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EFFECT OF SPEED OF OPENING ROLLER AND ROTOR ON THE QUALITY OF OPEN END YARN

FIREHIWOT TSEGAW WALELIGN

ETHIOPIAN INSTITUTE OF TEXTILE AND FASHION TECHNOLOGY

BAHIR DAR UNIVERSITY

June, 2018

EFFECT OF SPEED OF OPENING ROLLER AND ROTOR ON THE QUALITY OF OPEN END YARN

BY

Firehiwot Tsegaw Walelign

A Thesis Submitted to the

Ethiopian Institute of Textile and Fashion Technology

InPartial Fulfillment of the Requirements for the Degree of

Master of Science

In

Textile Manufacturing

Under the supervision of

Asst. Professor: Addisu Ferede

ETHIOPIAN INSTITUTE OF TEXTILE AND FASHION TECHNOLOGY

(EiTEX)

BAHIR DAR UNIVERSITY

Bahir Dar

(June, 2018)

ABSTRACT

The speed of opening roller and rotor of a rotor spinning machine are among various parameters which can influence the quality of spun yarn. Different Opening roller and rotor speed have been used for the production of 20 Ne 100% cotton carded yarn at Bahir dar Textile Share Company to caryout this research work. Strength, elongation, twist amount, and evenness have been investigated for all the samples. Based on the result the optimum opening roller speed(8800rpm) and rotor speed (80000 rpm) for yarn tenacity, twist and unevenness, Where as for yarn elongation the opening roller speed (8800rpm) and rotor speed (75000rpm) values are suitable for 20/1 Ne. When the opening roller speed increase up to 8800rpm and rotor speed 80000rpm to improve yarn properties such as (tenacity, elongation, twist and imperfection).

Key words: opening roller speed, rotor speed, yarn tenacity, yarn elongation, yarn twist, yarn mass uniformity, yarn imperfection.

APPROVAL

I certify that I have supervised/read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in quality and scope, as a thesis for the fulfillment of the requirements for the degree of Masters of Science.

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External Examiner	Academic status	Signature

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Internal Examiner Chairman (Examination Committee member)	Academic status	Signature

This thesis was submitted to the Ethiopian Institute of Textile and Fashion Technology, Bahir Dar University and is accepted as fulfillment of the requirements for the degree of Masters of Science.

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DECLARATION

I hereby declare that the thesis is submitted in fulfillment of the Master's degree is my own work and that all contributions from any other persons or sources are properly and duly cited. I further declare that the material has not been submitted either in whole or in part, for a degree at this or any other university. In making this declaration, I understand and acknowledge any breaches in this declaration constitute academic misconduct, which may result in my expulsion from the programme and/or exclusion from the award of the degree.

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Signature of Candidate: ________________

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This is to certify that the thesis entitled "Effect of speed of opening roller and rotor on the quality of open end yarn" submitted in partial fulfillment of the requirements for the degree of Master's with specialization in **Textile Manufacturing**, the postgraduate studies Program of the Ethiopian Institute of Textile and Fashion Technology and has been carried out by **Firehiwot Tsegaw** ID. No **MTM/R/005/09**, under my supervision. Therefore I recommend that the student has fulfilled the requirements and hence hereby can submit the thesis to the Institute.

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I hereby certify that all the corrections and recommendation suggested by the Board of Examiners are incorporated into the final Thesis entitled "Effect of speed of opening roller and rotor on the quality of open end yarn" by Firehiwot Tsegaw.

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I would like to express my deep appreciation for my adviser,Ass.prof.Addisu Ferede, who I feel honored to study with, for his constant guidance, encouragement, support and fatherly care during my thesis.

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Firehiwot Thegaw Walelign

June 2018

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ABBREVIATIONS

- GLM :General Linear Model
- HVI : High Volume Instrument
- SPSS : Statistical Package for the Social Sciences
- TPM : Turns per meter
- NE: English cotton count
- RPM: Revolution per minute
- U%: Yarn uniformity
- CV%: Coeifficent of mass varation
- IPI: Imperfection index
- CN/Tex: Centi neuton per tex
- Cm: Centimeter
- BDTSC: Bahir Dar textile shear company
- EiTEX:Ethiopian institute of textile and fashion technology
- ASTM: American society of testing material

CHAPTER ONE

INTRODUCTION

1.1. Background

Nowadays, due to the advancement of spinning technology,there are many spinning systems available such as ring spinning, air vortex spinning, friction spinning, disc spinning, solo spun spinning, siro spinning, air jet spinning, wrap spinning and rotor spinning(Klein 1995). The best process of producing better quality yarn from very poor grade of cotton and even from wastage is rotor spinning.

Rotor spinning system rising due to the considerable reduction in space and personnel(Klein 1995, Ahmed, Syduzzaman et al. 2015). The volume of production on rotor spinning has also increased in recent years which are quite understandable considering the present trend in the production and consumption of textile products. Rotor spinning gives new era to produce more uniform, fuller, aerated and regular in strength cotton yarn(Nawaz, Jamil et al. 2003). Rotor spinning is cognized spinning system mainly for medium and course counts.

The yarn characteristics of rotor spun yarn are affected by many factors mainly related to raw material, machine and processing parameters. Many researchers have already studied the effect of rotor and carding parameters on yarn quality from different outlooks(Manohar, Rakshit et al. 1983, Salhotra and Balasubramanian 1985). The results of several investigations have revealed that machine parameters significantly affect the physical and mechanical properties of yarn(Özdemir and Oğulata 2011).

Rotor yarns are less irregular compared to the ring spun yarn because of multiple doubling or back doubling of fibers in the rotor groove. In addition, rotor spun yarns are not as affected by roller drafting wave as ring yarns [2].Widely used natural fiber in the world around 35% of total world fiber is cotton which provides the natural comfort, soft hand, durability, visual appeal, good absorbency and reasonable strength and these are the main reasons for selecting cotton fabrics in this study.

The objective of this experiment is disclose the effect of rotor speed from 75,000 to 90,000 rpm and opening roller speed from 7800 to 9800rpm on yarn characteristics and produces the quality cotton yarn by using rotor spinning system that can be used for weaving and knitting fabrics.

Yarn quality basis on CV%, IPI,Tenacity, and opening roller speed on yarn characteristics and produce the quality cotton yarn by using rotor spinning system that can be used for weaving and knitting fabrics. Yarn quality basis on coefficient of mass variation (CV%), imperfection index (IPI), Tenacity and force at break properties will be investigated. The efficient opening at blow room stage not only improves fiber cleaning but also yarn properties such as yarn tenacity and total imperfections(Ahmed, Saleemi et al. 2014).

1.2. Justification

The various factors cause the variation of yarn quality such as fiber causes, operator cause, air conditioning and machine causes. The Fiber causes are fineness, elongation, strength, length, micronier value, maturity and color, air-conditioning relative humidity and temperature.Where as, the machine cause, opening roller speed, rotor speed, rotor type and diameter.

Different scholars studied and investigated the effect of fibers, air conditioning, operator causes, and some of machine causes on yarn quality and properties. From the machine causes some researchers showed that the effect of opening roller and rotor speed on yarn quality. But this research work is unique due to different raw materials, working conditions. So this research work concern the effect of opening roller and rotor speed on yarn properties and qualities such as strength, evenness, twist amount, elongation and mass variation percentage .In this thesis work to select different opening roller and rotor speed and their influence on the quality of cotton yarn by carrying out proper testing and analysis from the produced sample yarn.

1.3. Statement of the problem

During my survey at Bahir dar Textile Share Company, The problem found that the company used different speeds of opening rollers and rotors for a particular yarn and aslo ignorant about their associated effects on the quality of the open end spun yarn. This thesis was designed to creat awareness and suggests possible solution.

1.4. Scope of the research

Even though there are many factors affecting quality of yarn such as raw material, processing parameters, type of recycled waste and related, this research work is focused on effect of speed of opening roller and rotor on the quality of open end yarn at BDTSC.

1.5. Objectives:

The general objective is to inivestigate the effect of varying opening roller and rotor speeds for a particular yarn and set the optimum value for production of better quality open end spun yarn.

Accordingly, the following specific tasks will be carried out:

- To study the effect of opening roller speed on the properties of 20Ne open end cotton yarn
- To study the effect of rotor speed on the properties of 20Ne open end cotton yarn
- To optimize the opening roller speed for 20Ne open end cotton yarn
- To optimize the rotor speed for 20Ne open end cotton yarn
- To create awareness on the effects of opening roller and rotor speed on yarn quality.

1.6. Benefits and Beneficiaries

1.6.1. Benefits

The benefits of this thesis work are directly related

- To satisfy the customer and increasing income with proper yarn quality and properties.
- To understand the effect of opening roller and rotor speed on yarn quality and property.
- To reduce production cost.
- To increase rotor life span

1.6.2. Beneficiaries

The major beneficiaries of this thesis work are;

- Industries which produce yarn with varying opening roller speed frequently faces problem on the quality and properties of the output.
- People who work on yarn producing |open end machine
- The weaving operator
- Eitex

CHAPTER TWO

LITERATURE REVIEW

2.1. Technology of Rotor spinning

Rotor spinning, which was invented in 1965, has a high percentage of production around the world(Klein 1995). Nowadays, this spinning process still has a large production in the world, because, compared with ring spun yarn, rotor spun yarn has the advantage of good evenness, less count variation and imperfections. Furthermore, rotor spinning, compared with ring spinning method, exhibits less energy cost because of less machinery involved in the yarn production process. Also, yarn breakage rate in rotor spinning is lower. This fact enhances production and yarn quality.

The rotor spinning process involves opening and cleaning of cotton lint in blow room and carding. Further lint processing, includes more opening, cleaning and drafting using draw frames and rotor spinning machine is done to get the final yarn product.

The open-end rotor system is the only real alternative to ring spinning for producing coarser yarn counts with the successful processing of fibre at significantly higher speed(Klein 1995). The basic principle involves the separation of the sliver fed in to individual fibres, which are gathered on the collection groove of the rotating rotor, inserting twist into the fibres.The yarn produced is then taken up onto a cross wound package, eliminating theneed for a separate winding process, as in ring spinning. Compared with ring spinning, open-end spinning has the following advantages(Ahmed, Syduzzaman et al. 2015):

- Elimination of some processes, such as roving and winding,
- Lower yarn fault content,
- Lower power consumption per kg of yarn produced for short staple yarn

- Cheap raw material is available and there is less waste,
- Larger delivery package size,
- Reduced labour requirements and open to automation,
- Higher speed of twist insertion and delivery speed up to 200 m/min,

2.2. Operational principle of rotor spinning

At the rotor spinning machine, the input material is the draw frame sliver (see Figure21). Firstly, drawn slivers were feed through a sliver guide via a feed roller and feed plate to rapidly rotating opening roller. The rotating teeth of the opening roller comb out the separate fibers from the sliver clamped between feed plate and feed roller. Then the fibers were feed to inside wall of the rotor after completing action in transport channel. The fibres moved forward to the rotor groove from the conical rotor wall by centrifugal forces in the rapidly rotating rotor. Finally, the yarn formed in the rotor is continuously taken off by the delivery shaft and the pressure roller through the nozzle and the draw off tube and wound onto a cross wound package(Palamutcu and Kadoğlu 2008).

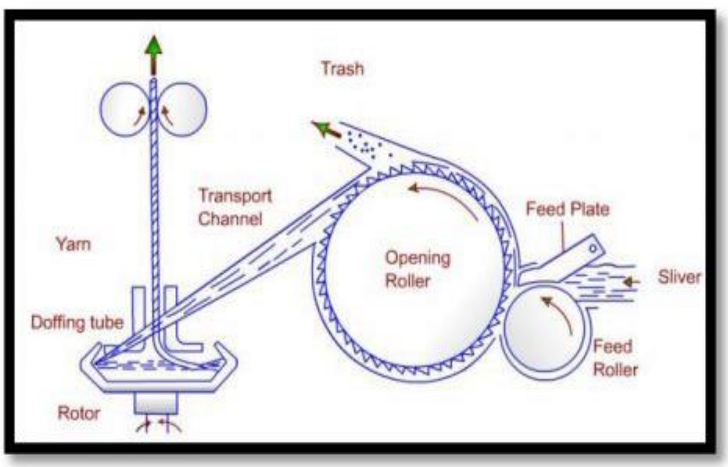


Figure2. 1.Passage of material through open end machine

Most of the quality defect and production problems appeared during the yarn manufacturing process could eventually cause various limitations for further textile processes including weaving, knitting, and tailoring. Rotor spun yarn can be affected by raw material and their properties, yarn properties and machine parameters.

2.3. The relationship of opening roller speed on open end yarn quality

The main purpose of the opening roller is to open the fiber sliver to individually aligned single fibers. The efficiency of the opening fiber on the roller surface depends on the total opening force affecting the fibers, caused by the opening roller tooth. Well straightened, aligned and parallelized fibers of the opened sliver are expected to build twisted rotor yarn bodies(Palamutcu and Kadoğlu 2008) efficiently.

There are two kinds of opening rollers: the pin roller and saw-toothed roller. The saw-toothed roller can be made of garnet wire mounted or of a multiple leaf saw-toothed assembly. The specification and speed of the opening roller are important factors which influence combing effects(Nibikora and Wang 2010). It can be seen that along with an increase in opening roller speed, the degree of fiber separation improves. A pin roller is better than a saw-toothed roller, especially in low speed conditions.

The contents of short fiber will increase when the speed of the saw-toothed roller increases; however, there is no change when the pin speed increases. Nevertheless, it needs an advanced manufacturing technique and is hard to make(Gnanasekar, Chellamani et al. 1990). The parameters of the saw-toothed roller are the wire work angle, wire-wedge angle, wire-rear angle, the tooth height, the tooth depth and the tooth density.

The main factors influencing combing effects are the wire-work angle and tooth density. For spinning different materials, various types of saw toothed roller must be used. Several choices exist for the opening roller wire. The wire most used in the industry is saw-tooth shaped and hardened with diamond and nickel. Depending on the fibre being used, the angle of the wire is selected to allow for the most effective combing and fibre removal.

Several studies have been published on the effect of opening roller clothing in rotor spinning. The main findings relate to the angle of the tooth and point density required to obtain effective fiber separation with minimal fiber breakage. It was reported that there is a marked increase in twist efficiency with an increase in opening roller speed. The increase in twist efficiency is the result of a decrease in the percentage of sheath fibres.

Greater fiber separation at higher opening roller speeds reduces the possibility of some fibers becoming wrapper simply because they happen to entangle with the fibres undergoing belt formation. The slightly increased number of twists at high opening roller speeds can be attributed to the high degree of fiber separation at high speeds. The teeth shape and number of teeth on the surface coating material are important features affecting the opening force and opening efficiency of a sliver on a rotor spinning unit.

Increasing the opening roller speed raises fiber separation efficiency and maintains a better twist insertion rate(Vigo and Barella 1981).according to Reiter standard the range of opening roller speed shows in table 2.1.

Table 2.1.opening roller speed(Klein 1995)

Opening roller speed										
Opening roller revolutions [1/min]	5000	5500	6000	6500	7000	7500	8000	8500	9000	10000
Discharge of impurities from the sliver										
Removal of fibres from the covering										
Fibres opened up more										
Fibre treated more care-fully										

Considering rotor speed, higher speeds creates a strain in the yarn which in return reduces elongation. Other factors which affect yarn tensile properties of rotor spun yarn include preparation of the feed material and opening roller speed(Khan and Rahman 2015).

Acal et al(Ülkü, Acar et al. 1993)study the effects of opening roller speed on the fiber and yarn properties in open-end Friction Spinning. Acal et al showed that the opening roller in an open-end spinning system causes fiber damage of varying degrees, differing from one material to another. As the speed of the opening roller increases, fiber breakage becomes higher. The choice of the opening roller speed can therefore significantly affect the resulting yarn properties. There is much deterioration in the yarn when it is processed at high opening roller speeds. This deterioration is mainly detected in yarn tenacity, elongation, evenness, and imperfections due to high fiber breakage and low fiber straightness.

On the other hand D. Parsi, et al (Persi, Chaitali et al. 2011*)* studied the effect of opening roller speed and torque stop on open end yarn quality; they showed that as the opening roller speed is increased the yarn quality parameters are found to be improved. As the opening roller speed increases up to optimum level the fibers are more opened and individually fed in to the transport duct so far it will improves the yarn quality by removing the trash & dust. Arain *et al(Arain, Tanwari et al. 2012)* showed that the effect of yarn count, yarn twist, opening roller speed and rotor speed on yarn tensile properties was investigated by the effect of single factors showed that yarn strength decreased with increase in count and opening roller speed but increased with increase in twist and rotor speed while elongation decreased with increase in count but increased with increase in twist, roller speed and rotor speed up to certain specified values and then reduced.

2.4. The relationship of rotor speed on open end yarn quality

Rotor speed is an essential parameter as it influences productivity of the machine. High rotor speed upshots in increased productions, as yarn delivery increases with increasing rotor speeds which in turn facilitate the manufacturer to compete in international market(Khan and Rahman 2015).

In the course of development, rotor speeds have been increased from approx. 30,000 rpm originally to160,000 rpm today. However, this has only been possible by simultaneously reducing rotor diameter. Economical running behavior can only be achieved by keeping in observation the effects of process parameters on yarn properties and raw material(Arain, Tanwari et al. 2012).According to Reiter standard the range of rotor speed corresponding to the yarn count see table 2.2.

Table 2.2 rotor and caps for the C120 spinning box(Klein 1995)

Rotor type	Cap	D (mm)	Angle α	R (mm)	H (mm)	Recomend-ed speed (1000/min)	Surface finish	Yarn (Tex) (Ne)	Processed material
C531/R-D	C5 with pin	31	33	0,2	11	100-110	D	14,5-36 40-16,4	Cotton, VSs,Blend, PAN
C531/T-D	C5 with pin	31	40	0,2	11	100-110	D	14,5-36 40-16,4	
C533/U-D	C5 with pin	33	45	0,3	11	80-110	D	14,5-60 40-10	Cotton, VSs,PESs, Blend, PAN
C533/T-D	C5 with pin	33	40	0,3	11	80-110	D	14,5-60 40-10	
C536/U-D	C5 with pin	36	45	0,3	11	75-95	D	16,5-72 35-8	
C338/U-D	C3 with pin	38	45	0,3	11	65-85	D	20-100 30-6	Cotton, VSs,PESs, Blend, PAN, Regenerated fibres, waste
C341/U-D	C3 with pin	41	45	0,3	11	60-80	D	20-120 30-5	
C344/U-D	C3 with pin	44	45	0,3	11	50-70	D	20-120 30-5	
C248/U-D	C2 with pin	48	45	0,3	11	45-65	D	20-150 30-4	
C248/S-D	C2 with pin	48	35	0,3	11	45-65	D	20-150 30-4	
C250/U-D	C2 with pin	50	45	0,3	11	40-65	D	20-150 30-4	
C254/U-D	C2 with pin	54	45	0,3	11	40-60	D	20-200 30-3	

Many researchers reported that the influence of rotor speed on yarn properties. Like, Roudbari found that fiber orientation deteriorated with increase in rotor speed, rotor diameter and use of grooved navel(Arain, Tanwari et al. 2012). Koc and Lawrence also reported formation of Wrapper fibers at higher rotor speeds because of augmented centrifugal force(Koç, Lawrence et al. 2005). On the other hand increment in Yarn Production was observed at higher rotor speeds, which turned down with increase in yarn twist at same rotor speed(Hasani and Tabatabaei 2011).

It has also been reported that knit ability of open end yarns affected as rotor speed and fiber denier increased. According to Arain et al(Arain, Tanwari et al. 2012)rotor speed affects yarn tenacity, elongation and regularity in a linear manner. While Manohar, Rakshit and Balasubramanian concluded that, rotor speed had insignificant effect on yarn strength however,elongation brought down steeply with increase in rotor speed (Manohar, Rakshit et al. 1983).Ahmed et al(Ahmed, Saleemi et al. 2014) considered the effect of rotor speed and count on the properties of rotor spun yarns Vila and Trajkovic(Gnanasekar, Chellamani et al. 1990) stated that rotor speed,rotor diameter and preparatory process influenced hairiness of rotor yarns. Whereas Ahmedand Palamutcu(Palamutcu and Kadoğlu 2008) found that rotor speed, fiber type and twist factor are the most important parameters, that affects twisting efficiency of pure cotton and cotton/polyester blended rotor yarns.

Table 2.3 Production related setting parameter(Klein 1995)

Rotor speed	30,000-160000Rpm
Opening roller speed	5 000 - 10 000 rpm
Delivery speed Cylindrical	up to 350 m/min (240 rotors) up to 270 m/min (500 rotors)
Delivery speed, conical	up to 60 m/min (500 rotors)
Package weight, cylindrical	up to 6 kg or 350 mm diameter
Package weight, conical	up to 270 mm diameter

Rotor spun yarn can be characterized by measuring yarn tensile properties (strength and elongation), yarn evenness and imperfection (neps, thick and thin places). The factors which affect the tensile properties of cotton rotor spun yarns include, cotton fiber properties, yarn properties and machine parameters. Therefore for a given cotton lint, the spinner needs to consider a wide variety of cotton properties, yarn and machine parameters. The general approach is to consider a few selected factors and then keep the other factors constant as an investigation is carried out on the quality parameters of rotor spun yarns.

Most researchers have considered rotor speed, opening roller speed, rotor diameter and carding conditions, but all considered at least one value at a time or at most three factors(Koç, Lawrence et al. 2005, Furter 2009). While previous works have given an insight on the influence of rotor spinning parameters on rotor spun yarns more investigations needs to be done so as to further improve the quality properties of rotor spun yarns.

This study therefore aimed that investigating the effect of opening roller speed and rotor speed on 20Ne open end yarn quality for cotton yarn. The experiments were carried out in a spinning department of a textile factory in Bahir Dar textile Share Company and the experimental sample to be tested in Bahir Dar University Eitex laboratories.

CHAPTER THREE

MATERIALS AND METHODS

3.1. Materials

The materials, equipments and tools used throughout the process to achieve the objective of the study are: cotton fiber, from Bahir Dar textile Share Company (blow room , integrated draw frame, R-923 open end machine and different size of opening roller gears.), 20Ne cotton yarn, fiber and yarn properties testing equipments such as HVI, USTER 5 tester, fast count analyzer, Uster tensorapid tester, and electronic twist tester

Yarn preparation

Cotton Fiber

IDF

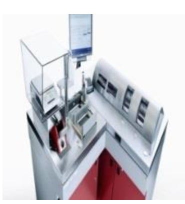
Opening roller gear

R-923 OE

Figure3. 1. Yarn preparation

Testing equipments and test stundards

HVI



Uster evenness

STATIMATE ME+

Fast count

Electrical Twist Tester

Fig 3.2.Testing Equipment

Table 3.1 Testing equipment and standard

	Name of equipment	Test parameter	Standard	Located in
1	HVI (uster tester 1000)	Fiber property	ASTM D4604	EiTEX
2	Count Tester	yarn Linear density	ASTM D1059	EiTEX
3	Uster 5 evenness tester	Yarn imperfection	ASTM D5647	EiTEX
4	Uster tensorapid	Yarn strength	ASTM D2256	BDTSC
5	Electronic twist Tester	Twist	ASTM D1422	EiTEX

The slivers of 0.11 hanks with 100% virgin cotton will be collected from Bahir Dar Textile Share Company in Spinning Mills. Table 3.2 indicates the cotton fiber properties used in this experiment those were assessed by Uster- HVI instrument according to the standard testing condition.

Table 3.2 Fiber properties

Type of fiber	Origin	Staple length(mm)	Short fiber (%)	Strength (g/tex)	Elongation (%)	Micronaire	Trash %
Cotton (100%)	Ethiopia	24.92	12.2	20	6.7	3.77	3.07

3.2. Methods

3.2.1 Sampling

The rotors used in BDTSC R-923 with a diameter of 33mm, experimental design are used to design the experiment. 20 experiments as shown in Table 3.3 the count range was selected based on the factory requirements of 20Ne for its weaving needs. All other factors were selected based on previous factory values, with allowances for high and low values so as to enable a study of the effect of these factors on yarn properties such as, tensile strength, elongation ,count,imperfection and twist value of yarn. Ten yarn packages per each experimental design were spun and tested as per ASTM standard. The processing of the cotton yarn included blow room to carding with integrated draw frame so as to produce a sliver to be fed to rotor spinning machine for yarn production. The machines used during the manufacture of the yarn are shown in figure 3.3.

Figure.3.3 Cotton processing from blow room to rotor spinning

The effect of opening roller speed and rotor speed on yarn properties will be investigate using statistical techniques. First the effect of each individual factor (while keeping the other constant) on yarn properties will be investigated. This is referred to as the effect of each factor on yarn properties.

Experimental plan

20 yarn samples were produced by changing opening roller and rotor speed as shown in the table 3.3

Table 3.3 Experimental Design

Opening roller speed rpm	Rotor speed rpm 75000	80000	85000	90000
7800	A0	A1	A2	A3
8300	B0	B1	B2	B3
8800	C0	C1	C2	C3
9300	D0	D1	D2	D3
9800	E0	E1	E2	E3

Where A_0 up to E_3 experimental design samples

Four different opening roller and rotor speed used to produce the 20Ne yarn samples, all possible combinations between opening roller and rotor speed were used to give different treatment combinations as shown in the Table 3.4

Table3.4 Sample Combination

combination	Opening roller speed	Rotor speed rpm
A_0	7800	75000
A_1	7800	80000
A_2	7800	85000
A_3	7800	90000
B_0	8300	75000
B_1	8300	80000
B_2	8300	85000
B_3	8300	90000
C_0	8800	75000
C_1	8800	80000
C_2	8800	85000
C_3	8800	90000
D_0	9300	75000
D_1	9300	80000
D_2	9300	85000
D_3	9300	90000
E_0	9800	75000
E_1	9800	80000
E_2	9800	85000
E_3	9800	90000

Table3.5 Opening Roller and Rotor Speed rpm

Between-Subjects Factors

		Value Label	N
Openingroller speed rpm	7800.00	O1	40
	8300.00	O2	40
	8800.00	O3	40
	9300.00	O4	40
	9800.00	O5	40
Rotor speed rpm	75000.00	R1	50
	80000.00	R2	50
	85000.00	R3	50
	90000.00	R4	50

3.2.2. Testing and Evaluation Procedures

All tests were carried out under standard atmospheric conditions, i.e. 20±2 C° temperature and 65±2 % relative humidity. The samples were conditioned for a minimum 24 hours before tests.

Yarn twist

Twist measuring instruments based on untwist-re twist principle for measuring the twist in ring spun yarns. An automatic twist tester, which works on untwist-re twist principle in accordance with ASTM D1422 standard, and the average of 10 test results were presented for each yarn sample. In addition, twist to break test is used, where the yarn is over twisted in the original twist direction until the yarn breaks, and the yarn was untwisted and then re twisted until the yarn breaks, and the twist was calculated based on these two measurements.

Tensile strength

The standard ASTM D2256 was used for the tensile tests. The tensile strength was determined using the Tensoriped 50 centimeter of samples yarn. It was used to measure the resistance of yarn, cable and similar products. The maximum force is 50 kgf (500 Newton). it has features of reading maximum rate of breaking off. Device saves resistance of sample which was pressed between jaws device has an automatic feeding system for 10 bobbins.

Yarn evenness

Uster5 evenness tester was used to determine the unevenness and imperfection (IPI) of the yarn at a speed of 450 m/ min.Each sample was tested five times and 1000 m of samples were tested each time**.** The observed parameters were U%, CV%, thin places (-50%), thick places (+50%), neps (+280%) and hairiness. The imperfection (IPI) is the sum of no. of mass increase (thick places), mass reductions (thin places), and short mass increases (neps).

Yarn count

Yarn count was determined through the digital fast cont analyzer, which gives direct reading.

Yarn quality parameter for 20Ne open end cotton spun yarn exsisting yarn properties test result

3.2.3. Existing BDTSC process parameters

Table 3.6 Existing Machine parameter

Type	Opening roller speed(rpm)	Rotor speed(rpm)	Rotor diameter(mm)	Rotor type
Value	9800	90,000	33	U shape

Table 3.7 Existing yarn properties test result

Sliver count Ne	Yarn count Ne	Twist TPm	Elong %	Tenacity cN/tex	Cv %	U %	Imperfe Ction
0.11	19.85	822	3.92	8.69	12.97	10.26	77

3.2.4. General procedure

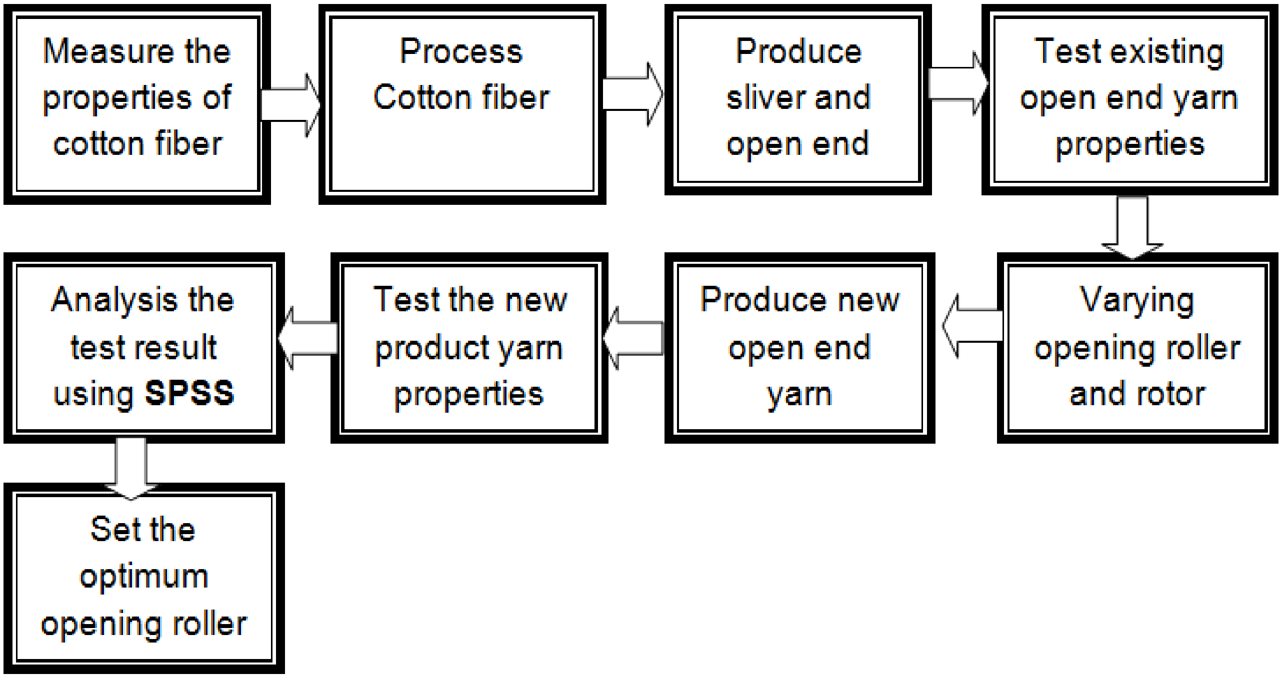


Figure 3.4 General procedure

3.2.5. Analytical methods

This study was use different methods to analyze the data; the main modern software is statistical analysis or Design of Experiment which is **spss** general linear model. Because it is especially powerful for data manipulation, calculations and plots. Its features include: an integrated and very well-conceived documentation system; efficient procedures for data treatment and storage; a suite of operators for calculations on tables, especially matrices; a vast and coherent collection of statistical procedures for data analysis; advanced graphical capabilities; a simple and efficient programming language, including conditioning, loops, recursion and input-output possibilities.

CHAPTER FOUR

RESULT AND DISCUSSION

To study the effect of opening roller and rotor speed on rotor yarn quality , 100% cotton material was spun with 20Ne count at opening roller speeds of 7800,8300,8800,9300 and 9800rpm and rotor speeds of 75000, 80000, 85000, and 90000 rpm. Twist level for all the yarn samples was kept at 920 tpm.

4.1. The effect of opening roller and rotor speed on yarn count

Yarn count was determined through the digital fast count analyzer,By preparing the length of yarn 120yd in hank form which gives direct measured Yarn count in the form of **Ne** of the yarn .The sample test result show table4.1.

Table4.1 Test records for yarn count Ne at different opening roller and rotor speed

Opening roller speed rpm	Rotor speed rpm	No of test										
		1	2	3	4	5	6	7	8	9	10	Aveg
	75000	19.82	19.6	20.2	20.29	20.03	19.91	20.41	20.53	20.54	20.48	20.18
7800	80000	19.97	19.82	20.5	20.4	20.1	20.52	20.43	20.53	20.35	20.39	20.3
	85000	19.98	20.53	20.6	20.69	20.93	20.08	19.93	20.05	20.53	20.32	20.36
	90000	20.29	20.72	24.2	20.7	19.92	19.97	20.1	20.83	19.83	20.6	20.72
	75000	19.81	19.7	20.2	20.29	20.03	19.91	20.38	20.52	20.55	20.48	20.18
	80000	20.97	19.82	20.7	20.39	20.15	20.53	20.23	20.73	20.35	20.49	20.43
	85000	19.98	20.53	20.6	20.79	20.93	20.05	19.93	20.03	20.53	20.06	20.34
8300	90000	20.29	20.6	24.2	20.45	19.92	19.97	20.1	20.83	19.83	20.6	20.68
	75000	20.25	20.23	20	20	20.93	20.68	20.19	20.49	20.29	20.01	20.31
	80000	19.76	19.88	20.4	20.07	20.58	20.93	20.77	20.23	20.98	20.78	20.43
	85000	20.43	20.42	20.1	20.74	20.97	20.71	20.31	20.12	20.31	20.45	20.46
8800	90000	20.76	20.26	19.9	20.99	20.2	20.51	20.59	20.23	20.16	20.29	20.39
	75000	20.4	20.22	20	20.86	20.46	20.01	20.1	20.86	20.73	20.3	20.4
	80000	20.05	20.1	20.2	20.53	20.07	20.48	20.04	20.04	20.41	20.54	20.25
	85000	20.92	20.69	20	20.21	20.75	20.58	20.3	20.27	20.67	20.6	20.5
9300	90000	20.86	20.32	20.8	20.14	20.98	20.19	20.99	20.08	20.5	19.82	20.47
	75000	20.76	20.93	20.1	20.33	19.75	20.52	20.37	20.14	20	20.44	20.33
	80000	20.65	20.47	20.6	20.46	19.92	20.33	19.84	20.99	20.61	20.26	20.42
	85000	20.68	20.61	20.1	20.68	20.84	20.44	20.47	20.43	20.18	20.55	20.5
9800	90000	19.61	20.26	20.1	20.18	20.14	20.01	20.06	20.47	20.57	20.04	20.15

In order to evaluate the significance of the opening roller and rotor speed and their interactions on the yarn count, the analysis was performed on the test results by using **SPSS** general linear model (GLM) procedure. The results of the analysis of test are reported in Table 4.1(a and b).

Table4.1.a Analysis test result of opening roller and rotor speed on yarn count

Tests of Between-Subjects Effects

Dependent Variable: yarncount/Ne

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Openingrollerspeed	.099	4	.025	.096	.984
Rotorspeed	1.136	3	.379	1.472	.224
Openingrollerspeed * Rotorspeed	2.949	12	.246	.955	.494
Error	46.330	180	.257		
Total	83193.594	200			
Corrected Total	50.515	199			

Table4.1.b The mean value of count at different opening roller and rotor speed

Descriptive Statistics

Dependent Variable: yarn count/Ne

opening roller speed/rpm	rotorspeed/rpm	Mean	Std. Deviation	N
O1	R1	20.1770	.32809	10
	R2	20.3010	.24902	10
	R3	20.3600	.33944	10
	R4	20.7160	1.27806	10
	Total	20.3885	.69558	40
O2	R1	20.1830	.30869	10
	R2	20.4340	.32592	10
	R3	20.3400	.36998	10
	R4	20.6790	1.28111	10
	Total	20.4090	.70001	40
O3	R1	20.3100	.30605	10
	R2	20.4340	.43955	10
	R3	20.4550	.27906	10
	R4	20.3910	.31862	10
	Total	20.3975	.33281	40
O4	R1	20.3970	.32609	10
	R2	20.2450	.21793	10
	R3	20.5020	.28248	10
	R4	20.4710	.42131	10
	Total	20.4038	.32401	40
O5	R1	20.3290	.35816	10
	R2	20.4160	.34674	10
	R3	20.4950	.23368	10
	R4	20.1470	.26323	10
	Total	20.3468	.32111	40
Total	R1	20.2792	.32422	50
	R2	20.3660	.32162	50
	R3	20.4304	.29999	50
	R4	20.4808	.84212	50
	Total	20.3891	.50383	200

The results of analysis of yarn count are shown in the above Table4.1.a These indicate that there is no significant effect of opening roller and rotor speed on yarn linear density at the 95%· confidence level.

4.2.The effect of opening roller and rotor speed on yarn strength

Yarn strength measured in the form of tenacity and elongation of the yarn .The sample test result show below.

Table4.2 Test records for Tenacity CN/Tex at different opening roller and rotor speed

Opening roller speed rpm	Rotor speed rpm	No of test										
		1	2	3	4	5	6	7	8	9	10	Aveg
	75000	8.26	8.72	9.53	9.32	9.91	8.96	7.81	9.6	9.98	8.86	9.1
	80000	10.13	8.16	9.85	10.1	7.26	8.08	8.9	9.6	9.4	9.62	9.11
	85000	8.72	8.96	7.6	8.74	8.52	9.58	9.3	9.91	9.28	9.4	9.0
7800	90000	9.3	8.44	9.3	9.03	8.26	9.3	9.5	9.85	8.75	8.95	9.07
	75000	9.75	8.6	9.54	9.31	8.8	9.18	9.2	9.14	8.99	9.38	9.19
	80000	9.25	9.63	9.3	9.24	9.1	9.43	9.11	8.31	9.48	9.01	9.18
	85000	8.6	8.53	9.25	8.86	8.91	9.5	8.17	8.59	9.24	9.0	8.87
8300	90000	9.84	9.44	8.15	8.16	9.59	9.47	8.26	9.12	9.68	9.15	9.09
	75000	9.75	8.53	9.54	9.31	8.21	9.18	8.95	10	8.99	9.38	9.18
	80000	9.25	9.63	8.91	9.24	9.1	9.43	10.3	8.89	9.2	9.39	9.34
	85000	8.9	8.81	9.25	8.86	8.91	9.1	10.2	8.59	9.24	9.2	9.11
8800	90000	9.2	9.44	8.15	8.16	9.59	9.47	8.26	9.12	9.68	9.15	9.02
	75000	9.01	8.21	9.55	8.57	7.57	8.72	8.68	10.3	9.07	8.86	8.86
	80000	9.1	8.07	8.84	7.7	10.5	9.01	9.02	8.17	9.55	8.5	8.84
	85000	8.42	10.18	8.2	8.28	8.32	9.63	9.08	8.67	9.61	9.23	8.96
9300	90000	8.61	8.73	7.97	8.19	7.76	9.0	8.55	8.97	9.09	9.48	8.64
	75000	8.55	9.14	9.3	9.12	7.87	7.9	8.56	7.87	9.89	8.6	8.68
	80000	9.73	8.32	8.59	9.25	9.12	8.97	8.78	6.72	7.89	8.61	8.6
	85000	8.99	8.76	8.04	8.14	8.77	8.98	7.6	7.43	8.32	8.42	8.35
9800	90000	8.66	8.25	9.23	9.78	9.09	7.85	7.87	9.4	8.62	8.48	8.72

Table4.2.a The mean value of yarn tenacity CN/tex at different opening roller and rotor speed

Descriptive Statistics

Dependent Variable: TenactyCN/tex

Openingrollerspeedrpm	Rotorspeedrpm	Mean	Std. Deviation	N
O1	R1	9.0950	.70749	10
	R2	9.1080	.97429	10
	R3	9.0010	.65242	10
	R4	9.0680	.48573	10
	Total	9.0680	.69928	40
O2	R1	9.1890	.33821	10
	R2	9.2240	.36068	10
	R3	8.8650	.40186	10
	R4	9.0860	.65568	10
	Total	9.0910	.46152	40
O3	R1	9.1840	.54120	10
	R2	9.3380	.41864	10
	R3	9.1070	.44242	10
	R4	9.0220	.60303	10
	Total	9.1628	.50099	40
O4	R1	8.8560	.73763	10
	R2	8.8440	.80135	10
	R3	8.9620	.68899	10
	R4	8.6350	.53637	10
	Total	8.8243	.68125	40
O5	R1	8.6800	.68411	10
	R2	8.5980	.83374	10
	R3	8.3450	.54830	10
	R4	8.7230	.64588	10
	Total	8.5865	.67533	40
Total	R1	9.0008	.62754	50
	R2	9.0224	.74124	50
	R3	8.8560	.59913	50
	R4	8.9068	.59589	50
	Total	8.9465	.64243	200

According to the results of SPSS table4.2.b shows for strength, the independent variables opening roller and rotor speed have a significant effect on yarn strength ($p<0.05$).

Table4.2.b Analysis test result of yarn tenacity CN/tex at different opening roller and rotor speed

Tests of Between-Subjects Effects

Dependent Variable: TenactyCN/tex

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Openingrollerspeedrpm	9.078	4	2.270	5.816	.000
Rotorspeedrpm	.924	3	.308	.789	.035
Openingrollerspeedrpm * Rotorspeedrpm	1.889	12	.157	.403	.046
Error	70.239	180	.390		
Total	16090.103	200			
Corrected Total	82.130	199			

Table 4.2(a and b) and figure 4.1 shows values for cent Newton per Tex of all the samples in the study. Overall, the mean values for each of the treatment combinations. The results show a specific trend on the effect opening roller or rotor speed on tenacity. There were significant differences in the tenacity of the samples although higher results were seen in the 8800 rpm opening roller speed at rotor speed of 80000rpm mean value 9.34cN/tex. At 8800 rpm opening roller speed the centrifigual force on the rotor groove is high compared to that at 9800 rpm. The resulting pulling of the fibers due to tension is therefore lower at the 8800 rpm opening roller than at 9800 rpm. it is clearly seen that yarn strength increased with the increase of rotor speed. The most important forces acting on the yarn inside the rotor is the centrifugal force . However, higher centrifugal force will be resulted at higher rotor speed that performs better consolidation of fibers which in turn will lead to higher yarn strength. Yarn quality for the incidence of strength deteriorates at high combing roll speed.

Fiber individualization and trash removal% will be better with increasing speed but fiber breakages occur intensively. Therefore, fiber damaging overweighs the effect of better individualization and trash removal. As a result, lower yarn strength has been observed in higher combing-roll speed. The best results are found at combing-roll speed of 8800 rpm and rotor speed of 80000 rpm

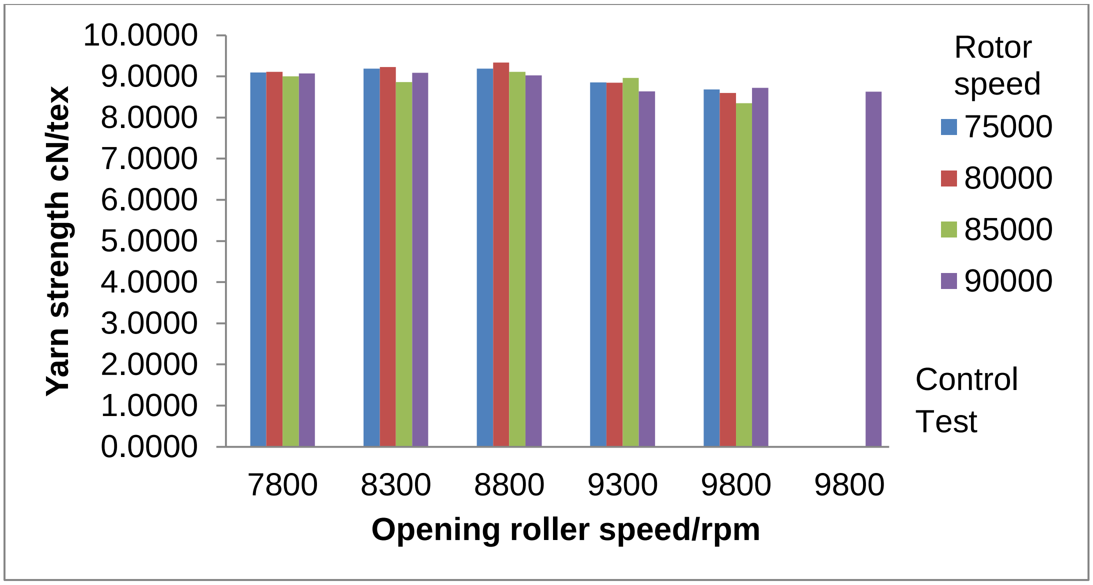


Figure 4.1 comparison yarn tenacity CN/tex at different opening roller and rotor speed.

Control test at a speed of 9800rpm opening roller and 90000rpm rotor speed.

The test result of all combination of opening roller and rotor speed have better yarn tenacity CN/tex as compared to control test.

4.3. The effect of opening roller and rotor speed on yarn elongation

Table4.3 Test records for Elongation% at different opening roller and rotor speed

Opening roller speed rpm	Rotor speed rpm	1	2	3	4	5	6	7	8	9	10	Aveg
		No of test										
	75000	4.43	4.34	4.6	4.25	4.08	4.12	4.2	4.9	4.24	4.2	4.34
	80000	4.22	4.48	4.14	4.45	3.93	3.12	4.1	4.32	4.03	3.78	4.06
	85000	3.72	3.66	3.92	3.4	3.91	2.67	3.82	3.91	3.58	3.36	3.6
7800	90000	3.43	2.6	2.97	3.63	3.42	3.65	3.38	3.55	3.68	3.65	3.4
	75000	4.43	4.34	4.6	4.25	4.08	4.12	4.7	4.9	4.24	4.2	4.39
	80000	4.22	4.48	4.14	4.45	3.93	3.8	4.1	4.32	4.03	3.78	4.13
	85000	3.72	3.66	3.92	3.4	3.91	3.7	3.82	3.91	3.58	3.36	3.7
8300	90000	3.43	3.6	2.97	3.63	3.42	3.65	3.38	3.55	3.68	3.65	3.5
	75000	5.42	5.32	5.37	5.2	4.98	5.26	4.78	4.69	5.59	5.2	5.18
	80000	5.37	4.89	4.99	5.09	5.33	5.19	5.17	4.41	4.85	4.97	5.03
	85000	4.86	5	4.69	4.63	4.76	5.16	4.8	4.76	4.71	4.88	4.83
8800	90000	4.47	4.43	4.39	4.22	4.3	4.28	4.11	4.34	4.27	4.28	4.31
	75000	4.41	4.14	4.38	5.02	4.37	4.48	4.01	3.74	4.51	4.35	4.34
	80000	4.24	4.13	4.42	4.17	3.36	4.53	4.15	4.23	4.31	3.93	4.15
	85000	3.53	3.93	4.05	3.9	3.68	4.06	3.99	4.2	3.56	3.24	3.81
9300	90000	3.58	3.47	3.26	3.72	3.06	3.34	2.76	4.13	3.32	3.37	3.4
	75000	4.4	4.18	4.5	4.61	3.89	4.23	3.31	4.84	4.34	4.2	4.25
	80000	4.12	4.05	4.06	3.83	4.37	4.03	3.21	4.19	4.17	3.64	3.97
	85000	3.46	4.07	3.73	3.81	3.48	3.97	2.74	3.83	3.88	5.19	3.82
9800	90000	3.64	3.39	3.39	3.49	3.32	3.03	3.36	3.75	2.42	3.24	3.06

Table4.3.aThe mean value of yarn elongation% at different opening roller and rotor speed.

Descriptive Statistics

Dependent Variable: Elongation%

Opening roller speed/rpm	Rotor speed/rpm	Mean	Std. Deviation	N
O1	R1	4.3360	.24999	10
	R2	4.0570	.39573	10
	R3	3.5950	.38350	10
	R4	3.3960	.35043	10
	Total	3.8460	.50388	40
O2	R1	4.3860	.26904	10
	R2	4.1250	.24749	10
	R3	3.6980	.20357	10
	R4	3.4960	.21428	10
	Total	3.9263	.41970	40
O3	R1	5.1810	.28454	10
	R2	5.0260	.27806	10
	R3	4.8250	.15834	10
	R4	4.3090	.10482	10
	Total	4.8353	.39480	40
O4	R1	4.3410	.33785	10
	R2	4.1470	.32156	10
	R3	3.8140	.29993	10
	R4	3.4010	.36943	10
	Total	3.9258	.48273	40
O5	R1	4.2500	.42056	10
	R2	3.9670	.33250	10
	R3	3.8160	.61330	10
	R4	3.3030	.36896	10
	Total	3.8340	.55302	40
Total	R1	4.4988	.46238	50
	R2	4.2644	.49547	50
	R3	3.9496	.57202	50
	R4	3.5810	.47126	50
	Total	4.0735	.60642	200

Table 4.3(a and b) and figure 4.2 shows values Elongation (%) of all the samples in the study. Overall, the mean values for each of the treatment combinations. The results show a specific trend on the effect opening roller or rotor speed on

yarn elongation. There were significant differences in the elongation (%) of the samples although higher results were seen in the 8800 rpm opening roller speed at 75000rpm rotor speed mean value 5.18%. At 8800 opening roller speed the drafting speed is low compared to that at 9800 rpm. The resulting pulling of the fibers due to tension is therefore lower at the 8800 rpm opening roller speed and 7000rpm rotor speed than at 9800 rpm. The consequence is that there is less strain on the drafted sliver and hence a more compact structure is produced by the machine at 8800 rpm. At higher speeds there is a tendency to pull the fibers from the main structure resulting in the reduction of fiber cohesion leading to lower results when the tests are carried out.

Table4.3.b Analysis test result of yarn elongation% at different opening roller and rotor speed.

Tests of Between-Subjects Effects

Dependent Variable: Elongation%

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Openingrollerspeedrpm	29.316	4	7.329	68.240	.000
Rotorspeedrpm	23.762	3	7.921	73.749	.000
Openingrollerspeedrpm * Rotorspeedrpm	.773	12	.064	.600	.024
Error	19.332	180	.107		
Total	3391.781	200			
Corrected Total	73.182	199			

However, at high rotor speeds the fibres are peeled off and twisted at higher tension which created a permanent strain in the yarn. This higher spinning tension straightened the curliness in fibres provided increased centrifugal force made the yarn more compact. Combine effect of both factors lessened the fiber slippage during tensile testing which in return reduced the elongation.

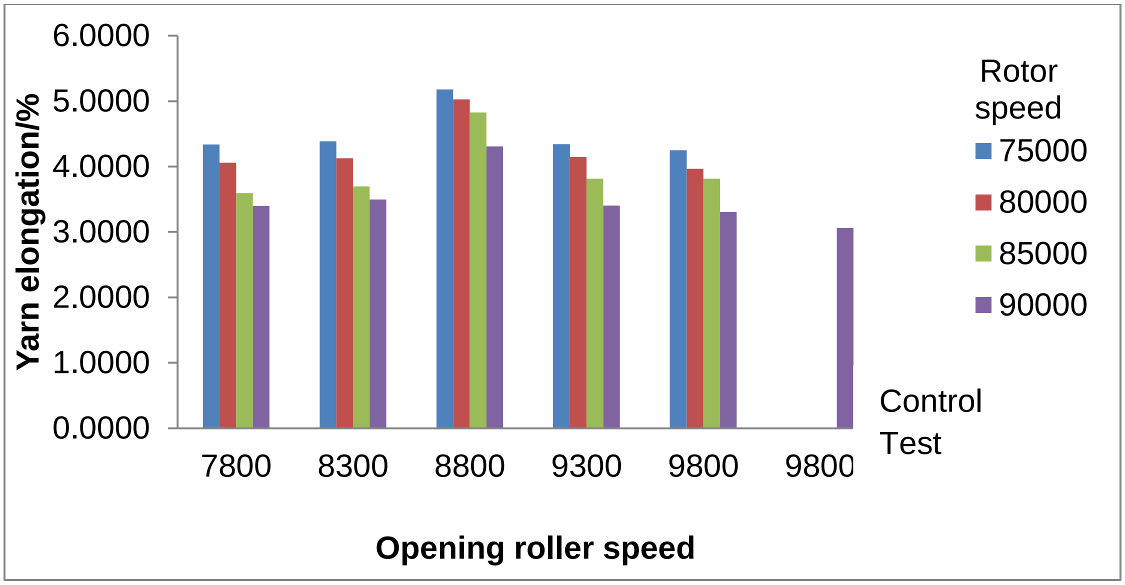


Figure 4.2 comparison yarn elongation% at different opening roller and rotor speed

■ Control test at a speed of 9800rpm opening roller and 90000rpm rotor speed.

The test result of all combination of opening roller and rotor speed have better yarn elongation(%) value as compared to control test.

4.4. The effect of opening roller and rotor speed on yarn twist

In simple terms the machine untwists 50 cm of the samples and re twists in the Z direction back to the original length.The test result show below

Table4.4 Test records for twist Tpm at different opening roller and rotor speed

Opening roller speerpm	Rotor speed rpm	No of test										
		1	2	3	4	5	6	7	8	9	10	Aveg
	75000	848.5	839.5	865.6	823.7	852.1	865	812	836.2	858.6	878	847.9
	80000	832.7	856.7	860	864.5	847.7	841	861.3	848.2	856	840	850.8
	85000	841.5	823.1	849	855	851.3	815.6	856	846.6	819.5	854.5	841.2
7800	90000	861.8	828.5	815.6	858.8	861.3	838.3	869.3	823.5	828	830	841.5
	75000	848.5	839.5	865.6	823.7	852.1	865	812	836.2	858.6	885.8	848.7
	80000	832.7	856.7	860	864.5	847.7	865	861.3	848.2	856	840	853.2
	85000	841.5	823.1	859.1	855	851.3	815.6	856	846.6	819.5	854.5	842.2
8300	90000	876.5	828.5	815.6	858.8	861.3	838.3	869.3	823.5	828	830	843
	75000	847.5	843.1	854.5	843.3	853.5	880.5	886	883.5	881.4	880	865.3
	80000	880.7	851.8	854.5	843.8	883.7	848.3	888.7	850	884.4	883.9	867
	85000	863.1	861.1	880	868.7	879	852	872.3	850.8	878.2	846.1	865.1
8800	90000	868.2	887.5	884	870.5	865	842.5	854.3	840	832	884	862.8
	75000	842.5	831.3	858.8	824	836.6	821	869.6	823.8	862.3	853.5	842.3
	80000	863	846	846.2	840	875.5	820.6	875.3	821.5	866.7	843.7	849.9
	85000	817.8	825	849.7	840.6	849.8	868	851	873.2	860.3	864	849.9
9300	90000	857.5	834.1	828	818.6	830.3	851	861	839.1	856.1	823	839.9
	75000	792.7	806.1	840.5	882.5	783.8	782.6	844.5	782.8	814.3	788	811.8
	80000	816.6	818.6	846	831	841	892.7	878.8	865.5	869	832.7	849.2
	85000	817.3	827.3	812.6	813.5	837.3	831.2	856.2	809.1	866	855.5	832.6
9800	90000	829.1	837.5	856.5	825.3	830.8	824.3	802	840.2	824.8	853.2	832.4

Table4.4.a Analysis test result of yarn elongation% at different opening roller and rotor speed.

Tests of Between-Subjects Effects

Dependent Variable: TwistTpm

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Openingrollerspeedrpm	22869.076	4	5717.269	15.300	.000
Rotorspeedrpm	3676.041	3	1225.347	3.279	.022
Openingrollerspeedrpm * Rotorspeedrpm	5739.328	12	478.277	1.280	.036
Error	67262.702	180	373.682		
Total	143526128.060	200			
Corrected Total	99547.146	199			

The Twist analysis results of the yarn samples in Table 4.4(a and b) and illustrated in Figure 4.3. The results show that the twist values turns per meter of all the samples in the study. Overall, the mean values for each of the treatment combinations a significant difference.

Table4.4.bThe mean value of yarn elongation% at different opening roller and rotor speed.

Descriptive Statistics

Dependent Variable: TwistTpm

Opening roller speed rpm	Rotor speed rpm	Mean	Std. Deviation	N
O1	R1	847.9200	20.34725	10
	R2	850.8100	10.54666	10
	R3	841.2100	15.74918	10
	R4	841.5100	19.33566	10
	Total	845.3625	16.79998	40
O2	R1	848.7000	21.73093	10
	R2	853.2100	10.79408	10
	R3	842.2200	16.60487	10
	R4	842.9800	21.48854	10
	Total	846.7775	18.07298	40
O3	R1	865.3300	18.30489	10
	R2	866.9800	18.52942	10
	R3	865.1300	12.51098	10
	R4	862.8000	19.87483	10
	Total	865.0600	16.91472	40
O4	R1	842.3400	17.72420	10
	R2	849.8500	19.95758	10
	R3	849.9400	17.99884	10
	R4	839.8700	15.44870	10
	Total	845.5000	17.74379	40
O5	R1	811.7800	33.89378	10
	R2	849.1900	26.04745	10
	R3	832.6000	20.54864	10
	R4	832.3700	15.67617	10
	Total	831.4850	27.50060	40
Total	R1	843.2140	28.37807	50
	R2	854.0080	18.64114	50
	R3	846.2200	19.59732	50
	R4	843.9060	20.48636	50
	Total	846.8370	22.36598	200

The results show a significant difference on the effect opening roller and rotor speed on twist value. 9800rpm opening roller speed used at a rotor speed of 90000rpm had the lowest average and the minimum value for the twist values while the 9800 produced the minimum values when compared to the other combination. The 8800rpm opening roller speed at 80000rpm rotor speed produced yarns with the highest maximum in each combination reading**.** In general when increase the rotor speed to get high value turn per meter so, specific pattern can be described by the results and hence it can be said that the opening roller and rotor speed found to be significant effect . There is interaction between the opening roller and rotor speed also significant.

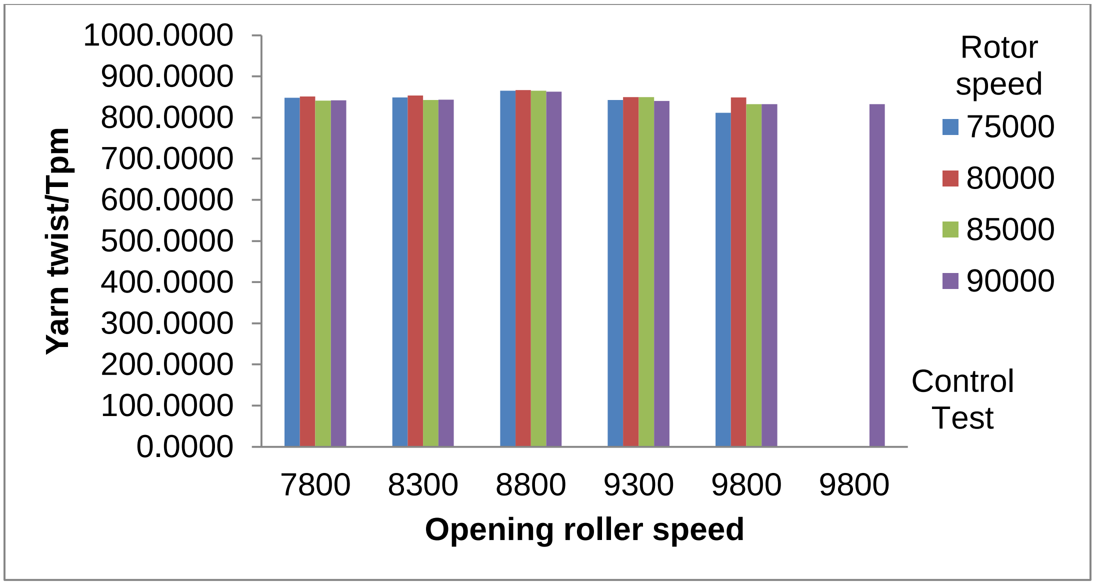


Figure 4.3 Comparison yarn twist Tpm at different opening roller and rotor speed

■ Control test at a speed of 9800rpm opening roller and 90000rpm rotor speed.

The test result of all combination of opening roller and rotor speed have better yarn twist(Tpm) value as compared to control test.

4.5. The effect of opening roller and rotor speed on yarn Unevenness

The unevenness and imperfection (IPI) of the yarn at a speed of 450 m/ min.Each sample was tested five times and 1000m of samples were tested each time.

Table4.5Test records for Yarn uneveneness U% at different opening roller and rotor speed/rpm

Opening roller speed rpm	Rotor speed rpm	No of test 1	2	3	4	5	6	7	8	9	10	Aveg
	75000	10.0	10.32	10.45	10.12	10.61	10.2	10.02	10.15	10.12	10.21	10.22
	80000	8.74	9.95	9.57	9.69	9.77	9.74	8.95	9.57	9.6	9.87	9.545
	85000	6.0	8.3	10.14	9.8	10.07	7.0	8.3	10.54	9.78	10.07	9.0
7800	90000	8.54	9.78	10	9.84	9.56	9.54	8.78	10.45	9.84	9.56	9.589
	75000	10.72	9.27	9.35	9.98	9.65	10.22	9.11	9.35	9.98	9.65	9.728
	80000	9.5	9.6	10.14	10.73	10.77	9.8	10.1	10.73	10.24	10.17	10.18
	85000	9.33	10.14	10.49	10.68	10.31	10.03	10.44	10.59	10.68	10.11	10.28
8300	90000	10.24	10.64	9.76	9.99	10.11	10.64	10.14	9.76	10.1	10.11	10.15
	75000	8.95	9.48	9.51	9.46	10.27	9.1	9.68	9.51	9.46	10.27	9.569
	80000	6.12	7.97	8.64	9.39	9.54	6.58	8.14	8.84	9.39	9.54	8.415
	85000	9.03	10.11	9.8	9.92	9.39	9.83	10.11	9.8	10.1	9.33	9.742
8800	90000	9.78	9.99	9.93	9.62	10.66	9.78	10.13	9.98	9.72	10.66	10.03
	75000	10.72	9.27	9.35	9.98	9.65	10.72	9.27	9.05	9.98	9.12	9.711
	80000	9.5	9.6	10.14	10.73	10.77	9.5	9.6	10.04	10.83	10.77	10.15
	85000	9.33	10.14	10.49	10.68	10.31	9.33	10.14	10.49	10.68	10.31	10.19
9300	90000	10.24	10.64	9.76	9.99	10.11	10.24	10.64	9.76	9.99	10.11	10.15
	75000	9.18	9.43	8.9	9.92	10.96	9.18	9.43	8.9	10.11	10.96	9.697
	80000	9.45	9.83	10.07	10.13	10.15	9.45	9.83	10.07	10.13	10.05	9.916
	85000	9.36	9.63	9.49	9.89	10.27	9.23	9.63	9.47	9.85	10.07	9.689
9800	90000	9.65	10.47	10.88	9.8	9.83	9.65	10.47	10.88	9.8	9.83	10.13

Table4.5.aThe mean value of yarn unevenness U% at different opening roller and rotor speed.

Descriptive Statistics

Dependent Variable: U%

Openingrollerspeedrpm	Rotorspeedrpm	Mean	Std. Deviation	N
O1	R1	10.2200	.19114	10
	R2	9.5450	.39238	10
	R3	9.0000	1.53440	10
	R4	9.5890	.56092	10
	Total	9.5885	.92273	40
O2	R1	9.7280	.49919	10
	R2	10.1780	.46043	10
	R3	10.2800	.40828	10
	R4	10.1490	.30256	10
	Total	10.0838	.46013	40
O3	R1	9.5690	.42647	10
	R2	8.4150	1.22799	10
	R3	9.7420	.37205	10
	R4	10.0250	.36619	10
	Total	9.4378	.91523	40
O4	R1	9.7110	.62273	10
	R2	10.1480	.58021	10
	R3	10.1900	.49139	10
	R4	10.1480	.30821	10
	Total	10.0493	.53314	40
O5	R1	9.6970	.77159	10
	R2	9.9160	.27097	10
	R3	9.6890	.32702	10
	R4	10.1260	.49606	10
	Total	9.8570	.51870	40
Total	R1	9.7850	.56388	50
	R2	9.6404	.92460	50
	R3	9.7802	.87404	50
	R4	10.0074	.45680	50
	Total	9.8033	.73867	200

Table4.5.b Analysis test result of yarn U% at different opening roller and rotor speed.

Tests of Between-Subjects Effects

Dependent Variable: U%

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Openingrollerspeedrpm	12.872	4	3.218	8.442	.000
Rotorspeedrpm	3.453	3	1.151	3.020	.031
Openingrollerspeedrpm * Rotorspeedrpm	23.640	12	1.970	5.168	.000
Error	68.616	180	.381		
Total	19329.323	200			
Corrected Total	108.580	199			

The uniformity of mass(U%) analysis results of the yarn samples in Table 4.5(a and b) and illustrated in Figure 4.4. The results show that the U% values of all the samples in the study. Overall, the mean values for each of the treatment combinations. The results show a significant difference on the effect opening roller and rotor speed on U% value. The 8800rpm opening roller speed at 80000rpm rotor speed produced yarns with the lowest Um% values in each combination reading**.**The results on yarn uniformity show that the yarn unevenness (U%) tends to go up as the rotor speed is increased. Similar results have been reported by other research workers. The increase in unevenness could be due to the fact that at high production speeds, fibre individualization is poor because of the higher feed rate of sliver. This increases the average number of fibres per fibre aggregate, leading to high short-term irregularity. That fibre individualization can play an important role in the uniformity of yarn is further confirmed by the general downward trend in U% as the combing roller speed is increased. Beyond the combing roller speed of 9300 rpm, the Um% values show very little change,possibly due to the fact that at such a high speed fibre individualization is already adequate and further increase in speed does not improve individualization.

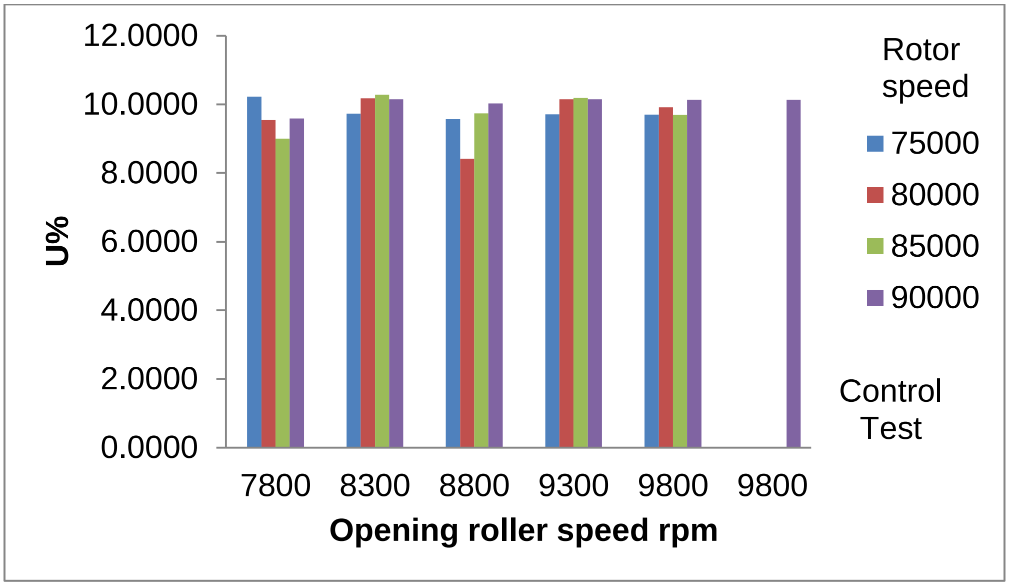


Figure 4.4 Comparison yarn mass uniformity (U %) at different opening roller and rotor speed

■ Control test at a speed of 9800rpm opening roller and 90000rpm rotor speed.

The test result of all combination of opening roller and rotor speed have better yarn mass uniformity (U %) value as compared to control test.

Table4.6 Test records for Yarn imperfection at different opening roller and rotor speed (rpm)

Opening roller speed rpm	Rotor speed rpm	No of test 1	2	3	4	5	6	7	8	9	10	Aveg
	75000	34	48	75	93	93	40	48	73	93	101	69.8
	80000	56	68	71	38	84	46	66	75	41	81	62.6
	85000	7	35	114	97	74	17	35	102	88	74	64.3
7800	90000	63	52	103	81	73	53	61	95	85	78	74.4
	75000	92	27	52	32	55	84	24	48	37	56	50.7
	80000	28	37	42	85	66	25	27	57	80	65	51.2
	85000	45	46	66	71	68	50	46	69	71	68	60
8300	90000	82	92	60	66	59	92	85	63	68	61	72.8
	75000	82	74	69	84	53	73	81	69	84	57	72.6
	80000	3	36	31	47	71	6	39	33	49	73	38.8
	85000	79	86	75	83	72	83	85	78	84	72	79.7
8800	90000	45	109	80	136	147	49	111	81	136	148	104.2
	75000	96	27	52	32	55	97	30	50	33	51	52.3
	80000	28	37	42	84	66	30	39	40	87	68	52.1
	85000	48	46	66	71	68	45	46	63	72	68	59.3
9300	90000	82	92	60	66	59	86	89	71	57	60	72.2
	75000	39	72	26	66	103	36	72	29	68	101	61.2
	80000	47	48	102	73	160	51	53	99	74	154	86.1
	85000	66	100	53	69	247	68	102	55	72	241	107.3
9800	90000	73	83	150	73	212	75	78	135	75	197	115.1

The imperfection(thin place,thick place and neps) analysis results of the yarn samples in Table 4.6(a and b) and illustrated in Figure 4.5. The results show that the imperfection values of all the samples in the study. Overall, the mean values for each of the treatment combinations. The results show a significant difference on imperfection.

Table4.6.aThe mean value of yarn imperfection at different opening roller and rotor speed.

Descriptive Statistics

Dependent Variable: Imperfection

Openingrollerspeedrpm	Rotorspeedrpm	Mean	Std. Deviation	N
O1	R1	69.8000	25.26658	10
	R2	62.6000	16.50724	10
	R3	64.3000	37.92991	10
	R4	74.4000	17.26396	10
	Total	67.7750	25.16457	40
O2	R1	50.7000	22.80862	10
	R2	51.2000	22.38948	10
	R3	60.0000	11.56623	10
	R4	72.8000	13.45610	10
	Total	58.6750	19.76449	40
O3	R1	72.6000	10.92601	10
	R2	38.8000	23.18429	10
	R3	79.7000	5.29255	10
	R4	104.2000	38.75507	10
	Total	73.8250	32.63464	40
O4	R1	52.3000	25.48224	10
	R2	52.1000	22.10807	10
	R3	59.3000	11.51858	10
	R4	72.2000	13.75823	10
	Total	58.9750	20.13351	40
O5	R1	61.2000	27.96347	10
	R2	86.1000	42.31745	10
	R3	107.3000	73.87685	10
	R4	115.1000	54.64929	10
	Total	92.4250	54.69209	40
Total	R1	61.3200	24.03946	50
	R2	58.1600	30.27787	50
	R3	74.1200	40.70634	50
	R4	87.7400	35.86642	50
	Total	70.3350	35.07369	200

The effect of opening roller and rotor speed on imperfection value. The 8800rpm opening roller speed at 80000rpm rotor speed produced yarns with the lowest imperfection values in each combination reading. The imperfection of yarn shows in figure 4.6 an upward trend with increase in rotor speed for all the five opening roller speed. The imperfection,in general,decrease with increase in opening roller speed until reachs the optimum opening roller speed 8800rpm and after reach the optimum opening roller speed 9800 increase the imperfection value. So the optimum opening roller and rotor speed for 20Ne carded cotton yarn are 8800rpm opening roller speed and 80000rpm rotor speed.

Table4.6.b Analysis test result of yarn imperfection at different opening roller and rotor speed.

Tests of Between-Subjects Effects

Dependent Variable: Imperfection

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Openingrollerspeedrpm	30868.280	4	7717.070	8.277	.000
Rotorspeedrpm	27338.055	3	9112.685	9.773	.000
Openingrollerspeedrpm * Rotorspeedrpm	18764.520	12	1563.710	1.677	.028
Error	167831.700	180	932.398		
Total	1234205.000	200			
Corrected Total	244802.555	199			

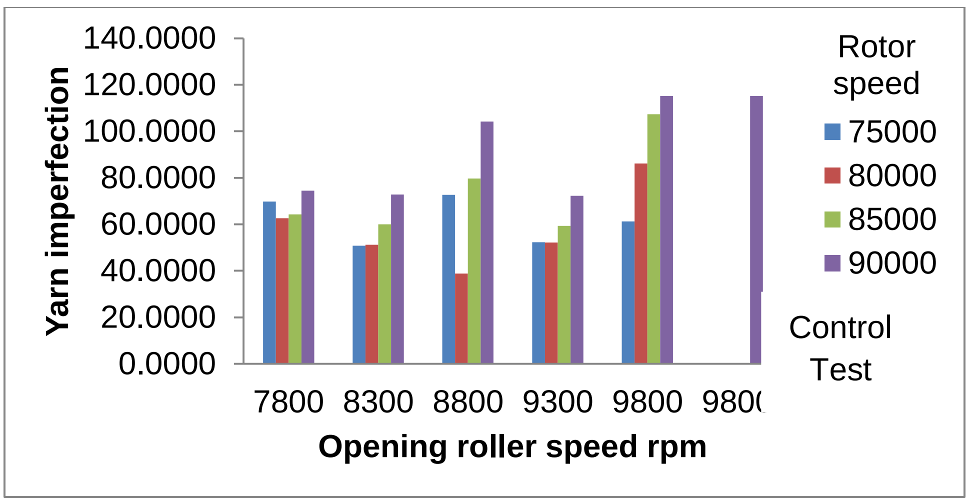


Figure 4.5 comparison yarn imperfection at different opening roller and rotor speed

- Control test at a speed of 9800rpm opening roller and 90000rpm rotor speed.

The test result of all combination of opening roller and rotor speed have better yarn mass uniformity (U %) value as compared to control test.

CHAPTER FIVE

CONCLUSION AND RECCOMENDATIONS

5.1. Conclusion

An open end spun yarn can be used for various applications where in their optimal opening roller and rotor speed should be set accordingly. The speed of opening roller and rotor of a rotor spinning machine are among various parameters which can influence the quality of spun yarn. Different opening roller and different rotor speed have been used for the production of 20 Ne 100% cotton carded yarn at Bahir dar Textile Share Company. Based on the results found that the optimum opening roller speed(8800rpm) and rotor speed (80000 rpm) for yarn tenacity, twist and unevenness, Where as for yarn elongation the opening roller speed (8800rpm) and rotor speed (75000rpm) values are suitable for 20/1 Ne .

In general when the opening roller speed increase up to 8800rpm and rotor speed 80000rpm to improve yarn properties such as (tenacity, elongation, twist and imperfection).

5.2. Reccomendations

To recommend that for 20 Ne 100% cotton carded yarn in Bahir Dar textile Share Company according to end use yarn for weaving to use different opening roller and rotor speed specially for weaving to use opening roller speed (8800rpm) and high rotor speed (80000 rpm).

Similarly to study the effect of opening roller and rotor speed at different yarn count

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