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Comparative Study on Tensile Properties of Imported and Pakistani Cotton Yarn

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Abstract: It was planned to compare the spinning potentials of imported cottons viz. Amercian cotton (Acala 1517-95), Uzbek cotton (C-6524), Australian cotton (Sicala- 40), Brazilian cotton (Matta), and Zimbabwean cotton (Albar SZ-9314) with Pakistani cotton (MNH-93), in term of their utility value in textile mills. American and Brazilian cottons generates the better results.

Key Words: Tensile properties of Imported and Pakistani Cottons

Introduction

Cotton is cultured, natural product and is always referred as a non-homogeneous raw material. It exhibits variation from fibre to fibre, bale to bale, area to area, and season to season due to climatic conditions, growing areas and harvesting methods etc. Tensile properties of cotton yarn (single yarn strength, yarn breaking length and yarn elongation) largely depend upon the raw material properties rather than technology. In textile industry, quality of the end product mainly depends upon the quality of yarn. Yarn quality means all factors concerning regularity, strength, cleanliness and appearance of the yarn, which obviously, not only converted by the processes, but correct selection of raw material is also involved.

Nabi (2000) declared that single yarn strength of 20s yarn was 331.3 to 399 g/tex and yarn elongation of 20s cotton yarn ranged from 4 to 5.32 percent. Maqsood (2000) observed that the single yarn strength of 20s cotton yarn was 410.24 to 455.85 gm/tex and RKM value for 20s yarn was 14.05 to 15.71 g/tex. Farooqi (1992) reported that RKM value for 20s yarn ranged from 14.69 to 16.93 g/tex. Amjad (1999) reported that yarn elongation range from 6-10 percent for various Pakistani cottons. Higher fibre elongations will results in better yarn elongation, required by subsequent process of weaving and knitting etc. he also stated that better yarn breaking strength resulted from the more elastic fibres. (fibres that had higher value of fibre elongation).Booth (1983) defined the breaking length as the length of the specimen, which just break under its own weight when hung vertically. The expression of strength in terms of breaking length is useful for comparing single fibre strength with the yarn strength. Sheikh (1991) described that the yarn elasticity and elongation is also very important in post yarn spinning process. Yarn with low elasticity i.e. low elongation tends to break more frequently in weaving. Frydrych (1992) mentioned that yarn tensile response based on fibre parameters such as fibre strength, length, maturity, trash content and fineness. Faerber (2000) narrated that fibre strength translates directly into yarn strength, which is a decisive criterion for the subsequent processing behavior in fabric formation. Anonymous (2000) reported that yarn strength and yarn elongation could be negatively effected by shorter span length.

Materials and Methods

The present research work entitled "Tensile Properties Of Imported And Pakistani Cotton Yarn" was initiated in the Department of Fibre Technology, University of Agriculture, Faisalabad and conducted at Nishat Mills Limited Faisalabad, during the year 2002.

The processing detail and methods applied to record the data for various quality characteristics of raw cotton and yarn are briefly described here with.

Material Used: Lint cotton samples(given in table-A) from six cotton exporting countries viz. America, Australia, Brazil, Uzbekistan, Zimbabwe and Pakistan were collected from the godown of the mill. The fibre characteristics of these cotton samples are as under:-

These cotton samples were processed through blow room, card, drawing frame, simplex frame and ring frame at constant machine settings and processing variables. The count that was spun from above cotton samples is 20^s.

Tensile Properties of Single Yarn: Tensile properties viz. single yarn strength, elongation and breaking length (RKM Value) were determined by Uster Tensorapid, which applies a constant rate of extension (CRE) principle of testing. CRE describes the simple fact that the moving clamp is displaced at a constant velocity. As a result the specimen between the stationary and moving clamp extended by a constant distance per unit time and force required to do so, is measured. The breaking tenacity is calculated from the peak force, which occurs any where between the beginning of the test and the final rupture of the specimen. The breaking elongation is calculated from the clamp displacement at the point of peak force. The procedure adopted is given in detail in ASTM Standards (1997).

Rupture per Kilometer (RKM) is calculated by applying the following formula:

RKM=Single Yarn Strength ´ 0.00169 ´ Actual Count

Atmospheric Conditions: The testing work was carried out under the standard laboratory conditions, which were maintained at 65±2% relative humidity and 20±2 0C temperature.

Statistical Analysis of Data: Completely Randomized Design was applied in the analysis of variance for testing differences among various quality characters as suggested by Steel and Torrie (1984).

Duncan's Multiple Range test was also applied for comparison of individual means among various quality characters. The data thus obtained was subjected to statistical manipulation on computer employing M-Stat compute program devised by Freed (1992).

Results and Discussion

Single Yarn Strength: The analysis of the data in respect to single yarn strength of 20s yarn spun from American, Australian, Brazilian, Uzbek, Zimbabwean, and Pakistani cottons is presented in Table-1. This shows that differences among various cottons studied for this

Table (A): Physical Characteristics of Raw Material

Country	+Variety	Staple Length (mm)	Uniformity Index (%)	Micronaire Value	Maturity Ratio	Fibre Bundle Strength	Trash Content (%)
America	Acala 1517-95	28.50	85.80	4.38	0.93	30.10	1.38
Australia	Sicala 40	28.40	83.50	4.38	0.93	29.98	1.80
Brazil	Matta cotton	28.45	82.50	4.40	0.91	30.02	5.30
Pakistan	MNH-93	28.45	83.62	4.40	0.97	30.02	8.27
Uzbekistan	C-6524	28.40	85.12	4.42	0.97	29.96	2.00
Zimbabwe	Albar SZ 9314	28.50	83.70	4.40	0.94	30.00	2.50

Table 1: Analysis of Variance for Single yarn Strength

S.O.V.	D.F.	S.S.	M.S.	F. Value	Prob.
Cotton	5	46707.561	9341.512	39.965	0.0000 **
Error	24	5609.802	233.742		
Total	29	52317.363			

Highly Significant = **
Co-efficient of variation = 3.14%

Table 2: Analysis of Variance for Breaking Length (Rkm)

S.O.V.	D.F.	S.S.	M.S.	F. Value	Prob.
Cotton	5	47.254	9.451	33.555	0.0000 **
Error	24	6.760	0.282		
Total	29	54.014			

Highly Significant = **
Co-efficient of variation = 3.24%

Table 3: Analysis of variance for yarn elongation

S.O.V.	D.F.	S.S.	M.S.	F. Value	Prob.
Cotton	5	3.199	0.640	4.114	0.0077 **
Error	24	3.733	0.156		
Total	29	6.932			

Highly Significant = **
Co-efficient of variation = 8.10%

Table 4: Comparison of Individual Mean Values Using DMR Test

Cotton	Means	Means	Means
American	553.3 a	18.53 a	4.87 abc
Australian	493.2 b	16.42 c	5.34 a
Brazilian	427.9 d	14.72 d	4.38 c
Pakistani	454.9 c	15.15 d	5.22 ab
Uzbek	506.5 b	17.12 b	4.67 bzc
Zimbabwean	488.2 b	16.25 c	4.75 bc

* Any two mean sharing letters do not differ significantly at 5% level of probability

parameter are highly significant.
On further comparison of their individual mean values, it is stated that Uzbek, Australian and Zimbabwean cottons differ significantly from American, Pakistani and Brazilian cottons. Likewise, American Pakistani and Brazilian cottons are found to be different significantly from one another. But Uzbek, Australian and Zimbabwean cottons differ non-significantly from one another.
The range of mean values of single yarn strength is recorded as 427.9 to 553.3 g/tex. The highest mean value of single yarn strength is found for American cotton as 553.3 g/tex followed by Uzbek, Australian, Zimbabwean, Pakistani and Brazilian cotton with their respective mean values as 506.5, 493.2, 488.2, 454.9 and 427.9 g/tex.
Present results of single yarn strength are slightly correlated to the findings of Maqsood (2000) who reported that single yarn strength for 20s cotton yarn ranged from 410.24 to 455.85 g/tex. Present results for single yarn strength differs from the value of 331.3 to 399 g/tex as reported by Nabi (2000). Difference in the mean values of single yarn strength may be due to the fact that fibre properties such as fibre length, length uniformity, fibre strength, and fibre fineness affect the tensile properties of yarn. Similarly, Anonymous (2000) reported that yarn strength and yarn elongation could be negatively effected by shorter span length. Faerber (2000) narrated that fibre strength translates directly into yarn strength, which is a decisive criterion for the subsequent processing behavior in fabric formation.
Breaking Lenght (RKM): The analysis of the data pertaining to breaking length (RKM) of 20s yarn spun from American, Australian, Brazilian, Uzbek, Zimbabwean, and Pakistani cottons is presented in Table-2 which shows that differences among arious cottons studied for this parameter are highly significant.
Further comparison of the individual mean values narrates that Uzbek and American cottons differ significantly from each other and also from Australian, Brazilian, Pakistani and Zimbabwean cottons. Similarly, Australian and Zimbabwean cottons are significantly different from Pakistani and Brazilian cottons but Pakistani and Brazilian cottons are non significant from each other. Likewise, Australian and Zimbabwean cottons are non significant from each other.
The range of mean values of breaking length for 20s yarn is estimated as 14.72 to 18.53 g/tex. The highest mean value of breaking length is found 18.53 g/tex for yarn spun from American cotton followed by Uzbek, Australian, Zimbabwean, Pakistani and Brazilian cotton with their mean values as 17.12, 16.42, 16.25, 15.15 and 14.72 g/tex respectively.
Present results of breaking length (RKM value) for 20s cotton yarn are correlated with the findings of Farooqi (1992) who reported that RKM value for 20s yarn ranged from 14.69 to 16.93 g/tex. Where as Maqsood (2000) stated slightly similar results of RKM value for 20s yarn as 14.05 to 15.71 g/tex. Amjad (1999) stated that better yarn breaking strength resulted from the more elastic fibres (fibres that had higher value of fibre elongation).
Booth (1983) defined the breaking length as the length of the specimen, which just break under its own weight when hung vertically. The expression of strength in terms of breaking length is useful for comparing single fibre strength with the yarn strength.
Yarn Elongation: The analysis of the data pertaining to yarn elongation of 20s yarn spun from American, Australian, Brazilian, Uzbek, Zimbabwean, and Pakistani cottons is presented in Table-3. This shows that differences among various cottons studied for this parameter are highly significant.
The comparison between the individual mean values shows that Australian cotton differs significantly from Zimbabwean, Uzbek and Brazilian cottons but Australian, Pakistani and American cottons are non significant from one another. Similarly, American, Zimbabwean, Uzbek and Brazilian cottons are different non-significantly from one another.
The range of mean values of yarn elongation is found as 4.38 to 5.34 percent. Australian cotton has the highest mean value of yarn elongation as 5.34 percent followed by Pakistani, American, Zimbabwean, Uzbek and Brazilian cotton with their respective mean values as 5.22, 4.87, 4.75, 4.67 and 4.38 percent.
Present results for yarn elongation are highly correlated with those of Nabi (2000) who recorded that yarn elongation of 20s cotton yarn ranges from 4 to 5.32 percent. Amjad (1999) also reported that yarn elongation range from 6-10 percent for various Pakistani cottons. Higher fibre elongation will results in better yarn elongation, required by subsequent process of weaving and knitting etc.
Frydrych (1992) mentioned that yarn tensile response based on fibre parameters such as fibre strength, length, maturity, trash content and fineness. However, Sheikh (1991) described that the yarn elasticity and elongation is also very important in post yarn spinning process. Yarn with low elasticity i.e. low elongation tends to break more frequently in weaving.

Conclusion

Since the fibrous material Particularly raw cotton differ from lot to lot,time to time,place to place,pick to pick and variety to variety.So it is difficult to say that particular cotton variety/country produces all quality characteristics better.The testing of ultimate yarn samples shows that yarn spun from Amercian and Brazilian cottons produced the best results for strength parameters of cotton yarn.

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