Analysis of ring spun yarn quality on the basis of spindle speed

G. M. Faysal

Abstract— Supima cotton fibre used to produce fine count 70Ne and 90Ne yarn in different spindle speed at ring frame where all parameter of Blow-room to Ringframe were same. The produced yarns were analyzed in Uster Tester 4 for assessing the quality of yarn. Yarn Unevenness %, IPI, Hairiness and yarn strength were monitored with the variation of spindle speed. The end breakage was also noted with the variation of spindle speed. The yarn U%, IPI and Hairiness were increasing trend with the increasing of spindle speed and yarn strength was decreasing trend with the increasing of spindle speed. Due to the decreasing trend of yarn strength the end breakage was also increasing trend. The increasing trend of end breakage was decreasing the efficiency of machine. So the profit of spinning mills was hampered due to the decreasing trend of machine efficiency. So the maximum profit of spinning mills depends on the optimum setting of spindle speed of ringframe according to the requirement of customer demand.

Index Terms— Fibre, Spindle speed, IPI, Hairiness, Strength.

1 INTRODUCTION

Bangladesh is a developing country where the economy of Bangladesh depends on textile sector. There are 425 spinning mills established in Bangladesh which provide the raw materials yarn to the textile sector [1]. The size of spinning determine by the number of spindle of a spinning mills. The total numbers of spindles are 12410000 in 425 spinning mills in Bangladesh [1]. The quality of ring spun yarn depends on many factors and the production of yarn depends of ring spindle speed. So the effect of spindle speed of ring frame on yarn quality is very important. The aim of this research is to produce maximum yarn with high quality in optimum spindle speed. The productivity of ring frame is directly related to the profitability of a spinning mill and also the productivity of a spinning mills is depends on the spindle speed of ring frame. So the profitability of a spinning mills depends on the spindle speed of ring frame [2]. But the higher spindle speed effect the quality of yarn as well as end breakage [3]. The yarn tension depends on the spindle speed for a specific traveler number. It is recommended to use light traveler for higher spindle speed and vice versa [2].

The yarn hairiness increases with the increasing of spindle speed [4]. The accurate setting of the spindle reduces the yarn tension and optimizes the production as well as quality of yarn. The yarn quality is determined by the analysis of yarn Uniformity%, IPI, Hairiness, strength and Elongation properties. So it is very important to select the spindle speed according to materials.

On the other hand the fibre properties directly related to yarn quality. Approximate 70 to 80% yarn quality depends on fibre properties like staple length, uniformity, short fibre contents, fineness, strength, elongation, maturity, etc. The yarn strength, elongation, U%, IPI and end breakage depends on fibre micronaire value which present the coarseness and fineness of fibre. So it is very important to select the fibre to get better quality of yarn. After all the spinning mills profit is depends on the proper selection of raw material with optimum spindle speed setting.

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2 Materials and Method

The Supima cotton fibre was selected for this research. The 100% Supima cotton fibre was analyzed in AFIS and recoded the data. Then this fibre was processed in spinning sequences Blowroom to Ringframe with same parameters. The 70Ne and 90Ne yarn produced from this process where the spindle speed was 17,328rpm and 19,080rpm respectively. The end breakages were noted in different spindle speed from dissimilar spindle at different length of yarn. Then the produced yarn analyzed in Uster Tester. Finally the yarn quality was compared and analyzed in different spindle speed of Ring frame.

3 Results and Discussion

Supima Cotton Fibre Properties

Supima cotton fibre was analyzed in AFIS and these fibre properties were presented in Table 01. This fibre used to produce 70 Ne and 90 Ne cotton yarn in different spindle speed and analyzed the quality of yarn.

Table 01: Fiber Properties

Fibre Properties	***Supima 100% Cotton***
Target Count	*70Ne and 90 Ne*
MIC (Micronaire)	*4.00*
MAT (Maturity)	*0.90*
UHML (Upper Half Mean Length)	*35.93*
ML (Mean length)	*31.12*
UI (Uniformity Index)	*85.97*
SFI (Short Fibre Index)	*5.59*
Strength	*41.23*
Elongation %	*6.87*
Moisture	*4.66*
Rd	*69.08*
+b	*12.22*

Yarn quality assessment

Supima cotton fibre used to produce 90Ne yan in spindle speed 19,080 and 20517. On the othe hand 70Ne yarn produced in spindle speed 17328 and 18932. This produced yarn analyzed in Uster tester-4 for assessing yarn quality as like U%, Hairiness and IPI. The uster yan quality test result presented in Table 02.

Yarn Unevenness (U %)

The variation of linear density along the length of a continuous stand or yarn is called unevenness[5]. Yarn unevenness directly affects the fabrics appearance. U% should be preferably around 12-15%. Table 02 Shows the U% and CVm% were increasing with the increasing of spindle speed for 90 Ne and 70 Ne.

Yarn Imperfection Index (IPI)

IPI is the Imperfection Index of yarns. An imperfection is the explanation for thin, thick places and neps in 1000m of yarn. For ring spun yarn imperfections of yarn refer to the total number of thin places (-50%), thick places (+50%) and neps (+200%) present per 1000 meter of yarn[6]. Table 02 shows the yarn IPI were increasing with the increasing of spindle speed for both count.

Yarn Hairiness

Hairiness is the total amount of fibers protruding from the structure of the yarn[7]. The yarn breakage was increasing with the increasing of yarn hairiness. Table 02 shows the increasing of yarn hairiness with the increasing of yarn hairiness for both counts.

Table 02: Uster Yarn quality test result

Count	*90 Ne*		*70 Ne*	
Spindle Speed	*20517*	*19,080*	*18932*	*17,328*
U%	*12.36*	*11.92*	*11.17*	*10.95*
CVm %	*15.10*	*14.54*	*13.41*	*13.91*
Thin -50%	*84.30*	*46.70*	*24.10*	*16.30*
Thick +50%	*98.30*	*81.40*	*71.30*	*64.90*
Neps +200	*164.40*	*159.90*	*135.60*	*124.70*
Hairiness (3-10 mm)/100m	*51.60*	*42.20*	*191.60*	*147.40*
Hairiness Index	*3.39*	*2.92*	*10.49*	*9.20*

IPI	*347*	*288*	*231*	*206*

Yarn Strength

The yarn strength test was done according to ISO 2062 and ASTM D2256 methods. These tests were used to determine the breaking force, elongation, and toughness properties of the yarn. The breaking tenacity and the ratio of the breaking force to yarn are linear density and also a common property for evaluating the strength of yarn. The Table03 present the decreasing of both count yarn strength with increasing of spindle speed.

Table 3: Yarn Strength test report

Count	*90 Ne*				*70 Ne*			
Speed	***High Speed (20517 rpm)***		***Low Speed (19,080rpm)***		***High Speed (18932 rpm)***		***Low Speed (17,328 rpm)***	
Particulars	***Mean***	***CV***	***Mean***	***CV***	***Mean***	***CV***	***Mean***	***CV***
Breaking Force	*143.18*	*13.18*	*180.19*	*9.90*	*179.89*	*9.96*	*180.14*	*10.02*
Elongation	*4.13*	*14.24*	*5.12*	*10.54*	*5.12*	*10.61*	*5.10*	*10.34*
Breaking Load (g/Tex)	*23.90*	*13.18*	*24.18*	*10.10*	*24.28*	*10.10*	*24.51*	*10.32*
Breaking Work	*146.6*	*25.3*	*207.2*	*19.2*	*208.1*	*18.1*	*211.3*	*18.1*

End Breakages and Idle Spindle

End breakage depends on the quality of fibre and yarn. Yarn strength, Elongation directly effect on end breakage. Table 03 shows that the yarn strength was decreasing with increasing of spindle speed. As like that Table 04 shows the end breakage, was increasing with increasing of spindle speed due to decreasing the yarn strength. The machine efficiency depends on end breakages as well as yarn strength.

Table 4: End Breakages and Idle Spindle

Particulars	*90 Ne*		*70 Ne*	
Speed	***High Speed (20517 rpm)***	***Low Speed (19,080rpm)***	***High Speed (18932 rpm)***	***Low Speed (17,328 rpm)***
End Breakages Rate %	*8.14*	*6.50*	*7.16*	*5.11*
Idle Spindle	*11*	*5*	*6*	*2*
Worst Spindle	*26*	*14*	*17*	*7*

4 Conclusion

The profit of spinning mills depends on the quality production. The quality production mainly depends on the knowledge of optimum spinning machine settings. These research presented that the yarn quality U%, IPI and yarn strength is directly depends on the Ring frame spindle speed. So the end breakage mainly depends on yarn strength and the end breakage directly affects the efficiency of machine. The spinning mills profit depends on efficiency of machine. After all the profits of a spinning mills depends on the optimum setting of spindle speed of a spinning mills. So the spindle speed should be adjusted according to the customer required yarn quality for optimum quality production.

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