ISSN 2515-8260 Volume 07, Issue 07, 2020

The Influence Of Top Flat Speed Of Carding Mashine On The Sliver And Yarn Quality

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Abstract: Processing parameters play an important role in influencing the quality of the final product in any kinds of production. The aim of this project is to observe the quality of the carded sliver and yarn by applying different flat speeds on the carding machine while the other machine parameters were fixed. Five flat speeds (200, 240, 280, 320, and 360 mm/min) have been used to produce slivers and yarns. Sliver fineness of Ne0.11 and yarn of two different counts (Ne20 and Ne30) were produced for assessing the quality. The unevenness and tensile properties are found to be best for flat speed 360 mm/min with significant increasing of waste percentage.

Keywords: Flat speed, carded sliver, carding process, carded yarn, neps, unevenness, strength, carding action

1. INTRODUCTION

Spinning is considered the basis of all textile production, and the process of carding is the heart in spinning technology [1]. In the process of carding, the speed of the flats is responsible for cleaning and removing short fibers; the frequency of rotation of the main cylinder affects the individualization and orientation of the fibers; The speed of the liker-in affects the removal of neps and can also lead to fiber damage. The study of all these parameters plays an important role in achieving the best quality in the production of carding sliver [2]. Fats act to open and separate the bundles into separate fibers, and form a uniform continuous sliver [3].

Setting the parameters of the carding machine play an important role, and the slightest change in the settings will be sufficient to produce improved quality of card sliver [1]. So it is, as a rule, the quality of the yarn very much depends on the quality of the sliver.

Over the past three decades, various improvements have been observed with cotton. Peng-zi and Jing-dang [5] studied the effect of the suction wind flow on the operation of the cotton weave cleaner on the carding machine on the quality of the carding sliver and the result shows that under conditions of neither too much nor too little wind flow, the back plate is favorable for the quality of the carding sliver. Jing-dang also worked on influencing the quality of the yarn in the position of the cotton weave cleaner on the enclosing rear cover of the carding machine [9].

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This article was devoted to changes in carding elementary technological parameters of machines for the production of higher quality carding sliver, as well as yarn. Among the many variable parameters of the machine, that is, the speed of the main cylinder, the speed of the flats, the speed of the liker-in, the speed of the feed and the speed of delivery, but in our example we worked on the influence of the speed of the flats, while all other parameters were fixed.

From the literature it was revealed that the parameters of the whole process have a significant effect on the intensity of carding of the fibers, damage to the fibers, and the reduction of short fibers and impurities. Therefore, the selection of a suitable flat speed also plays an important role in the quality of sliver and yarn. Therefore, in this work an attempt was made to study and analyze the effect of the speed of the flats on the carding sliver and the properties of the yarn, while other process parameters remain the same.

2. EXPERIMENTAL WORK.MATERIAL.

Fiber samples were selected for transitions in the process with fluid materials by random sampling at the spinning mill of URG TEX LLC. Cotton samples were tested in laboratory equipment using the AFIS and HVI systems [2]. The investigated properties of the cotton fiber sample are shown in Table 1.

Samples for researching a card sliver with linear density Ne-0.100 and yarn of two different numbers (Ne 20 and Ne 30) were developed.

Table 1.

Physical-mechanical properties of cotton fiber determined on systems USTER AFIS and HVI

Properties	Values
Total NepsCnt (cnt/g)	265
Micronaire value (µg/in)	4.30
5% L(n)	34.2 mm
UHML (upper half mean length)	28.20 mm
Tenacity	29.30 g/tex
Yellowness (+b)	9.28
Reflectance (Rd)	81.22
Maturity index	0.82
Uniformity index (%)	81.60
Elongation (%)	7.10
Short fiber index (%)	6.77

3. METHOD.

*Carding process:*in the process of carding, various flat speeds were used on the carding machine (Truetzschler TC-15), while other machine parameters were fixed. Five different speed modes of flats (200, 240, 280, 320 and 360 mm / min) were used for the production of card sliver and yarn. The technological process of carding is shown in table 2.

*Spinning process;*in the spinning process, Zinser 72 model ring spinning machines were used for yarn production. Cotton yarn numbers Ne 20 and Ne 30 were produced from roving

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number Ne 0.80. Important technological parameters of the spinning process are shown in table 3.

*Neps and Short Fiber Count (SFC).*The short fibers in quantity and weight, the number of neps and the cleaning efficiency of the neps on the card sliver were tested using the Uster AFIS PRO laboratory equipment for each changed flat speed. For each flat speed, 10 readings were taken and the average values calculated.

Table 2.

The technological process of the carding machine.

Item of parameter	Values
Feed speed	500-600 g/m
Taker-in speed	1250 r/min
Cylinder speed	520 r/min
Flat speed	200/240/280/320/360(mm/min)
Delivery speed	200 m/min
Total number of flats in rotation	99
Cylinder to flat distance (in five different positions from back to front	position 1: 250 position 2: 250 position 3: 220 position 4: 220 position 5: 200

Table 3.

Important process parameters for the spinning process.

ITEM	**Machine parameters**	
	Ne30	**Ne20**
Drawnsliver hank	Ne0.115	Ne0.115
Roving hank	Ne0.80	Ne0.80
Twist per meter	44	44
Ring frame speed (RPM)	17000	16000
Twist per inch	19.36	18.21
Drafting arrangement (ring frame)	3 on 3	3 on 3
Draft (ring frame)	42.85	30.28
Doubling (breaker draw frame)	6	6
Doubling (finisher draw frame)	8	8

*Irregularity and defects (IPI).*Uster Tester-5 laboratory equipment was used in the production of carding sliver samples to determine irregularities. Five cans with card slivers were prepared to determine the unevenness of the sliver. Which were randomly selected for each flat speed, and uniformity indicators (U%) were taken from each pelvis for 10 samples. The average value for the unevenness (U%) of the tape was calculated from 50 individual indicators. To determine the unevenness of the yarn, eight ring yarn spindels were worked out, which were tested for each flat speed process, and the average value was calculated.

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IPI denotes common defects of yarn, which is a description for thick places, thin places and neps in the 1000 m section of yarn and for ring spinning yarn according to the IPI definition the following values are taken;

Thick places (+ 50%), Thin places (-50%) and neps (±200%)

*Number and strength.*The linear density (number) of the yarn was determined using laboratory equipment, AUTO SORTER-5, which automatically gives evidence. Yarn samples were also tested in the TEXTECHNO tester to measure the strength of a single yarn. All tests were performed under standard laboratory testing conditions.

(temperature: 20 ± 2 ° C and relative humidity: 65 ± 2%) [10].

*The flats comb.*Short fibers and particles of impurities that are removed between the main cylinder and the flats are called a "flat comb." Fibers that are deeply embedded in the flats cannot be reached by the teeth of the main cylinder and also become a flat comb.

4. RESULT AND DISCUSSION.

*The content of Neps and NRE% (Nepsremoval efficiency) on the carding sliver.*In fig. 1 (a) and (b) show the content of neps / gram and NRE% on the carding sliver, respectively, for different flat speeds.

It was revealed that with an increase in the speed of the flat, the content of neps decreases, and NRE% increases. It was found that at flat speeds of 200, 240, 280, 320, and 360 mm / min, the content of neps / gram and NRE% was 88, 82, 77, 66, as well as 59 and 63, 67, 73, 77, and 83, respectively.

One of the reasons why the number of neps has been reduced is that when the speed of the flat increases, more and more flats come into contact with fiber processing activities which contribute to a reduction in neps. In addition, on the frame of the carding machine there is a cleaning roller mounted on top of the flats for cleaning. As speed increases, more and more flats come into contact with the cleaning roller at a time, which improves the cleanliness of the flats and leads to a better carding action.

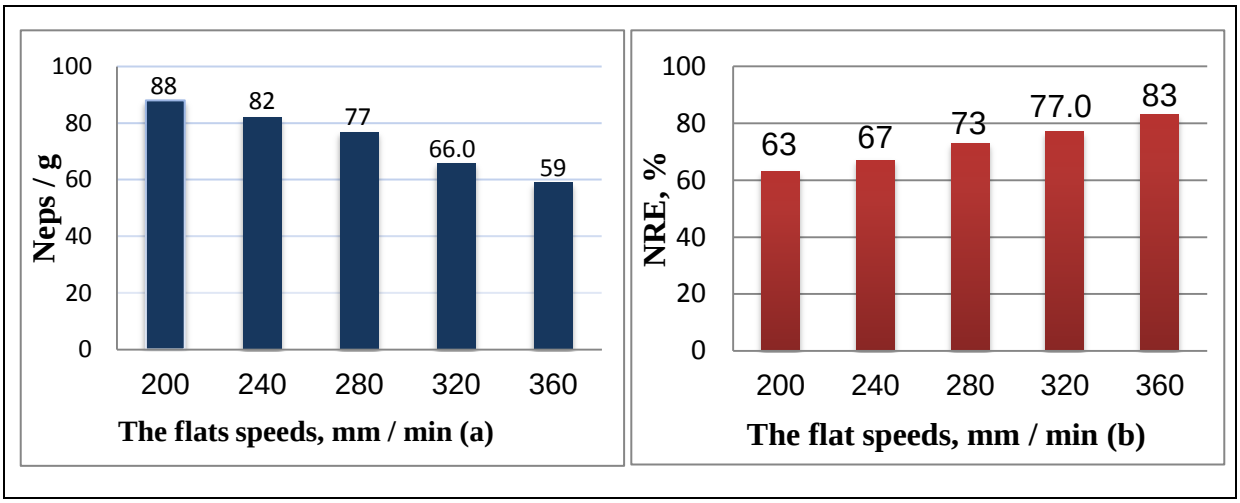

Fig. 1.The effect of the speed of the flats on the removal of Neps / g. and Neps removal efficiency, NRE%.

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*Short fibers on the card sliver.*Figure 2 (a) and (b) show that there was a significant decrease in the content of short fiber in the carding sliver with an increase in the speed of the flats. We observe that when the flat speed was 200 mm / min, the short fiber content in terms of SFC (n) was 23.5 and the short fiber content in terms of SFC (w) was 8.3.

Whereas when the flat speed was increased to 360 mm / min, the short fiber SFC (n) decreased to 13.25% as 19.6 and SFC (w) also decreased to 26.5% as 6.2. As the speed of the flats increases, more flats come into contact with the fiber, which eliminates more short fibers, and therefore a better carding action occurs.

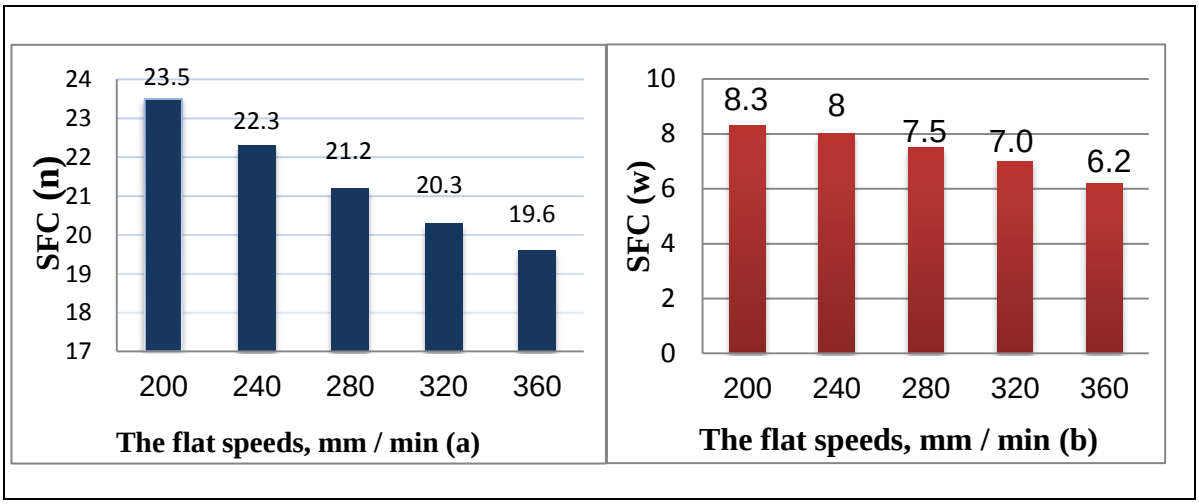

Fig. 2.The effect of flat speed on short fibers by the amount of SFC (n) (a) and short fibers by weight of SFC (w) (b).

*Unevenness of a carding sliver.*The unevenness values (U%) and unevenness coefficient (CV%) of the carding flat are shown in Figure 3 (a) and (b). With an increase in the speed of the flats 200, 240, 280, 320 and 360 mm / min, the index of the carding sliverdecreases by U% and CV% which are 3.25, 3.08, 2.75, 2.61 and 2.47 and also 4.13, 4.06, 3.67, 3.46 and 3.1 , respectively, show a decreasing trend. U% and CV% decrease to 24% when the flat speed increases from 200 to 360 mm / min.

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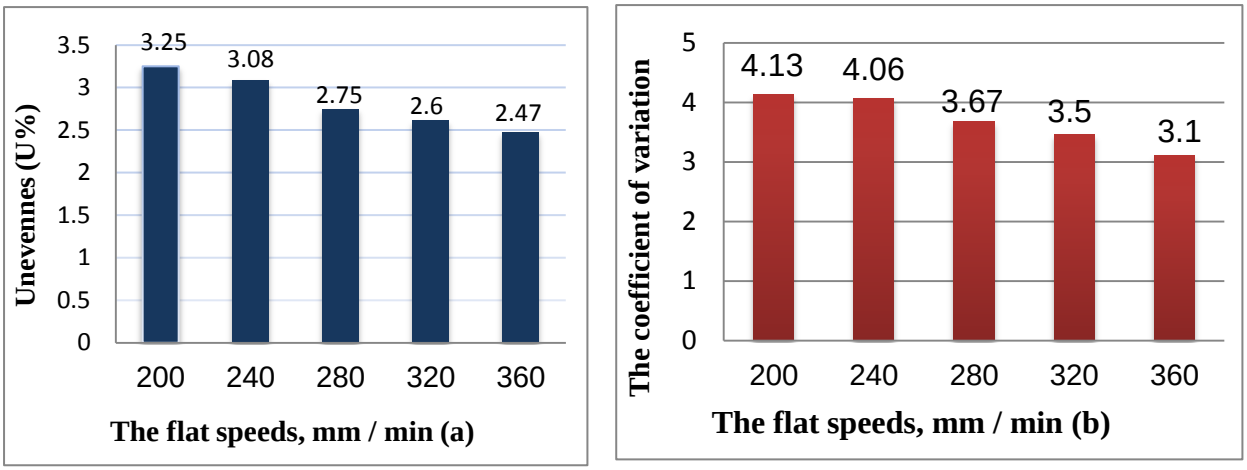

Fig. 3.The effect of the speed of flats on unevenness (U%) and on the coefficient of variation (CV%) of the carding sliver.

*Unevenness of yarn.*The unevenness (U%) of the yarn yarn of linear density Ne20 and Ne30 are highlighted in Figure 4. At this stage, there is a clear tendency to reduce the unevenness of the yarn with an increase in the speed of the flat. From the figures shown, Ne30 yarn displays a higher level of unevenness than Ne 20 yarn. When the flats speed increases, the Neps content and the content of short fibers increase, and the parallelization of the fiber also increases, thereby reducing unevenness. Regardless of the speed of the flat, the unevenness of the yarn increases as the yarn becomes thinner as expected.

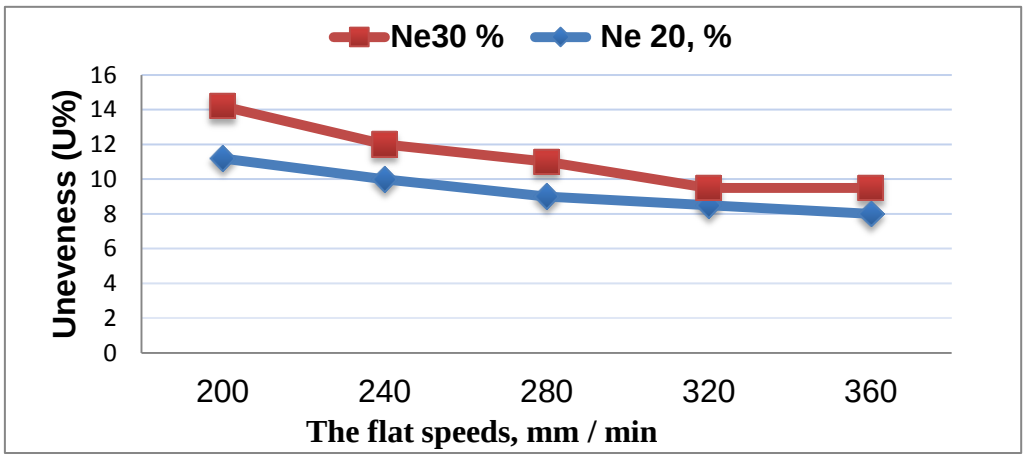

Fig 4.The effect of the speed of the flats on the unevenness of the yarn Ne20 and Ne30. Defects and defects of yarn (IPI). Figure 5 (a) to (d) depict yarn defects. Here we look at thick places, thin places and Neps.

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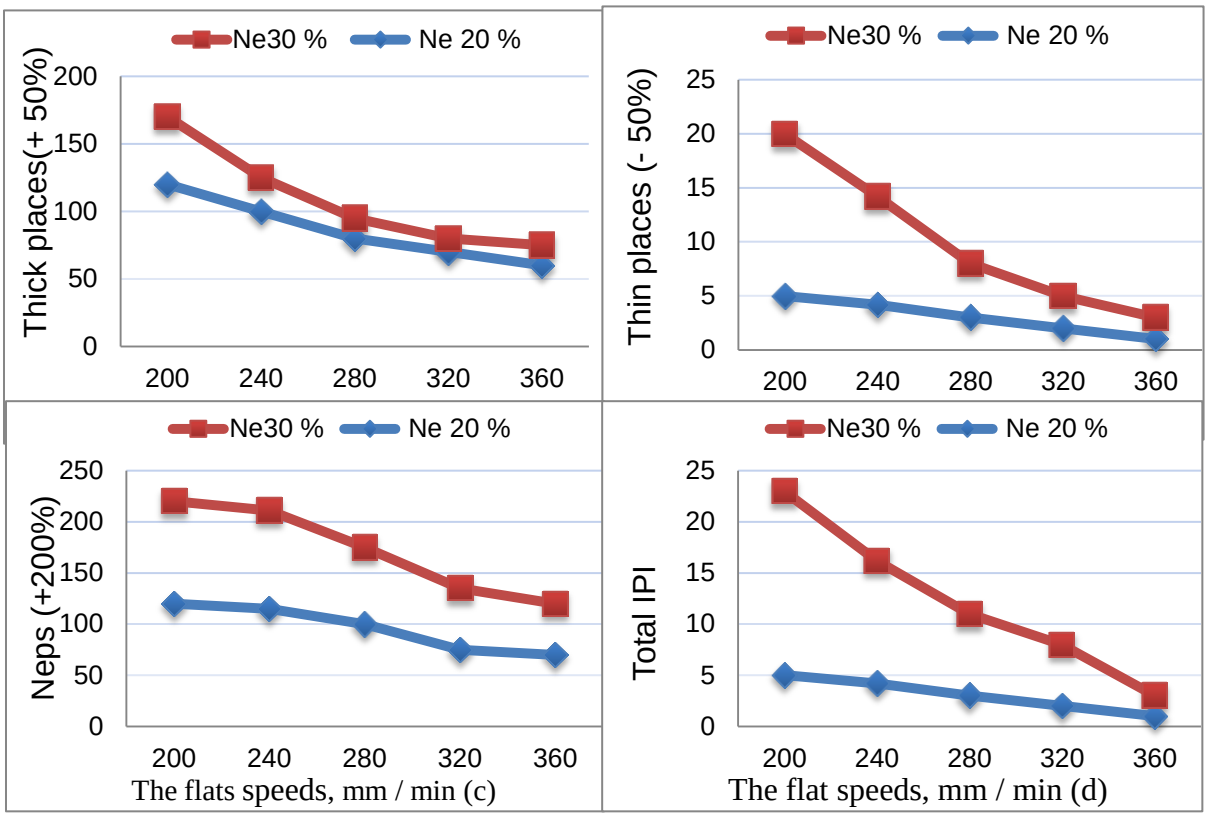

Fig.5 The effect of the speed of flats on IPI value: thick, thin places and neps.

In all cases, it has been clearly shown that defects in yarn decrease with increasing speed of the slivers for both Ne20 yarn and Ne30 yarn as well. In general, we also investigated the value of IPI and found the same results. The reason for this result is simple, as the speed of the flats of the carding machine increases, the action of carding (removal of weed impurities, neps, short fibers, etc.) will be more intense. As a result, the degree of parallelization of the fiber will also be greater, which will reduce the variation in changes in the thickness of the sliver and yarn. Thus, defects and defects (thin places, thick places and neps) were reduced.
Strength and relative breaking force (cN / tex). Figure 6 shows the significant effect of increasing the flat speed on yarn strength. Using the graphs, we investigated that a consistent increase in the intensity of the flat speed of the carding machine increases the strength and relative breaking force (cN / tex).

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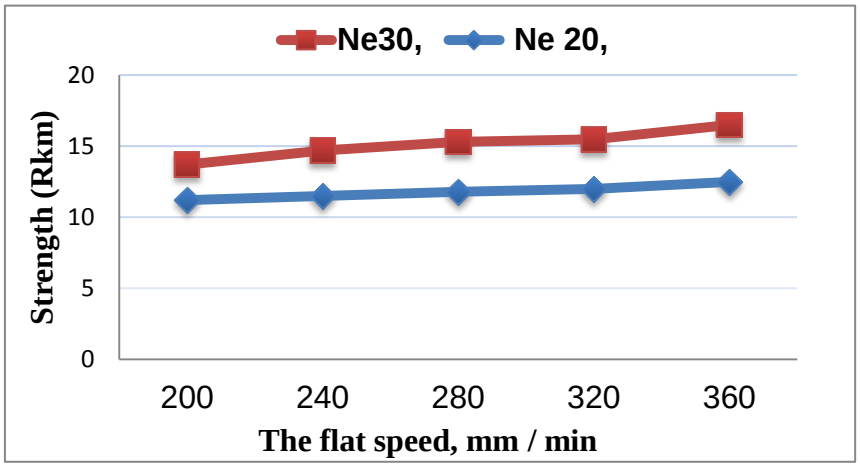

Fig. 6.Effect of flat speed on yarn strength (Rkm) / cN / tex.

The graphs show a 21.5% and 15.2% increase in strength for Ne24 and Ne30 yarn, respectively. From these results, it can be assumed that there is a relationship between the speed of the flats and the strength of the yarn. Perhaps this can be explained by the fact that by increasing the speed of the flat of the carding machine, short fibers and unevenness are reduced. Therefore, the contraction of uncontrolled fiber, uniform twist and a large migration of fibers leads to an increase in the strength of the yarn.

5. CONCLUSIONS.

This scientific work was investigated to optimize the appropriate speed of the flat of a carding machine for the production of cotton carded yarn and to evaluate the quality of the final products. The study determined that carded yarn made at high flat speeds provides the best quality. The content of short fiber and neps on the carding sliver at the highest flat speeds is lower than at other speeds. This is due to the large difference in the speed of the flats, which leads to an improvement in the effect of carding. Sliver and yarn unevenness decrease when yarn strength increases as the proportion of flat speed increases. Ne20 cotton yarn is of the highest quality than Ne30 yarn, but both graphs showed a similar trend with an increase in hat speed. Although the flat speed at 360 mm / min shows significant improvements in the quality of the sliver and yarn, this study recommends 320 mm / min as the appropriate flat speed, as a further increase in speed causes a significant amount of fiber loss, which can increase production costs. The main results of this study suggest that yarn with good quality in a spinning mill can be achieved due to the higher speed of the flats.

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