shown the properties of three different types of fibers tested from HVI & AFIS machines. So, the tests result of HVI & AFIS machines are given below Table 2.

Yarn Unevenness

Unevenness is an essential property of yarn which helps the spinners to take decision for the assumption of the quality of yarn. Yarn unevenness deals with the variation in yarn fineness. This is the property, commonly measured as the variation of mass per unit length along the yarn. In other words, it refers to the variation in yarn count along its length. We have shown in figure 1, the unevenness properties of yarn produced from three different fibers. From the figure:1 it is observed that unevenness percentage of Cameroon yarn is less than that of Mali & Ivory Coast yarn. Since the SCI value of Cameroon fiber is higher than the other fibers so that the Um (%) of Cameroon is less than others (Figure 1).

Yarn imperfection result: Imperfections are the description for thin, thick places and neps in 1000m of yarn. Evenness Tester is required to calculate the IPI of yarns with the results of different yarn evenness parameters. It is a fault of yarn. For ring spun yarn imperfections in the yarn refer to the total number of thin places (-50%), thick places (+50%) and neps (+200%) present per 1000 meter of yarn. Imperfections can both be the cause of ends down in downstream processing and also make a disturbing appearance in the fabric. The less imperfections in then yarn, the better the appearance of the fabric. We have shown in figure 2, the yarn imperfection properties of yarn produced from three different fibers. From the figure 2 it is seen that the Mali yarn has less IPI & Ivory Coast yarn has greater IPI than compared to Cameroon yarn. As the value of Neps (Cnt/gm) and SCN (Cnt/gm) for Ivory Coast fiber is higher than the other fibers that are why the value of IPI of Ivory Coast is less than others.

Yarn hairiness result: Hairiness is one of the significant properties of yarn which has immense impact on the appearance on fabric, particularly after dyeing and printing. In term of measurement Hairiness corresponds to the total length of the protruding fibers in unit length of one centimeter. We have shown in figure 3, the hairiness properties of yarn produced from three different fibers. In the figure 3 it can be observed that Mali yarn has higher Hairiness value comparing to the other two yarn of Cameroon & Ivory Coast. Since the value of SFC (%) of Mali fiber is higher than the other fibers so that the value of hairiness of Mali fiber is higher than the others (Figure 3).

Yarn Rkm, elongation& CSP result: Rkm, Elongation & Count lea-strength product values are shown in Figure. In all three cases the values of Mali yarn are highest and Cameroon yarn is lowest. Rkm can be expressed by the "Length of yarn in km" at which yarn will break of its own weight". This is equivalent to breaking load in g/tex. Breaking strength and elongation are

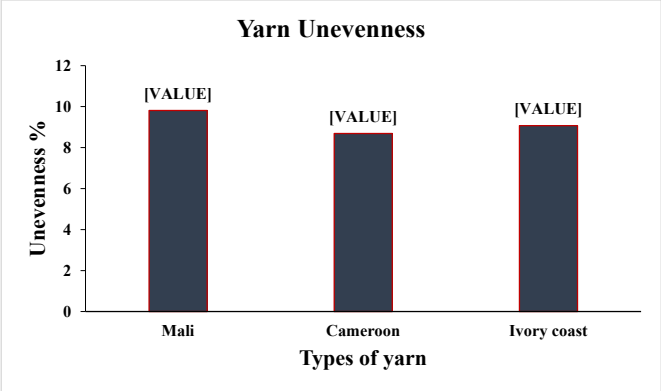

Figure 1. Unevenness Properties of Yarn.

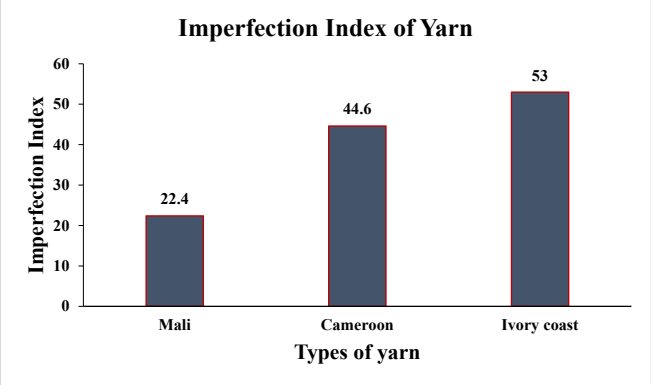

Figure 2. IPI Properties of Yarn.

Table 2. Fiber Properties.

HVI				AFIS			
Properties	Values			Properties	Values		
	Mali	Cameroon	Ivory Coast		Mali	Cameroon	Ivory Coast
SCI	146.4	148.9	138.5	Nep (Cnt/g)	276	243	279
Rd (%)	79.1	76.3	73.4	Nep size (um)	697	691	709
(+) b	11.4	11.4	10.2	SCN (Cnt/g)	6	5	6
Mic Value	4.13	4.11	4.19	SCN (um)	1244	1126	1030
Maturity ratio	0.88	0.89	0.88	SFC (%)	28.2	26.8	25.2
UHML (mm)	29.53	30.2	29.1	UQL (mm)	28.98	30.63	29.1
UI (%)	83.3	82.2	82.6	5% (mm)	33.81	35.04	33.5
SFI (%)	7.9	8.3	8.5	Fineness (mtex)	147	148	143
Fiber bundle tenacity (g/tex)	31.3	32.9	30.9	IFC (%)	15.9	15.1	16
Elongation (%)	6.2	2.7	6.7				

two prime quality attributes of any spun yarn. The strength and the elongation of a yarn are mainly important for the following processes after spinning, i.e. knitting and weaving. From figures 4,5 and 6, it is seen that since the strength (gm/tex) of Mali fiber is higher than Ivory Coast fiber so that the Rkm, CSP value of Mali yarn is better than Ivory Coast's one. And the elongation (%) of Mali and Ivory Coast yarn is almost same. On the other hand, the elongation (%) of Cameroon yarn is the lowest. Due to its lowest fiber elongation value (Figures 4-6).

Splice strength and parent yarn strength: Splicing is a technique of joining two yarn ends by intermingling the constituent fibers so that the joint is not significantly different in appearance and mechanical properties with respect to the parent yarn. Splicing strength is also an important factor for the ultimate yarn. Moreover, the strength of parent yarn should be greater with respect to the splicer strength. From the figure 7, we can see that the variation of normal yarn strength and splice strength. In both cases of the figure the strength of Ivory Coast fiber produced yarn is greater and Mali yarn is smaller. Here, for measuring the splice strength the splice length was kept in Position 2. For the case of normal yarn strength, the Ivory Coast yarn has greater value and Mali yarn has lower value. Since the MIC value of Ivory Coast fiber is higher than the other fibers so that the parent yarn strength and splice strength of Ivory Coast yarn is higher than the others (Figure 7).

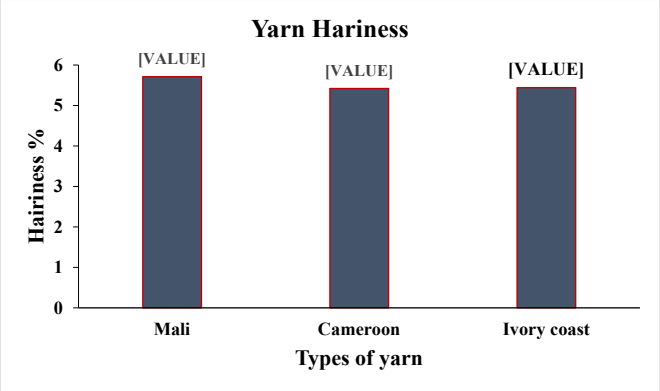

Figure 3. Hairiness of Yarn.

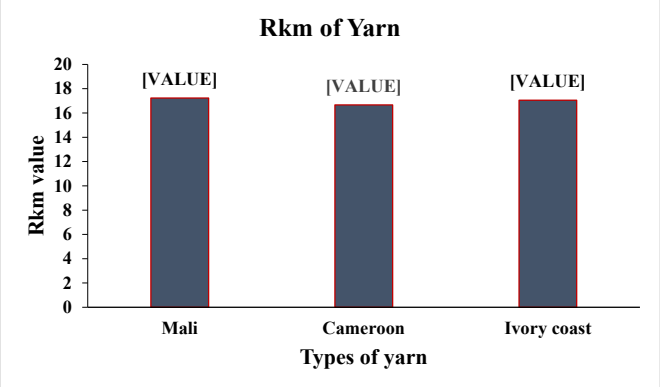

Figure 4. Rkm of Yarn.

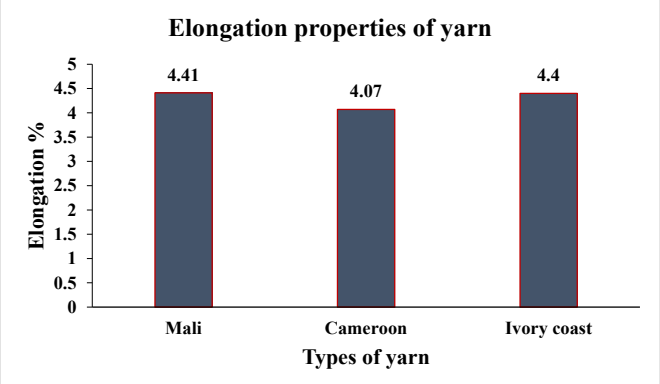

Figure 5. Elongation Properties of Yarn.

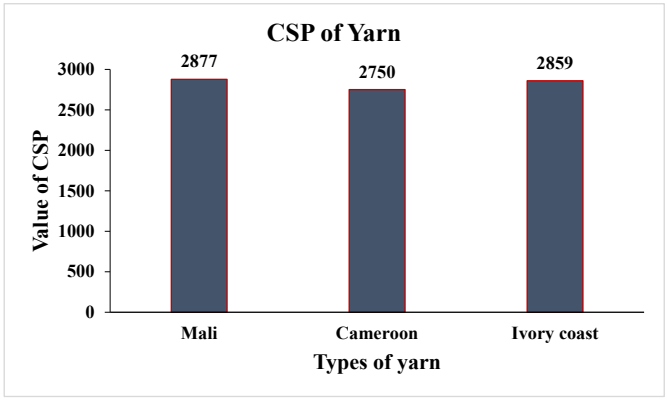

Figure 6. Count Strength Product (CSP) of Yarn.

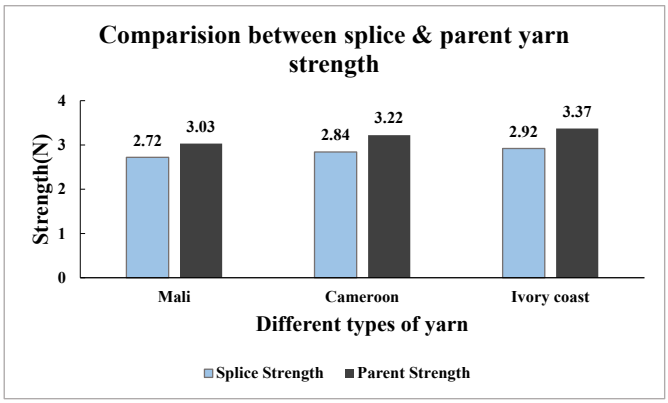

Figure 7. Comparison between Splice strength & parent yarn strength.

Conclusion

Winding has important influence on spinning because it is the last step where spinners can rectify their improvement if there is any fault in the previous stages. From the above description we have summarized that Ivory Coast yarn is the best in terms of the splice strength. Similarly, Mali yarn is best in terms of Rkm, CSP and IPI value. And Cameroon yarn is best in terms of Hairiness (%). Eventually, we can come in a decision that in terms of splice strength, Ivory Coast is the best of all because splice strength is the main parameter which defines the quality of yarn. Therefore, Ivory Coast cotton fiber should be used frequently in our industry for producing better quality yarn.

Conflict of interest the authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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