The impacts of roller gauge setting of ring frame machine on the characteristics of ring spun yarn

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Abstract - *In the complex landscape of yarn manufacturing, the roller gauge setting of a ring frame machine emerges as an important determinant influencing the quality and attributes of the final yarn product. This research explores the complex relationship between the roller gauge setting and Yarn properties, namely Imperfection Index (IPI), Uniformity, Hairiness, Count Strength Product (CSP), and Coefficient of Variation in mass (CVm%). Thus, the study measures how the changes in roller gauge of ring spun yarn machine affects the quality of end yarn. Understanding the effects of roller gauge settings is vital for optimizing the ring spinning process in textile manufacturing. The research employs a systematic approach, conducting experiments with varying roller gauge settings on a ring frame. The study unfolds through a systematic exploration of three distinct yarn counts-20 Ne, 26 Ne, and 40 Ne-under the wider and closer roller gauge setting. Employing modern testing methodologies, the study relied on the High Volume Instrument (HVI), Automated Fibre Information System (AFIS) and Evenness Tester to meticulously analyze and quantify the quality during the process and final yarn properties. The experimental results offer in depth insights into the complex relationship between roller gauge settings and yarn quality, presenting a comprehensive understanding of the dynamics at play. This research contributes substantively to the optimization of yarn manufacturing processes by providing empirical evidence on the direct influence of roller gauge settings on critical yarn attributes.*

Key Words: Yarn Characteristics, Roller gauge, Ring Frame, Uster Evenness Tester, Textile Manufacturing

1.INTRODUCTION

The textile industry has been developing rapidly and newer technologies are introduced and the only formula for survival is encapsulating those innovations into the manufacturing process and making the best of use them for increasing the productivity and quality. However, increasing market competition has raised significant concerns, making it essential for textile industries to transition toward more efficient and highly productive operations. In recent decades, for getting optimum and sustained yarn quality, minimum variations between spinning positions, easy handling and raw material cost saving- there has been a lot of works on this sector. But still there is a lot of opportunities to make the best use of machinery settings such as roller settings, this type of research focuses on how the settings of the rollers in a spinning machine can influence the properties and quality of the yarn produced.

Begum et al. [1] explores the relationship- between card cylinder speed and roller gauge settings during the breaker drawing stage and its consequential impact on the evenness and imperfections of combed yarn. The methodology, key findings, and implications of this research offer valuable insights into the initial stages of yarn formation.

Cui et al. [2] reports a systematic study on the SDS (Soft Drafting System), a modified drafting system based on the ring spinning frame, aimed at enhancing yarn quality. The research, divided into two parts, compared the SDS with the conventional drafting system for spinning different yarn types and explored the impact of key process parameters using Response Surface Methodology. The study revealed significant improvements in yarn evenness and a reduction in imperfections, with statistically significant parameters, but without notable interactions, and it identified optimal conditions for achieving high-quality yarn production.

Hossain et al. [3] utilizing Uster testing to evaluate yarn quality before the knitting and weaving processes can effectively mitigate problems associated with defective fabric production and suboptimal dyeing, leading to reduced production hurdles and a decreased likelihood of customer rejection. An experiment examining 40Ne, 50Ne, and 60Ne ring-spun yarns, which consisted of a 35% cotton and 65% polyester blend and were produced through the same fiber and sliver blending process, demonstrated that increasing yarn fineness corresponded to higher unevenness and coefficient of mass variation. Conversely, yarn hairiness decreased with the finer yarn types following a sequence of 40Ne > 50Ne > 60Ne.

Chaudhari et al. [4] present the role of draw frames in enhancing yarn quality through auto-leveling and doubling processes is crucial. The research emphasized the importance of auto-levelers in improving sliver thickness variation. Doubling becomes crucial for eliminating mass variation, ensuring uniformity in the delivery sliver. The draw frame's role in improving fiber orientation and removing imperfections is pivotal in yarn manufacturing.

The study dig dive into the optimization of draw frame bottom roller gauge settings. Trials with different settings (41/45, 40/44, 42/46) on LMW's LRSB 851 draw frame reveal that a setting of 40/44 mm yields superior yarn quality. The study highlights the need for meticulous parameter optimization, particularly in large-scale spinning operations. This study focuses specifically on studies investigating the impact of draw frame bottom roller gauge settings on overall yarn quality. By analyzing the methodologies and results of these studies, gained insights into the final stages of yarn production and the factors influencing the end product.

Siddiqua et al. [5] focuses on the pivotal role of traveller clearer settings in ring frame machines, as they are essential for preventing fiber congestion and maintaining yarn quality. Burkina Faso cotton fiber was used to produce 85's tex ring-spun yarn, and various traveller clearer settings were employed. Fiber properties were analyzed using High Volume Instrument (HVI) and Advanced Fiber Information System (AFIS). Among the tested settings, a 3.10 mm traveller clearer gauge yielded the most favorable results, exhibiting superior yarn properties such as a lower imperfection index, reduced hairiness, improved tenacity, and minimized end breakage rate. Statistical analysis through one-way ANOVA highlighted a significant difference in all properties except for yarn elongation.

Ahmad et al. [6] combing process is essential for enhancing the staple length of fibrous materials by removing short fibers, as well as eliminating impurities and neps. This leads to improved yarn aesthetics, smoothness, luster, and ensures soft, uniform, and robust yarn strength. Combing also facilitates blending with polyester fibers. The study suggests that certain technical adjustments within the combing machine can significantly impact sliver and final yarn quality. Therefore, investigating the influence of nipper gauge and drafting zone gauge on end product quality is recommended to better understand and enhance the combing process.

Karthikeyan et al. [7] conclude that textile industries face significant challenges in maintaining yarn quality and consistent dyeing due to fluctuations in cotton fiber quality. To address this, process parameters and machine settings must be tailored to the fiber's quality. The draw frame process, a crucial step in yarn manufacturing, was examined in this study, with modifications made to parameters like bottom roller setting, roller pressure, and break draft, based on cotton fiber properties. Standard testing methods were used to evaluate yarn physical properties. The results indicated notable improvements in yarn quality, with reduced unevenness, coefficient of variation, end breakage rate, and hairiness index after the modifications. Imperfections such as thin places, thick places, and neps were also significantly reduced, while yarn strength saw a notable increase. The study concludes that optimizing drafting roller parameters has a significant impact on enhancing yarn quality.

This study examines the influence of different roller gauge settings on the properties of ring-spun yarn, employing modern spinning machinery and testing methodologies. Through the examination of parameters including yarn uniformity, tensile strength, and defects, this research endeavors to offer helpful insights for the optimization of ring frame effectiveness and the enhancement of yarn quality. The objective is to address the deficiencies in the current literature and to provide concrete recommendations for the textile industry aimed at improving product quality and manufacturing efficiency.

2. Raw Materials and Method

2.1 *Raw Material*

100% cotton fibers of length 29 mm of Mali (West Africa) were used to produce ring spun carded yarn of 20 Ne, 26 Ne and 40 Ne. For the yarn samples preparations, blowroom to ring frame material processed through same machinery conditions as well as settings except one variable i.e. ring frame roller gauge setting. However, Uster HVI 1000 and Uster AFIS Pro 2 machines were used to measure the cotton fiber properties like length, strength, maturity, micronaire, color, trash, moisture content etc. shown in table 2.1 and table 2.2.

Table -2.1: HVI Report on Fibers Used:

HVI Parameter	Value
Average fiber length	29 mm
Spinning Consistency Index	140
Moisture %	7.0
Mic	4.38
Upper Half Mean Length	29.11 mm
Uniformity Index %	82.60
Short Fiber %	8.30
Rd	74.30
+b	9.80

Table -2.2: AFIS Report on Fibers Used:

AFIS Parameter	Value
Neps Content	71 per gram
Neps Mean Size	597 μm
Mean Length	33 mm
Short Fiber Content %	3.2

Fineness	169 mtex
Immature Fiber Content %	3.9

2.2 Machineries Used

At present, the short-staple (also called cotton or three-roller) spinning process is the most common spinning method worldwide. The name three-roller spinning comes from the arrangement of the rollers in the drafting zone in the most commonly used spinning machine, the ring spinning frame. This spinning principle is suitable for all fiber types with lengths up to 40 mm. It is very flexible with regard to the properties and applications of the produced yarns. Yarns manufactured by ring spinning are processed into wovens, hosiery, knits, and braidings in the areas of apparel, home textiles, and technical textiles.

Machine Flow Chart of Cotton Yarn Manufacturing Process:

2.2.1 Blowroom

The main functions of blowroom process are opening, cleaning, blending and mixing of cotton fiber tufts without overstressing of fibers. At first in blowroom the cleaning and opening of the bale was done by beaters and openers. The foreign materials like dust particles, seeds of cotton and other impurities were partially removed in this process, about 40%–70% trash was removed in this section. The cotton tufts had been opened and cleaned and mixing was also done after the study of the essential properties of fiber like staple length, tensile strength, fineness, uniformity etc. All machines in the blowroom section are manufactured by the brand known as Rieter.

Table -2.3: Parameters of Blowroom

Machine	Parameters	Value
Uniflock A-11	Beater Speed	1600 RPM
	Take off Depth	2.8 mm
	Travel Speed	14 m/min
Uniclean B-12	Cleaning Intensity	0.6
	Relative Waste Rate	4
	Speed	720
Unimix B-76	Cleaning Intensity	0.3
	Relative Waste Rate	3
	Degree of Opening	0.5
Unistore A-79	Cleaning Intensity	0.3
	Relative Waste Rate	4
	Stop Go	85%

2.2.2 Carding

After blowroom the cotton tuft was subjected to carding machine. Carding is the preliminary in spun yarn technology just after the blow room process where opening and cleaning, removing the small trash particles which have not been taken out from the blow room line – actions take place. It is called the mother or heart of spinning, because it prepares the fiber in such a way, which is ready to manufacture yarn because disentanglement, cleaning, and intermixing of fiber are happened. In this process the minute impurities like small seed particles, immature fibers etc. were removed.

The straightening and aligning of fibers were also done in small amount in this process and the blowroom lap of 0.0012 to 0.0015 lap hank was attenuated to the carded sliver.

Table -2.4: Parameters of Carding Machine

Machine	Parameters	Value
Carding (Brand: Rieter, Model: C70)	Model	C-70
	Production (kg/hr)	75
	Sliver delivered (gr/yd)	85
	Licker in Speed	1440 m/s
	Cylinder Speed	850 m/s
	Flats Speed	0.32 m/s
	Total Draft	110
	Chute Opening Roller Speed	850 m/s
	Licker in to Cylinder Gauge	0.3 mm
	Cylinder to Flat Gauge	0.250 mm
	Cylinder to Doffer Gauge	0.225 mm

Figure 2.1: Carding Machine

2.2.3 Draw Frame

Draw Frame is the machine where the slivers are doubled or combined, blended & mixed, leveled and attenuated transiently through a series of pairs of rollers. After carding process the carded sliver of 85 grains per yard was subjected to drawing and doubling operation. It was used as fibers need to be kept side by side termed as parallelization of fibers. Most of the improvement in fiber parallelization and reduction in hooks took place in this process.

Table 2.5: Parameters of Draw Frame

Machine	Parameters	Value
Breaker Drawing (Brand: Rieter, Model: SBD-45)	Model	SBD - 45
	Doubling	8
	Delivery Speed	650 m/s
	Sliver count	72 grains/yd
	Break Draft	1.3
	Bottom Roller Gauge	40×44 mm
	Bottom Roller Dia	30
Finisher Drawing (Brand: Rieter, Model: RSBD-45)	Model	RSBD - 45
	Doubling	8
	Delivery Speed	650 m/s
	Sliver count	72.5 grains/yd
	Break Draft	1.15
	Bottom Roller Gauge	39×43 mm
	Bottom Roller Diameter	30

Figure 2.2: Draw Frame machine

2.2.4 Simplex

Simplex is a machine which converts the drawn sliver into a thin strand of fibers having some amount of twist. It was used because the sliver from Draw-Frame was thicker and difficult to be fed into the Ring-frame, so the slivers were stretched and were made thinner by Drafting and mild twisting in Simplex and the end-product from this process was called as Roving and it was 0.7 Ne.

Table 2.6: Parameters of Simplex

Machine	Parameters	Value
Simplex (Brand: Toyota, Model: FL-200)	Model	FL – 200
	Roving Count	0.70 Ne
	TM	1.27
	TPI	1.1
	Bottom Roller Gauge	37.5×49.5×48.5 mm
	Top Roller Gauge	39.5× 51.5×46.5 mm
	Flyer Speed	1150 m/s
	Drafting System	4 over 4
	Condenser	15 mm
	Lifting Length	385 mm
	Cot Roller Hardness	83°

Figure 2.3: Simplex Machine

2.2.5 Ring Frame

A ring frame is a fundamental machine in the textile industry used to twist staple fibers into yarn by passing them through drafting zone then a rotating traveler and winding the resulting yarn onto a bobbin. This process is essential for creating high-quality, fine, and strong yarn for various textile applications.

In this project, roving of 0.70 Ne (0.70 hank/lb) is fed to two ring frame of different roller gauge keeping the same count of yarn produced from these ring frame machine. The roving is fed into the machine and passes through the drafting system, where it undergoes attenuation or stretching to reduce its thickness. This drafting process helps align the fibers and control the fineness of the yarn. Subsequently, the drafted roving enters the ring and traveler system, where twist is imparted to the fibers, and the yarn is wound onto a bobbin.

Table 2.7: Required parameters for two ring frame machines

Machine	Parameters	Value	Value	Value
Ring frame Brand: Zinser Model: 351 with auto-doffer	Yarn Count	20 KH	26 KH	40 KH
	Ratio	100% Cotton	100% Cotton	100% Cotton
	Roving fed	0.70 Ne	0.70 Ne	0.70 Ne
	TPI	16.55	18.85	23.40
	Spacer	3.5 mm	3.0 mm	2.50 mm
	Ring Traveller	1/0	2/0	4/0
	Average Speed	14500 RPM	16000 RPM	18000 RPM

Figure 2.4: Ring Frame Machine

2.2.5.1 Roller Gauge Length:

The roller gauge length is the distance between the front and middle as well as middle and back rollers within the drafting system, plays a pivotal role in determining the extent of drafting and twisting applied to the fiber strand. The setting exerts a considerable influence on various yarn properties, including count, strength, elongation, evenness, and hairiness etc.

Table 2.8: Roller Gauge for two ring frame machines

Gauge in Machine	Bottom roller gauge		Top roller gauge	
	Back zone (mm)	Front zone (mm)	Back zone (mm)	Front zone (mm)
Closer Gauge	65	42.5	68	49
Wider Gauge	70	42.5	71	51

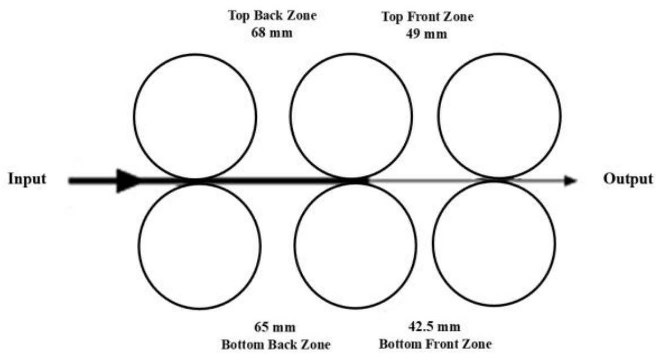

Figure 2.5 (a): Closer roller gauge setting in Ring frame machine

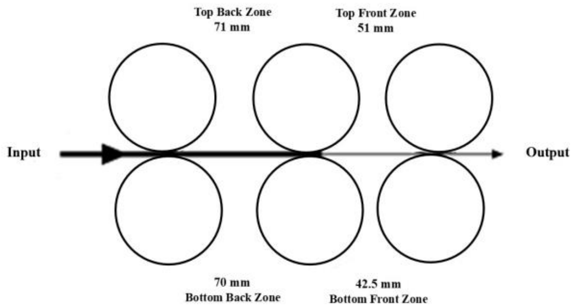

Figure 2.5 (b): Wider roller gauge setting in Ring frame machine

Figure 2.6 (a): Closer Gauge of Ring Frame

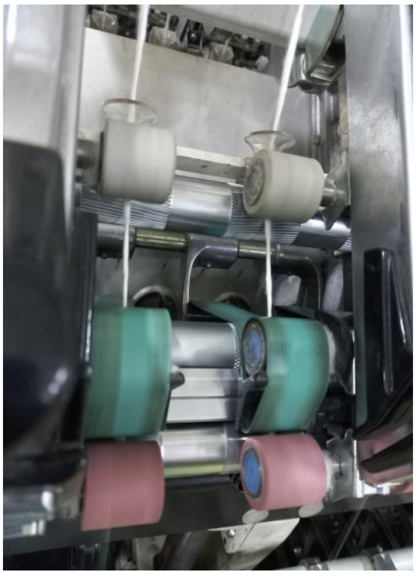

Figure 2.6 (b): Wider Gauge of Ring Frame

2.3 Testing Instruments Used

2.3.1 HVI

HVI, stands for High Volume Instrument, was a critical tool in the spinning industry used to measure essential properties of cotton fibers, such as length, strength, micronaire, maturity, and color, before they are processed in the spinning mill. It ensures that cotton lots are accurately assessed and helps yarn manufacturers produce consistent and high-quality yarn by optimizing the blending and spinning processes.

In the project, a sample of cotton fibers from blowroom was collected and conditioned to a standard testing parameter. This sample was then loaded into the HVI machine's feeding system, which can handle loose fibers or sliver. The HVI machine electronically measure properties such as length, strength, micronaire, maturity, and color. The resulting data was analyzed to determine the quality of the cotton sample.

Table 2.9: HVI Data

Bale ID	SCI	Mst	Mic	Mat	UHML [mm]	UI [%]	SF [%]	Str [g/tex]	Elg [%]
Avg	140	7.0	4.38	0.57	29.11	82.6	8.3	32.0	6.2

Rd	+b	CGrd	TrCnt	TrAr (%)	TrID TrGrd	Amount
74.3	9.8	22.1	25	0.22	2	-

Figure 2.7: HVI machine

Figure 2.8: Uster AFIS PRO 2

2.3.2 AFIS

AFIS (Advanced Fiber Information System) is a technology used in the spinning industry to analyze and assess properties of fibers, sliver such as length, fineness, maturity and trash content etc. It provides detailed data to help textile manufacturers make informed decisions in their production processes, ensuring the quality and consistency of yarn.

In the study investigating the effects of ring frame roller gauge settings on the characteristics of ring-spun yarn, a comprehensive process involving the Advanced Fiber Information System (AFIS) was employed. Three different yarn counts, specifically 14 Ne, 26 Ne, and 40 Ne, were examined under varying gauge settings. The preparatory phase involved collecting representative samples and ensuring their proper conditioning.

The AFIS machine was calibrated and configured to analyze parameters such as fiber length, diameter, maturity, trash content, and color. Yarn samples were loaded for analysis, and the resulting data, encompassing multiple yarn counts and gauge settings, were meticulously recorded.

Table 2.10: AFIS Test Report for Neps

Rep	Total Nep Cnt	Total Nep Mean Size	Fiber Nep Cnt	Fiber Nep mean size	SC Nep Count	SC Nep Mean Size
Mean	71	597	67	581	4	772
Std. Deviation	6	26	5	7	4	175
CV%	8.2	4.4	7.5	1.2	93.3	22.6

2.3.3 Uster Evenness Tester

The evenness tester, often referred to as a yarn evenness tester, is a specialized device used in the spinning industry to measure and evaluate the regularity and consistency of a yarn or textile strand. It also assesses the variations in yarn thickness, identifying imperfections such as thick and thin places in the yarn, which are critical for maintaining yarn quality.

The different counts, such as 20Ne, 30Ne, and 40Ne, in an evenness tester begins with the preparation of the yarn samples. These samples are unwound from their packages or bobbins and conditioned for consistent moisture content. The yarn samples are then fed into the evenness tester, which employs laser or optical sensors to continuously monitor variations in yarn thickness. The resulting data is analyzed to generate a graphical representation of the yarn profile, highlighting variations in thickness.

Table 2.11: Uster Evenness Tester Report for Roving

Nr	U%	CVm%	CVm% (1 m)	CVm% (3 m)	Rel Cnt ±
Mean	3.09	3.82	1.64	0.93	0

Figure 2.9: Uster Evenness Tester

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2.3.4 Lea Yarn Strength Tester

A Lea Yarn Strength Tester is a specialized device used in the spinning industry to assess the strength and tenacity of yarns. It measures the force required to break the yarn and calculates parameters like breaking strength and tenacity, helping ensure yarn quality for specific applications.

To identify the effects of ring frame roller gauge settings on ring-spun yarn characteristics were investigated using a Lea Yarn Strength Tester. Representative yarn samples were prepared, conditioned, and the tester was calibrated. The yarn samples were cut and loaded onto the machine, with tension settings adjusted accordingly. The testing procedure to measure tensile strength and elongation was initiated. The process was repeated for consistency, and the obtained data, including variations in yarn strength under different roller gauge settings, was recorded. The entire procedure was documented for reproducibility, and quality control measures were implemented to ensure result accuracy.

Figure 2.10: Lea Strength Tester Machine

3. Result and Discussion

3.1 Comparison of Yarn Properties for 20 Ne, 26 Ne and 40 Ne modifying the roller gauge setting

The project deals with comparing yarn properties for 20 Ne, 26 Ne, and 40 Ne yarns with modified roller gauge settings, variations in yarn characteristics become evident. The Ne count signifies yarn fineness, and as it increases, yarn becomes finer.

3.1.1 Unevenness Percentage (Um%)

"Um%" in spinning typically refers to "Unevenness Percentage". It is a measurement used to assess the irregularity or variation in the thickness or diameter of spun yarn. The Um% value indicates the degree of yarn thickness variation over a specific length. Table 3.1 shows the Um% varying the roller gauge for three different counts of yarn.

Table 3.1: Comparison of Um%

Yarn Count	Closer Gauge	Wider Gauge
20 Ne	9.65%	10.19%
26 Ne	10.83%	11.52%
40 Ne	12.18%	12.75%

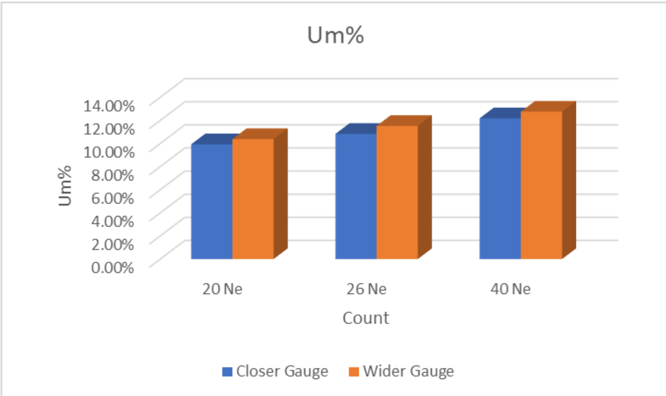

Figure 3.1: Changes of Um%

The bar diagram illustrates that unevenness of yarn increases with the increase of yarn count. It also shows higher Um% found in wider roller setting than closer roller setting.

The order: 40Ne > 26Ne > 20Ne

This irregularity can result from factors such as inconsistent spinning, fiber defects, blending issues, and mechanical problems. To mitigate this, manufacturers employ quality control measures such as regular monitoring, proper blending, fiber preparation, and machinery maintenance.

3.1.2 Coefficient of Variation (CVm%)

Coefficient of Variation (CVm%) in textiles measures the variation in a specific characteristic of yarn, such as its thickness or strength. It is expressed as a percentage and indicates the degree of variability within a set of yarn samples. Table 3.2 shows how the CVm% changes as the roller gauge is altered for three different yarn counts.

Table 3.2: Comparison of CVm%

Yarn Count	Closer Gauge	Wider Gauge
20 Ne	12.60%	13.14%
26 Ne	13.75%	14.63%
40 Ne	15.57%	16.30%

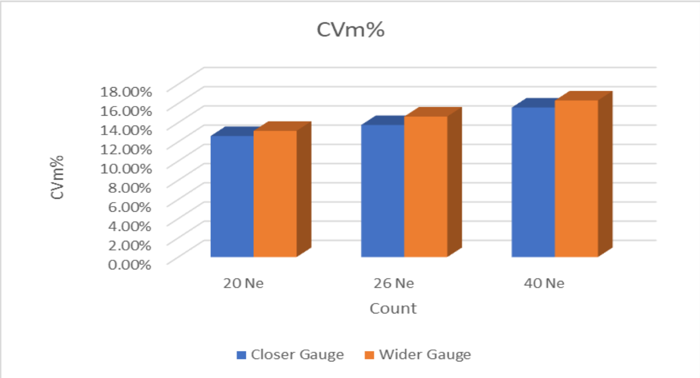

Figure 3.2: Changes of CVm%

The bar diagram illustrates that CVm% of yarn increases with the increase of yarn count. A wider roller setting was found to exhibit a higher CVm% compared to the closer roller setting.

The order: 40Ne > 26Ne > 20Ne

The lower CV% suggests that the yarn has consistent properties, while a higher CV% signifies greater variability. Textile manufacturers strive for lower CV% values to ensure that their yarn meets quality standards and produces uniform and consistent fabric in subsequent processing. Reducing CV% is often achieved through precise manufacturing processes, quality control, and careful selection of raw materials.

3.1.3 Imperfection Index (IPI)

The Imperfections Index (IPI) is a critical quality measurement used in the spinning industry to assess the presence of defects or irregularities in yarn. It quantifies the number of imperfections, such as knots, slubs or neps, found in a length of yarn. Tables 3.3(a) and 3.3(b) presents the variations in IPI while altering the roller gauge for three distinct yarn counts.

Table 3.3(a): Thick, Thin and Neps are shown

Count	Settings	Thin (-50%)	Thick (+50%)	Neps (+200%)	IPI
20 KH	Closer	0	45	36.3	81.30
	Wider	0.6	59.1	40.9	100.60
26 KH	Closer	0.6	75.9	76.6	152.04
	Wider	4.10	158.8	105.30	268.15
40 KH	Closer	11.6	229.1	450	690.32
	Wider	17.2	305.2	502.03	824.68

Table 3.3(b): Comparison of IPI

Yarn Count	Closer Gauge	Wider Gauge
20 Ne	81.30	100.60
26 Ne	152.04	268.15
40 Ne	690.32	824.68

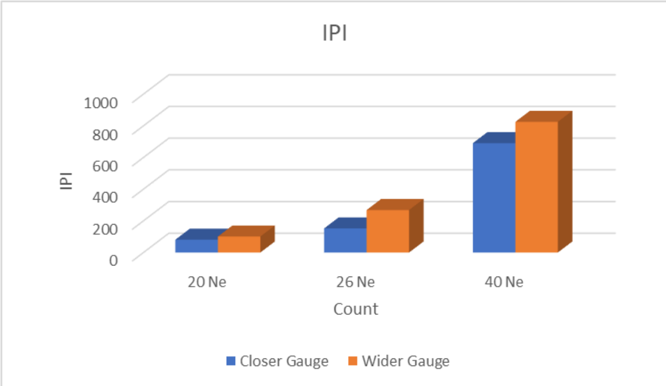

Figure 3.3: Changes of IPI

The bar diagram illustrates that IPI of yarn increases with the increase of yarn count. The closer roller setting demonstrates a lower IPI compared to a wider roller setting.

The order: 40Ne>26Ne>20Ne

The lower IPI value indicates higher yarn quality, as it signifies fewer imperfections. IPI is determined through visual or automated inspection processes and is a vital parameter in ensuring the production of high-quality textiles, as it directly affects the final fabric's appearance, strength, and durability. Manufacturers often implement quality control measures and defect-removal techniques to reduce IPI and improve yarn quality.

3.1.4 Count Strength Product (CSP)

Count Strength Product (CSP) is a crucial measurement as well, combining yarn count and its strength. This metric helps in evaluating the overall quality of the yarn. Table 3.4 displays differing CSP values based on adjustments to the roller gauge for three separate yarn counts.

Table 3.4: Comparison of CSP for 20 Ne, 26 Ne and 40 Ne

Yarn Count	Closer Gauge	Wider Gauge
20 Ne	2563	2611
26 Ne	2267	2330
40 Ne	2137	2239

Figure 3.4: Changes of CSP

The bar diagram illustrates that CSP of yarn decreases with the increase of yarn count. The closer roller setting results in a lower CSP compared to a wider roller setting.

The order: 20 Ne > 26 Ne > 40 Ne

The higher CSP value signifies a yarn that is both strong and fine, making it suitable for various textile applications.

3.1.5 Hairiness Index

The hairiness index is a quantitative measurement used in the textile industry to assess the level of hairiness in a spun yarn or fabric. It is a numerical value that indicates the degree of protruding fibers or tufts on the yarn's surface. Table 3.5 shows the variations in Hairiness Index as the roller gauge is modified for three distinct yarn counts.

Table 3.5: Comparison of Hairiness

Yarn Count	Closer Gauge	Wider Gauge
20 Ne	6.67	6.70
26 Ne	6.37	5.94
40 Ne	3.78	3.02

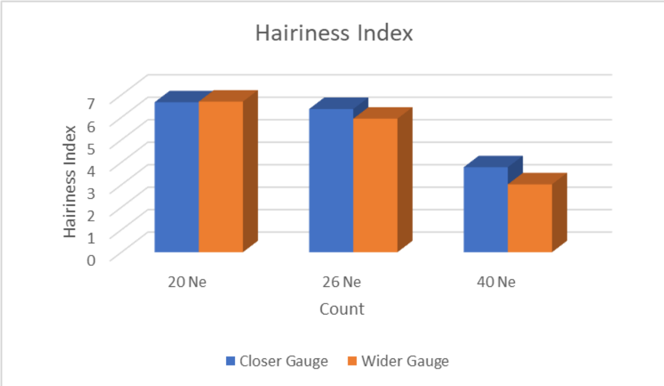

Figure 3.5: Changes of Hairiness

The bar diagram illustrates that Hairiness Index of yarn decreases with the increase of yarn count. The hairiness index increased by 19.48%, 43.30% and 16.29% respectively.

The order: 20 Ne > 26 Ne > 40 Ne

Hairiness Index in a textile material can lead to reduced aesthetic appeal due to a rough or uneven surface, potentially making it less desirable for various applications. Excessive hairiness can also result in pilling, which affects the material's durability and visual quality. To address these effects, textile manufacturers may implement quality control measures, use less hairy fibers, or modify production processes to reduce hairiness and improve the overall quality of their products.

3.2 Limitation

- The conditioning process was not carried out on the yarns.
- Some samples could not be collected due to mill authority restrictions
- The experiment could not be conducted individually on distinct machines.

4. CONCLUSIONS

The analysis of yarn properties for different counts (20 Ne, 26 Ne, and 40 Ne) produced on two ring frame machines of wider and closer drafting zone respectively revealed important insights. Yarn count had a significant impact on several key parameters, including unevenness, coefficient of variation, imperfections, count strength product, and hairiness index. Generally, higher yarn counts were associated with increased unevenness, variability, and imperfections, while finer yarns demonstrated higher strength and reduced hairiness. These findings underscore the importance of yarn count selection, quality control, and process optimization in textile manufacturing to meet the desired quality standards for various applications. Manufacturers should carefully consider these factors to produce consistent, high-quality yarn for the intended textile products.

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