



Daffodil
International
University

Faculty of Engineering

Department of Textile Engineering

Study on

“Comparative study among Siro yarn, Compact yarn and Siro compact yarn”

REPORT ON

Course Title: Project (Thesis)

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To

The Head

Department of Textile Engineering

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Daffodil Smart City (DSC), Ashulia, Dhaka-1341

Subject: Approval of Thesis Report of M.Sc. In Textile Engineering

Dear Sir,

It gives me pleasure to announce that the report of the Thesis topic “Comparative study among Siro yarn, Compact yarn and Siro compact yarn” by the student with ID 213-32-011 is available.

The information in this report has been prepared with care and correctness based on the study done in “MATIN SPINNING MILLS LTD, Sardaganj, Kasimpur ,Gazipur, Bangladesh.”. It includes checking data gathered by observation and including extra information to support it. To understand the Theses better, the student participated in every step of the activities.

Hence, I humbly appeal to any dedicated reader to pay attention to this Theses report and possibly use it for one final assessment. Your compliance with the above in this regard will be much appreciated.

Your Sincerely



.....
Md. Mashud Raihan

Assistant Professor

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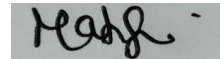
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I also want to say how much I appreciate my family members and parents’ love. I am truly thankful to everyone who has assisted, helped and encouraged me throughout the various stages of this work.

SUPERVISORE DECLARATION

I am announcing that, this report has been prepared following the guidance of Md. Mashud Raihan, Sir Assistant Professor Department of Textile Engineering, Daffodil International University. Also neither my report nor any part of it has been used to secure any academic credit.

Submitted By:



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Abstract

My thesis work examines how Siro yarn, Compact yarn and Siro Compact yarn work in performance, using 100% Australian cotton for all. Yarn samples were prepared with strict control to ensure 10,14,16,18,20,22,24 Ne yarn counts and twist amounts and draft were changed. The cotton was tested using equipment in the industry to determine Unevenness, Coefficient of Variation of mass, Imperfection Index (IPI), Hairiness, Tensile Strength (CN/TEX) and elongation. Siro Compact yarn is tested to have superior uniformity, less hairiness, higher strength and greater elongation than Siro and Compact yarns. When the Siro and Compact techniques are used together, the yarn mostly gains properties suitable for making tough, long-lasting textiles.

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Chapter One

1.0 INTRODUCTION

1.1 Background

People learned to make spinning wheels in ancient times, to turn fibers, whether from plants, animals or fabric, into yarn. For generations, people used a spindle and distaff to create yarn using their hands. Although spinning wheel enhanced the possibility of making more output during the High Middle Ages, it dawned on the 18 th century and the industrial revolution that the mass production came up. On large scale yarn is now produced using different techniques.

Among the various developments, ring, compact and Siro spinning are most often used by the industry. Spun yarn characteristics mainly depend on the natural fiber and the machinery used to spin them. Whichever spinning method is used, yarns with unfamiliar qualities are produced which influence the final textile item. Even so, the classic ring technology in spinning still brings about reduced output, takes more time and adds to the cost of production. A further complication with ring-spun yarns is that they are more likely to be uneven and have more fuzz and there is a difference in how the yarn is spun. As a result of these flaws, experts in textile manufacturing are constantly looking for new improvements to spinning. Improved yarn evenness using Siro spinning, along with the creation of less hairy and stronger yarns through compact spinning, have become popular. Uniting these two spinning methods—Siro-compact spinning—brings even better yarn results.

The purpose of this thesis is to compare Siro yarn, Compact yarn and Siro compact yarn. Various parameters of yarn quality are studied, for example, mass deviation (U%, CVm%), imperfection index (thickness equal, thinness equal, neps equaling Km), strength, hairiness and elongation mechanism. Spinning of cotton yarn from Australia was done by producing samples on the newest Auto Doffer Ring Spinning equipment. Determined results were obtained on the AUTODYN 2 Plus and by Uster testers.

Researchers discovered that Siro-Compact yarn has higher quality than both Siro and Compact types of yarns. The material is found to be both consistent and stronger in structure, appears smoother, has fewer hair-like features and offers improved stretchiness. They demonstrate that Siro-Compact spinning technology can help improve conventional spinning and make better yarn for more efficient textile products.

1.2 Present state of problem:

The textile industry keeps looking for innovation to improve the quality of yarns, enhance how items are produced and improve their performance. Yarns produced by ring spinning are normal, but Siro spinning and compact spinning ideas have introduced new ways to handle hairiness, strength and irregularity in yarns. Siro yarn stands out because it blends the threads from two rovings which gives it fewer hairy spots and makes it stronger than ring yarn. Using the Single Compact yarn process, the strand is condensed first which allows for more accurate fiber and hair alignment, as well as stronger and more attractive fabrics.

- By combining both technologies, Siro compact yarn could achieve even better yarn performance. On the other hand, there is not much literature on how these yarns measure up to each other based on mechanical features, fiber alignment, their hairiness and how they feel when you touch them. Few studies have compared all three important technologies together in the same setting.

1.3 Problem solving technique:

This study will tackle this problem by using this approach:

It should make samples of Siro, compact and Siro compact yarns under the same controlled spinning conditions for all the yarns out of the same fiber type and count, to ensure the result can be compared.

Carry out typical tests on samples of yarn, checking tensile strength, elongation, hairiness, unevenness and analyzing fiber orientation using Uster testing . Review and compare data on yarn types with the help of statistics, so you can find important variations and relationships. What the Results Mean and Recomillimeterendations Analyze outcomes to find out the pros and cons of every yarn type. Support fibre users by suggesting yarns that align with the requirements of their fabrics and the projects they plan.

1.4 Objectives

1.4.1 Focusing on spinning, this step looks at the types of Siro spinning, compact spinning and Siro compact spinning.

1.4.2 To compare a comparative analysis of this three yarn.

1.4.3 To compare test result and determine best spinning method.

1.4.4 Check the results from each spinning method in an organized way to see which leads to better quality yarn.

1.4.5 In order to analyse the key characteristics of yarns such unevenness (U%), co-efficient of variation of mass (CVm%), imperfections, hairiness, tensile strength and elongation, in different types of yarns, etc. siro, compact and siro compact.

1.4.6 To look at whether changes in the spinning process give the yarn new or improved properties.

1.3.7 The purpose of this section is to display the novelty of the research by exposing gaps in relevant literature.

1.3.8 To build a well-founded view of how Siro, compact and Siro compact yarns perform relative to each other.

CHAPTER TWO

2. LITERATURE REVIEW

Compact spinning is investigated in the paper to understand how it helps remove spinning triangles and optimize packed fiber volume. It does not provide information on Siro spinning or Siro compact spinning even though the paper does not explore their key features and value.[1] Compact spinning is used to enhance yarns by removing issues called spinning triangles and making the most efficient use of space for fibers throughout analysis. Since the paper neglected to mention key development matters, information about Siro spinning and Siro compact spinning is missing.[2] The account examines the manufacturing process of Siro yarn and explains how it works with flame-resistant fibers. While the article focuses on the benefits of Siro-spun yarns, it does not include the latest compact spinning systems that continue to be important for producers.[3] The study investigates a spinning technology that uses both compact and Siro systems to achieve improved yarn structure and its mechanical strength. As a result of this new technology, textile manufacturers now enjoy increased yarn strength and greater production speed.[4] Siro compact spinning is examined in the paper, showing that joining Siro with compact spinning produces better yarn that is less hairy and more strong—making the textile industry more productive and efficient.[5] In this study, we focus on Solo-Siro spun yarns which beat Solo spun yarns with both mechanical and physical properties. Making Solo-Siro yarns increases the consistency of fiber position, makes migration easier, reduces hairiness and so improves how strong and elastic the fiber is.[6] As reported in the paper, both kinds of Siro-spun yarn are more even and less hairy than ring-spun yarns, but compact-spinning in yarn knitting produces yarns with better packing ability and improved mechanical qualities. There is not much discussion in the paper specifically about "Siro Compact Yarn." [7] Both the even look and lack of hair on Siro yarn are superior to what ring-spun provides. Meanwhile, the higher density and reduced hairiness of compact yarn are not achieved by the others. Merging the most desirable points of Siro yarn leads Compact-Siro to be more stable in shape, offer balanced structure and cause less hairiness [8]. Yarns created through Siro compact process have all the good qualities of Siro and compact variants, plus excellent strength, less hairiness and are also more resistant to wear and damage than ring-spun, Siro or compact types. [9] Experimental findings indicate that fabric made from Siro-produced knitting yarn is both compact, hairless to a certain extent and strong which is suitable for underwear. [10] The process of fiber condensation improves through Compact spinning by removing the spinning triangle structure and creating negative pressure airflow which results in denser yarn packing. The spinning process using Compact technology results in regularized yarns with better U% performance while decreasing defects (IPI) to produce durable homogenous yarns.

The yarn quality improves through Compact spinning because this process eliminates the spinning triangle as well as enhances fiber condensation using negative pressure airflow and achieves higher packing density. Better yarn quality results through enhanced U% levels leading to stronger yarn that exhibits higher uniformity. [11] The yarns produced using the 3D-printed guiding device achieved optimal evenness while lowering imperfections through better fiber condensation during the compact spinning process. [12] The study demonstrates that compact three-roving and compact spun and compact siro-spun yarns have different levels of U% and IPI which shows compact spinning improves yarn consistency by better arranging fibers and making stronger yarn structures. [13] Yarn quality improves significantly when yarn manufacturers use Suessen Elite compact spinning because the technique improves U% values and reduces IPI measurements compared to regular ring spinning. [14] The research indicates that using Suessen Elite compact spinning both improves yarn evenness measurements (U%) and decreases IPI while maintaining superior yarn quality results. [15]

Positive pressure airflow within compact spinning compression fibers to improve their packing density by reducing hairiness. The parallel orientation of fibers in Siro Compact yarn makes yarn quality better while reducing hairiness to a minimum. [16] The CGC device decreases hairiness through its ability to capture float fibers resulting in a 40% reduction of pure cotton yarn. The

combination of Siro spinning techniques with this device creates improved fiber alignment thereby reducing hairiness to a greater extent.[17] The study examined a device should be with dynamic- and static-friction rollers that combats hairiness by regulating torsion on its fibers and generating friction gradients to obtain better yarn results.

[18] Compact siro spinning of viscose fibers achieves reduced hairiness by aligning fibers better during carding and drafting that results in uniform slivers with straighter and better-separated yarns.[19]The research paper evaluates a dual-bar system that controls yarn hairiness through spindle speed adjustments together with ring spinning machine contact angle manipulation but excludes compact spinning and Siro Compact yarn.[20]

The research investigates a rotor-spinning method to improve yarn strength through vortex reduction and enhanced fiber alignment but omits CSP breaking strength and elongation analysis between compact and Siro yarns.[21] The compact spun yarns have better broken strength (CSP) and elongation than convention ring spun yarns because they have better line up of the fibers as well as having low hairiness levels which contributes to high quality especially in the Long Staple cotton materials. [22] High tensile strength (CSP) together with better elongation attributes emerge in compact spun yarns because they utilize advanced fiber organization and minimized yarn roughness to improve fabric quality particularly for Long Staple cotton.[23] Testing of breaking strength (CSP) and elongation and strength evaluation between compact and Siro yarns regarding fiber alignment is absent from this paper.[24]According to the research, siro yarns demonstrated maximum strength with conventional ring spun yarns performing at the lowest level. Break elongation yielded its highest value for Coolmax fibers because of the spinning methods used in production.[25]

The paper examines sirofil pure cotton elastic yarn as a spandex replacement for elastic jean fabrics to enhance stiffness and smoothness while maintaining hand feel without evaluating sirofil and other types such as compact or siro compact.[26] This text examines a supersoft denier modal fiber compact siro spinning yarn suitable for textile underwear fabrics at the premium level because its compact form and low hairiness offers moderate strength properties.[27] High-count pure cotton yarn from compact siro spinning produces luxurious clothing quality and textured textiles with comfort and market worth while minimizing cost relative to traditional plied yarns.[28] This paper investigates compact siro spinning technology in yarn production while omitting information about siro, compact and siro compact yarn applications and final performance outcomes.[29]This paper explores blended yarn siro compact spinning technology for improving functional yarn properties. Premium-quality garments together with home textiles benefit from Siro compact yarn because it provides improved gloss and serviceability which facilitates high-performance applications.[30]

The fiber manufacturing speed increases to 64 g/h through core-sheath operations at lower operating pressures which minimizes energy usage per mass material.[31] The research analyzes compact-Siro spinning as an improved method for fiber waste reduction and enhanced fiber utilization although it does not present energy usage or production efficiency figures.[32] Specific measurements of energy consumption and efficiency levels are absent from the paper although it shows how Compact-Siro spinning increases fiber usage and minimizes waste when compared to traditional ring frame production.[33] This paper points out the advantages of compact spinning for fiber control without providing numerical data on energy use or efficiency while demonstrating how this method reduces sustainable waste.[34] Many specific energy and efficiency-related metrics are absent from the study although it demonstrates that compact-Siro spinning technology leads to better yarn quality which implies improved efficiency alongside

waste reduction.[35]

The paper examines the challenges of compact spinning that include financial costs along with operational process needs before recommending future research to enhance both performance efficiency and affordable solutions.[36] The paper shows that compact spinning technology ensures easier manufacturing steps and decreases power requirements and enhances yarn covering quality. Further research needs to optimize parameters which will enhance the performance and cost-effectiveness of Siro compact covering yarn.[37]The expenditure for compact spinning rises because it needs additional workforce and additional equipment alongside higher energy expenses. Wider acceptance of compact spinning requires additional research to perfect operational parameters and find solutions for air splicing and equipment maintenance.[38] A study of nano-microscale yarn production through siro spinning exists in the paper even though it lacks information about challenges, costs and process optimization within compact and Siro Compact spinning systems.[39] The document concentrates on compact Siro spinning folded yarn while discussing blending process parameters for nylon-66 and cotton without examining challenges or expenses.[40]

2.3 Yarn preparation and spinning

2.3.1 raw material selection and preparation

100% Australian cotton fibre were selected . this fibre has its high quality and consistency. Raw cotton firstly clean and blend to remove impurities and confirm uniformity. After that fibre are kept to an optimal moisture content to enhance spinning efficiency.

2.3.2 Yarn Preparation :

Cleaned cotton fibre were converted into roving's using carding, drawing,lap former combing process. It is maintain uniform roving properties to ensure a fair basis for comparison. This roving's were used as the feed material for the three spinning methods for this study.

2.3.3 spinning method

Three spinning techniques (siro, compact and siro compact) were maintain to produce yarn samples from the prepared roving's:

Siro spinning : here In Ring Spinning two rovings are fed simultaneously, there two rovings are towisted together to form a single Yarn. IN this process it develop fibre integration and lessen hairiness.

Compact Spinning : Here a compacting Zone or compacting device are placed in traditional ring spinning process, this compacting Zone or compacting device condense the fiber strand just before twist insertion.As a result it maintain better fibre alignment , lessen hairiness and increased yarn strength.

Siro compact spinning: this spinning process contain both Siro and compact spinning process by feeding two roving in a compact spinning frame. This dual roving input and passing through compcting zone gets both technologies benefits. And then get yarn with best mechanical and surface properties.

2.3.4 Yarn production:

Yarn are produced in ring spinning machine equipped by necessary attachments for siro and compact spinning . by given different twist and different draft different yarn count 10,14,16,18,20,22,24 Ne are produced. We get different properties Unevenness (U%), CVm %, Hairiness, Elongation, Imperfection Index (IPI), strength (CN/TEX) of different count 10,14,16,18,20,22,24 Ne .

CHAPTER THREE

3. EXPERIMENTAL DETAILS:

3.1 Material: from a supplier 100% Australian cotton fibers were procured collected and subjected to standard preparation processes before spinning. So for this study 100% Australian cotton fiber is used . it is superior in quality . In the experiment, the Yarn samples were generated in the three methods of spinning-Siro spinning, compact spinning, and Siro-compact spinning.

3.2 Properties of the Cotton Fiber:

Before spinning, the cotton fibers sample are tested by fibre testing machine such as High Volume Instrument (HVI). 100% Australian cotton fiber properties are summarized below:

The fineness of 4.5 micronaire indicates medium fine fibers, and the length of 28.8 millimeter, Uniformity Index: 85.5%, Strength: 30.1gm/tex, Elongation:6.8%, Maturity Ratio:0.90, Reflectance (Rd):75.2, Yellowness (+b):9.3, Moisture Content:7.0, SCI (spinning consistency index): 130, supports good spinning performance and yarn strength.

3.3 Experimental Design: in order to compare the quality of yarn produced through the three spinning techniques Siro spinning, compact spinning and Siro compact spinning the experimental setup was done diligently.:

- Spinning Methods:
 - Siro yarn
 - Compact yarn
 - Siro compact yarn
- Fiber: 100% Australian cotton
- Yarn Count: Constant yarn count (e.g.10, 14, 16, 18, 20, 22, 24 Ne) maintained for all samples.
- Twist: Different twist level applied for producing different count of yarn (e.g.10, 14, 16, 18, 20, 22, 24 Ne).
- Production Parameters: Spinning machine settings such as spindle speed, delivery speed were kept constant but draft was different for different count

3.4. Experimental Procedure: The Australian cotton fibers are being cleaned and mixed and then the fibres are conditioned at 65% relative humidity and 20degree centigrade in 24 hours to retain the optimum moisture level. Before spinning.

3.4.1 Yarn manufacturing flowchart:

Production important factor is process flow chart. In the present thesis work cotton fiber are opened, clean and mixed in blow room and carded, draw frame, lap former, comber, simplex, and ring frame process is used to produce the yarn. The below process flow chart is presented:

Process flow chart:

Input	→	Process	Output
Fibre	→	↓ Blow Room	→ Chute mat
Chute Mat	→	↓ Carding	→ Card sliver
Card Sliver	→	↓ 1 St /Breaker draw Frame	→ Drawn Sliver
Drawn Sliver	→	↓ Lap Former	→ Lap
Lap	→	↓ Comber	→ COMBED SLIVER
Combed Sliver	→	↓ Finisher draw frame	→ Finished sliver
Finisher Sliver	→	↓ Simplex	→ Roving
Roving	→	↓ Ring Frame/ Spg Frame	→ Yarn
Yarn	→	↓ Winding	→ Package Yarn

3.4.2 Blow room line: Blow room is a set of machineries. And it is the first stage in the cotton spinning process, responsible for opening, cleaning, and blending raw cotton fibers before carding. It plays a comillimeteron role in producing Siro cotton yarn, compact cotton yarn, and siro compact cotton yarn, and here use the same fiber and the blow room's job remain same for producing siro cotton yarn, compact cotton yarn, and Siro compact cotton yarn



Blow Room
Production rate (100%)=800 kg/hour
Efficiency: 95%

Uni Flock:

Manufacturer: RIETER (Switzerland)

Brand name: : Uni Flock

Model No. : A1

Function: To pick raw material and pass to next.

Uni Clean:

Cleaning intensity: 0.5

Relative waste: 8

Manufacturer : : RIETER (Switzerland)

Brand name: : Uni Clean

Model No.: B11

Function: To eliminate the dust and the trash particle.

Uni Mix:

Manufacturer : RIETER (Switzerland)

Brand name : Uni Mix

Model No.: B 70

Function: mixture of fiber and storage.

Uni Flex:

Cleaning intensity is : 0.6
Relative waste is : 10
Manufacturer: RIETER (Switzerland)
Brand name : Uni Flex
Model No.: B 60
Function: It works as a super cleaner.

Jossi:

Particale size: 1530
Color contrast-15
V tect-560
Magic Eye-30
Fire Detector:
Manufacturer: RIETER (Switzerland)
Function : To detect fire

Heavy Metal Detector:

Manufacturer: RIETER (Switzerland)
Function : To detect heavy metal.

Dust Collection System:

Air Suction System
Rotary Filter System

Mixing System:

Completely Auto Mixing System
Delivery System: Chute Feed System Equipment

3.4.3 Carding machine

In the cotton spinning process, carding machine is a one of the fundamental component especially when producing siro cotton yarn, compact cotton yarn, and siro compact cotton yarn using the same fiber. It makes cotton fibre into a uniform sliver suitable for further processing. In carding machine it removes impurities, short fibers, and neps, which is critical for all high-quality yarn types. Here fiber separation and parallelization are occurred, and condensed carded sliver by consistent web. here neps and foreign matter are effectively controlled.

for siro yarn, compact yarn, siro compact yarn, three yarns use the same fiber, same machine setting in carding machine. here machine's efficiency influences sliver quality, impacting yarn strength, smoothness, and performance. Carding machine here occur the necessary clean, alignment, and uniformity to support the production of high-performance yarns across siro cotton yarn, compact cotton yarn, and siro compact cotton yarn. The variation of sliver weight is generally high at 2.5 to 2.5%. in general control of hank is not generally practiced in factory. RIETER (Switzerland) machine is used in this process and model no is C 60. To calculate the sliver hank, 6 yards are taken and the sample are weighted in gram. Grain/yard: 100.0, production rate: 70 kg/hour. The other setting parameters of carding machine are given below-

Model: C 60

Manufacturer: RIETER(Switzerland)

Manufacture year: 2005

Efficiency: 95%

Rate of delivery speed: 62kg/hr

Feed roller dia: 172millimeter

Feed roller speed: 17-30rpm

Opening roller diameter:-292millimeter

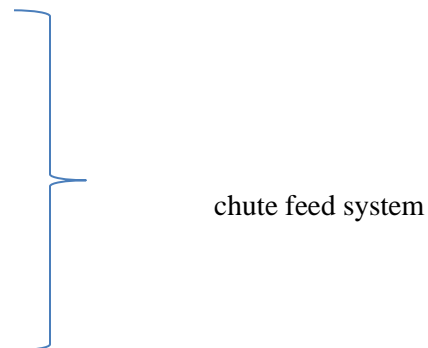
Opening roller speed:850rpm

The diameter of delivery roller: 156millimeter

Delivery roller speed: 17- 30rpm

The diameter of the feed roller: 100millimeter

Speed of feed rollers: 17-30rpm



Licker in dia; 253millimeter diameter

Licker in speed: 1300-1700rpm

The diameter of the cylinder is: 814millimeter.

Speed of the cylinder diameters: 875 rpm



Fig: Carding machine

- Doffer diameter: 680 millimeter
- Doffer speed: varies with/ depends on delivery
- Diameter of stripping roller: 118 millimeter
- Stripping roller speed: varies with/ depends on delivery
- Diameter of squeezing roller: 80millimeter
- Squeezing roller speed: varies with/ depends on delivery
- Diameter of cleaning roller 100millimeter
- Cleaning roller speed: varies with/ depends on delivery
- Disc roller diameter: 72millimeter
- Speed of disc roller: varies with/ depends on delivery
- Flat speed: dependent on cylinder speed 340 millimeter/min
- the number of flat:79
- Pre carding segment in Licker in
- Cleaning Efficiency depends on Suction hood & Knife
-
- Gauge Setting: Feed plate to Feed weight: 0.15 millimeter
 Feed roller to Licker in : 0.80 millimeter
 Licker in to Cylinder : 0.20 millimeter

Cylinder to Flat: 0.225millimeter
0.20millimeter
0.150millimeter
Doffer to Cylinder: 0.175
Doffer to Stripping roller: 0.15 millimeter
Stripping to Squeezing: 0.175

3.4.4 Breaker Draw Frame

Breaker draw frame is a preparatory machine in cotton spinning, especially when using the same fiber to produce different yarn types like siro cotton yarn, compact cotton yarn, and siro compact cotton yarn. It makes carded slivers to improve fiber alignment, blending, and sliver uniformity. Here is given a gentle draft that reduces sliver irregularities. And it is then ready for refinement in finisher draw frame. It is one of the important machine to control count. Here Making fibre more parallel. More uniform sliver by doubling and drawing cotton carded sliver treated some draft, make it more uniform, reduce sliver irregularity, minimizes end breakages, improves spinning stability, and contributes to yarn properties like strength, evenness, and reduced hairiness. The breaker draw frame uniformity in sliver.

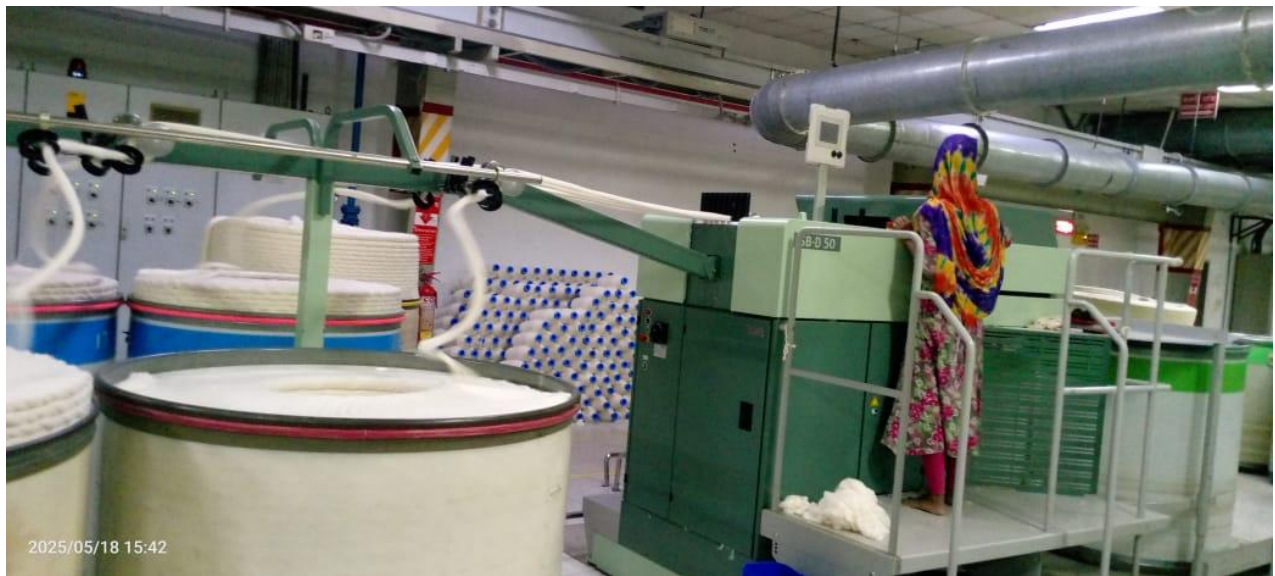


Fig: Breaker Draw frame

This machine also a foundation to produce high performance yarn and yarn production. It is essential step to get desired count and quality of siro, compact, and siro compact yarns. Some setting and information of Breaker Draw frame is given bellow:

Grain /yard: 75.0

Speed: 700 m/min

- Name of m/c: Breaker draw frame

- The Company Name: Rieter
- Country of Origin: Switzerland
- Model Number: SB-D15
- Manufacturing Year: 2005
- Drafting System: 4 Over 3
- Roller Diameter

top	Millimeter
Front	38
Second	38
Third	38
Back	38

bottom	Millimeter
front	40
middle	35
back	35

- Roller gauge:
 - Front to middle: 40 millimeter
 - Middle to back: 38 millimeter
- Cot roller hardness: 70 Shore (comb), 80(card)
- Creel roller dia: 70 millimeter
- Quartz length: 157 millimeter
- No of doubling: 6-8
- Maximum speed: 500 millimeter
- Pneumatic pressure: 140 bar (card), 120 bar (comb)
- Size of Condenser: 4.6 millimeter (inside dia)
- Type of roller: Black(comb), Gray(card)
- No of sensor: Delivery sensor, can change sensor
- Present of autoleveller: No
- Silver wt: 73grs/yd
- Power consumption: 5.65 KW
- Features: auto doffing
 - auto stop motions
 - Problem indicating lamp signals
 - Uniform sliver by doubling and drawing
 - Make more parallel fibre

3.4.5 Lap former

For produce high-quality Siro cotton yarn, single compact cotton yarn, and Siro compact cotton yarn production the Lap Former machine is a prior machine used before the combing process using the same fiber. It makes many carded slivers into a uniform Lap.



Fig: Lap former



Fig: Lap former

The lap former ensures not only even weight distribution of fibre but also makes fibre consistent width, and proper fiber orientation in the lap. Using the same fiber, makes uniform feeding to the comber, this machine also reduce variations and support better combing performance. For this reason it ensure superior sliver quality with less neps and short fibers, increasing yarn strength, smoothness, and appearance. It also lessen load variations of comber machine extends machine lifetime and also develop process efficiency. Overall, the lap former is important to produce uniform and clean and parallel fiber arrangements. Other setting is given bellow

Company: Reiter

- **Manufacturing Year: 2005**
- **Country of origin: Switzerland**
- **Model number: E-32**
- **number of doubling: 26 (maximum 28)**
- **Delivery speed: 120 meter/min**
- **Drafting system: 3 over 3**
- **Front roller Diameter: 39 millimeter**
- **Back roller Diameter: 32 millimeter**
- **Lap Diameter: 650 millimeter (max)**
- **Delivery length: 230 millimeter**
- **Lap weight: 20kilo gram**
- **Lap width: 300 millimeter**
- **Spool Diameter: 200 millimeter**
- **Top roller hardness: 83 shore**
- **Power consumption: 11 KW**

3.4.6 comber

All these yarns (Siro cotton yarn, single compact cotton yarn and Siro compact cotton yarn) are produced using the fiber. comber machine which improves fiber length uniformity and removes undesirable short threads, neps and impurities.

The final yarn is made better when the quality of the sliver is enhanced with combing. Because Siro yarn drafts two slivers and entwines them together, combing helps ensure both are even in length and clean which cuts down on problems in the final yarn. Thanks to combing, single compact yarn is highly aligned, pure and has both superior strength and few hair fibers. Because siro compact yarn uses both siro and compact spinning, good fiber management and consistency of quality rely on precise combing. For all yarn types, using the same fiber during combing means they all use a standard, reliable quality base. It also increases how well machines downstream can work, thanks to receiving fiber with all the edges clean and even. Sorters ensure that contained fibers enable the sliver to be pulled evenly and with less breakage in the spinning stage.



Fig: Comber

To sum up, a comber machine is needed for producing premium yarns because it guarantees the best fiber quality, consistency and alignment, straight away affecting the final characteristics of Siro, compact and Siro compact cotton yarns.

different setting are given bellow:

- Grain/yard: 75.00

- Nips/min: 435
- Feed/Nips: 5.20
- Noil : (14.5-15.5)%
- Draft: 8
- Manufacture: RIETER
- Place of origin: Switzerland
- Model: E-65
- Number of head: 8
- Delivery speed: 345-450 nips/mins
- M/C efficiency: 80-90 percent
- System of drafting:3 against 3
- Can size: (25millimeter*600millimeter*1200 millimeter)
- Feed/Nips:5.20 millimeter
- Noil: (14.5-15.5) %
- Auto stop motion: Yes
- Auto doffing: yes
- Lap dia-550 millimeter
- Lap lenght- 230 millimeter
- Lap weight:80 gram/m
- Spool diameter: 200 millimeter
- Problem response lamp system: Yes
- delivery Per machine: One
- Roller dia:

top	Front detaching roller diameter	24.5 millimeter
Top	Back detaching roller diameter	24.5 millimeter
Bottom	Front detaching roller diameter	25 millimeter
bottom	back detaching roller diameter	25millimeter

- Draw box roller dia:
 - Front roller-35 millimeter
 - Middle roller -27millimeter
 - Back roller-27 millimeter
- Total draft: 08-09
- Signal system: Yellow (Can change)
- Roller hardness: Front roller -76, middle roller -80, back roller - 80 (shore)
- Roller gauge:
 - Front to middle roller: 41 millimeter
 - Middle to back roller : 44millimeter
- Consumption of power: 3.79 KW

3.4.6 Finisher draw frame:

The Finisher Drawing machine matters most because it spins Siro cotton yarn, single compact cotton yarn and Siro compact cotton yarn. It picks up where the breaker draw frame leaves off and takes slivers from carding or combing to improve how even and straight the yarn becomes.

A combination of top-quality slivers in this machine results in a final sliver that shows excellent uniformity and consistency.

In case of Siro yarn, two parallel and smooth slivers are required in the comillimeteron draft and twist that is diligently prepared by the finisher. Uniformity and flatness of the yarn at the finishes in single compact yarn is significant factor in result. For siro compact yarn, a process called finisher drawing perfectly aligns the linear density and fiber distribution between the siro and compact yarn. The finisher drawing machine merges all leftover irregularities and gives all yarns the same consistent sliver quality. The process also ensures that different fibers are mixed properly when several slivers are used together. The Finisher Drawing machine controls the sliver so it has the characteristics needed for producing high-quality yarn, contributing to more stable operation and standard features in siro, compact and siro compact yarns. The other settin g are provided below:



Fig: Finisher Draw frame

- grain/yard: 75.50
- Speed is: 550 revolutions per Minute
- Name of the company: Rieter
- Place of origin: Switzerland
- Model no.RSB-D35
- manufacturing time: 2005

- drafting system is: 4 Over 3
- Roller Diameter

Top roller side	Millimeter
Front side roller	38
Second roller	38
Third roller	38
Back roller	38

Bottom roller side	Millimeter
Front roller	40
Middle roller	35
Back roller	35

- Roller gauge:
 - Front to middle roller :40 millimeter
 - Middle to back roller :38 millimeter
- Cot roller hardness:70 shore (comb) Shore,80 (card)
- Creel roller dia:70 millimeter
- Size of quartz: 157 millimeter
- Number of doubling: 6-8
- Maximum speed:500 rpm
- Pneumatic pressure 140 bar (card), 120 bar (comb)
- Condenser size:4.6 millimeter (inside diameter)
- Roller type: Black(comb) Gray(card)
- No. of sensor: Delivery sensor, Can changeable sensor
- Presents of autoleveller: Yes
- Sliver weight:75.50 grains/yard
- Consumption of power:5.78 KW

3.4.7 Simplex

The Simplex machine is also called the speed frame, is very important in preparing the yarn before ring spinning, especially if you want to produce siro cotton yarn, single compact cotton yarn and siro compact cotton yarn using a single type of fiber. The main task of the simplex is to transform drawn slivers into roving, a lightly twisted and worked fiber that can enter the spinning frame with greater control. Single compact yarn is made by the simplex which forms a neat roving that facilitates easy drafting and compacting for better results and stronger yarn. Siro compact yarn requires the simplex to produce two rovings that have the same quality, as it means the yarn has to meet both siro and compact spinning standards.



Fig: Simplex

Roving consistency, better fiber control and fewer fiber end breaks during spinning are achieved when making the simplex from the same fiber. It gives the fibers a slight twist so they stay joined, but allows plenty of moveability for your cardio workout. More simply, the simplex machine prepares the rovings, enabling smooth and consistent handling and transport to the ring frame for spinning.

Roving: 0.78

- TPI: 1.05
- Machine name: Simplex
- Company name is: TOYOTA
- Model no -FL-100
- Year it was manufactured: 2005
- number of machine: 9
- Creel number: 4
- Overall creel capacity 120
- Drafting system: 4 over 4
- Spindle gauge 133 millimeter
- The staff length:520 millimeter
- Auto stop motion: Yes
- Problem indicating lamp system: Yes
- Roller diameter:

Roller type	Bottom (millimeter)	Top(millimeter)
Front	28.5	28
Second	28.5	28
Third	28.5	28
Back	28.5	28

- Roller set:
 - Front to second: 37.5 millimeter
 - Second to third: 48.5 millimeter
 - Third to back: 48.5 millimeter
- Bobbin dimension
 - Bobbin length-445 millimeter
 - Lift length -385 millimeter
 - Shoulder angle-35
 - Avoiding Area-100 millimeter
 - Winding margin-35 millimeter
- Cradle type: OH-514
- manufacturer of aprons: Hokushin
- Spacer dimension

Color	Size(millimeter)
Black	4.5
Baise	5.4
Grey	6.5

- The sensor used in Simplex: Cover open sensor, Roving breakage sensor, Roving breakage in bobbin sensor, Sliver rupture sensor,
- rpm max in motin spg mills ltd is : 1200
- Advantages of modern simplex is written bellow:
 - More speed

- High efficiency
- Automatic tension control . auto Greasing System after 70hrs/ 6 min
- Bobbin information:
 - Weight: 237.337 gm
 - Length : 44.5
 - Outer Upper Diameter:4.5 centimeter
 - Outer Lower Diameter: 6 centimeter
 - Bobbin colour: Blue, orange, black, white, red, brown and yellow.
- Simplex machine power consumption: 10.64 KW

3.4.8 Ring Frame

In spinning, the Ring Frame is the key machine used to process fiber into lab-made siro cotton yarn, single compact cotton yarn and siro compact cotton yarn. The roving is drafted, twisted and then wound onto bobbins, where it become yarn. A special ring frame gathers and processes two rovings at once for siro cotton yarn, twisting them into a yarn that is both strong, soft and attractive. Using a single compact yarn production method, the ring frame compresses the drafted fiber before twisting which produces yarn with high strength, little fuzz and good uniformity. Using two rovings, the siro compact machine blends the features of its double process and then twists them, making a yarn with properties from both processes. It influences important aspects of yarn strength, hairiness, elasticity and the yarn's look.



Fig: Ring Frame

Siro Spinning: Two different rovings were spun together using dual rings, so that the Siro yarn formed would have better fiber integration and would be less likely to form hairy fibers.



Siro spinning system



Siro spinning system

Compact Spinning: The fibers were compacted in a special zone before twist insertion which created a tighter yarn with neater alignment and reduced hairiness.



Siro Compact Spinning system



Siro Compact Spinning system

Siro Compact Spinning: Feeding two roving's together in a compact spinning frame resulted in yarn with the hoped-for upsides of each technique. All of the spinning was performed using ring spinning machines that had Siro and compact attachments. All samples received the same settings for spindle speed, twist per inch and delivery speed to ensure fairness.

All in all, the ring frame machine carefully controls fiber movement to ensure that high-quality Siro, compact and Siro compact yarns are made using the same fiber source.

- Manufacturer company : TOYOTA
- Manufacturing country: JAPAN
- Model number: RX 240
- Manufacturing time:2005
- number of Spindle/machine: 1200
- speed of spindle: Up to 18000 rpm
- Spindle gauge: 75 mm
- Lift: 7 inch
- Ring cup diameter: 21.8 millimeter
- spindle type: Eye
- drafting system: 3 over 3 (SKF-PK2025)
- roller diameter

roller type	TOP (MILLIMETER)	BOTTOM (MILLIMETER)
Front	30	27
Middle	30	27
Back	30	27

- Roller gauge:

Back to middle roller 51 millimeter

Mid to fore roller: 42.5 millimeter

- Apron specification
 - Top-37 millimeter * 27.8 millimeter * 1 millimeter
 - Bottom-73 millimeter*30 millimeter*1.1 millimeter
- Spacer color: YELLOW
- Cradle type OH 2024
- Size of cradle: 36 millimeter
- Bobbin cops specification
 - Total lift height-180 millimeter
 - Chase length-44 millimeter
 - Ring bobbin dia: (a)-21 millimeter(top)-27 millimeter(bottom)
 - Bore diameter ring (38.40) millimeter
 - Bobbin length-210 mm
- Traveller specification:
 - Flange width:3.2 millimeter
 - Material-Raw material:Stainless steel
 - Traveller clearer gauge-(2.2-2. 5 millimeter)
- lappet spec.: bore diameter:2. 5 millimeter
- Spindle driving system: 4 kinds
- Roller pressure:

Color	Front (kg)	Middle (kg)	Back(kg)
Green	14	10	12
red	18	14	16
Black	10	10	10

- Wharves dia-18.5 millimeter
- Arbar dia: 19 millimeter
- Shape of flange: Regular
- Building system: Cop building
- Bobbin creel: Umbrella model
- Colour of bobbins:Brown,yellow, red, blue, black,baise, green, orange, and violet, white, and ash
- System of weighting: pendulum
- Drafting zone angle:45
- The range of counts: 10-55 Ne
- Auto doffing: present
- Traveller manufacturer- LAKSHMI (INDIA), KANAI (JAPAN)

➤ Traveller no.

Serial number	Yarn count	Tr No	M/c speed
1	36/1 CH	4/0	16500
2	30/1 CH	3/0	17500
3	32/1 KH	3/0	17500
4	30/1 KH	3/0	15100
5	26/1 KH	2/0	16500
6	18/1 KH	1/0	16000
7	20/1 KH	1/0	16000

➤ Volt amp consumption of ring section: 33 KW

CHAPTER FOUR

(Testing section photo and Testing)

Testing machine



Fig: Twisting



Fig: Drawing





Fig: lab knit machine



Fig: AUTODYN 2 PLUS single yarn testing machine



Uster HVI 1000



Fig: uster tester 6



Uster AFIS PRO 6



Uster AFIS PRO 2



Fig: Electronic Twist Tester



Fig: Lab Electr. WRAP REEL

4.0 Testing:

I prepared ring samples from 10, 14, 16, 18, 20, 22 and 24 Ne count and then did the following tests: Uster testing involves examining yarn quality for unevenness, difference in mass coefficients, imperfections and hairiness. The machine used to measure the tensile strength and elongation was an ASTM approved single-yarn standard tensile tester. The results from the tests were analyzed statistically to evaluate how different spinning methods affected the yarns.

- Uster Tester
- AUTODYN 2 PLUS automatic yarn strength,
- Wrap reel and balance

The process parameters of testing equipment's are given below-.

4.1 Uster Tester:- **Name of the Equipment: Uster tester-5 (UT-5)**

- Purposes: To test- Thin -50 %/km
 - Thickness: + 50 %/km
 - Neps +200 %/km
 - U%
 - CVm 3 meter
 - CVm 10 meter
 - Hairiness
- Slot counts:
- In the case of Slivers: 1 Slot
 - In the case of Roving: 1 Slot
 - In case of Yarn 2 Slot
- Principle of measurement: electronic Capacitance Method
- Speed of test:
- In the case of yarn – 400 meter / min
 - In the case of Roving – 50 meter /min
 - In the case of Sliver – 50 meter /min
- Testing results:
- Variation of mass (U%, CV %)
 - Imperfections (Thin/ km Thick/km, Neps/km)
 - Hairiness
 - Recurrent defects of the machine parts
 - Fabric Construction.
- Parameter of Quality|:
- a) Unevenness (Um %, CV%)

at different Cut length-

- *In the case of Sliver: 20 millimeter*
- In the case of Roving: 12millimeter
- For yarn: 8 millimeter

b) Imperfections

- Thin place/km: at -30%, -40%, -50% and -60% sensitivity
- Thick place/km: +35%, +50%, +70, and +100% sensitivity
- Neps/km: at +140%, +200%, 280 % and + 400% sensitivity

c) Hairiness (at various cut length and percent CV of hairiness)

d) Mechanical periodic faults

➤ Operating System:

- Turn the machine into power/switch on the power
- Choose `Test Program` and then press recall button.
- Type the changeable parameter through keyboard and initiated the test by Pressing the `start button
- Manually feed the test sample using the right guide. No interruption is permitted in test period.
- A report together with diagram is automatically printed through the printer just after a test has been completed.

➤ Report type:

- Single or overall values
- Diagram (mass)
- Diagram (hairiness)
- Spectrogram (mass)
- Spectrogram (hairiness)
- Histogram
- Variance-Length curve

4.2 AUTODYN 2 PLUS automatic yarn strength tester:

It is a an automatic yarn strength tester used in textile laboratories and gets mechanical properties of yarns,by this testing machine we evaluate Tensile Strength and Elongations. It is one of the key instrument to maintain quality control and research in yarn manufacturing factory. The objectives and feature of this AUTODYN 2 PLUS automatic yarn strength tester are described below:

- a. Yarn Elongation: can be find out the capacity of yarns to stretch under tension before break.
- b. Yarn Strength: Maximum force are estimated before break.
- c. Control the Quality: it maintain quality of every batch yarn.
- d. Research and development: It helps to Research and development



Fig: AUTODYN 2 PLUS automatic yarn strength tester

Key Settings:

- Test speed kept 500 millimeter/min, 1000 millimeter/min
- Gauge length: set between 100 millimeter to 500 millimeter depending on the yarn and test requirements.
- Different capacities (e.g., 10 N, 100 N, 500 N) depending on the expected strength of the yarn.

Test Results :

- Elongation at Break (%)
- Tenacity (cN/tex)
- Work to Break (Area under the curve)
- Breaking Force (N or cN)
- Modulus (initial or specific)

3.4.1 Yarn Twist Tester

Brand name : Mesdal Lab

Country : Italy

Year of manufacturing : 1995

Main settings/ parameters

Single twisted and plied natural and synthetic fibers yarns are suitable. Specimen length

: 0 to 50cm/20" with scale,

RPM : up to 1500

Supply : S & Z twist yarns. Absolute cessation of turn.

Results : TPM or TPI.

4.3 Wrap Reel Machine:

Textile testing laboratories rely on the Wrap Reel Machine to wind yarn into hanks to control their length and turns. Such hanks make it easier to assess yarn details such as strength and the measurements denier, tex or Ne. Make a hank of yarn and weigh it to find its weight for yarn count. After measuring the length and weight, I looked up a standard formula to calculate the yarn count.

Objectives:

- a. Wind yarn onto hanks, making sure each hank has the same, exact length, so it can be tested accurately.
- b. Measure the Yarn Count: You will measure Yarn Count (such as cotton count, tex, denier) by weight after the yarn has been wound.
- c. Supporting Other Tests: Hanks prepared on the wrap reel are later used for strength, moisture regain and twist tests.

Key setting:

1. .Reel Circumference:
 - a. Testing standards show that the standard circumference is 1.5 meters (or 54 inches).
 - b. There are machines that can be used with both metric and imperial sizes.
- 2.The number of times you wrap the scarf around your neck.
- 3.How fast a celestial body revolves around its center.
4. RPM can usually vary between 60 and 120, depending on the yarn, for easier adjustment.

Tension Control:

CHAPTER FIVE

5. RESULTS AND DISCUSSION

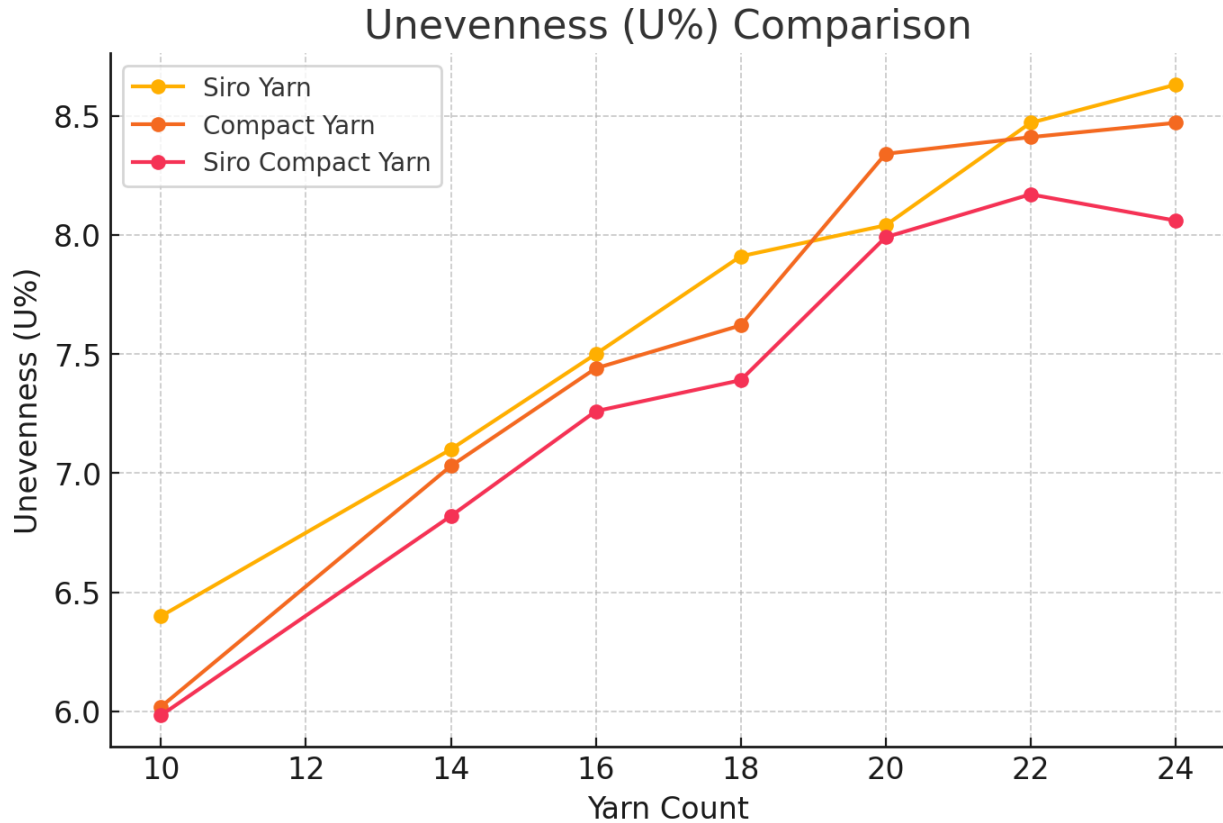
Yarn quality parameters were tested by using Wrap Reel, Uster Tester- 5, Twist Tester, AUTODYN 2 PLUS automatic yarn strength tester. By maintaining international standards, yarns are tested to get the actual result.

DATA:

Sl	Type of Yarn	Count	Actual count	Unevenness (U%)	CVm %	Hairiness	Elongation	Imperfection Index (IPI)	strength (CN/TEX)
1	2	3	4	5	6	7	8	9	10
1	Siro	10	9.78	6.4	8.06	5.4	9.17	2	11.49
	Compact		9.93	6.02	7.59	4.57	9.25	3	12.1
	Siro Compact		9.97	5.984	7.54	4.10	9.41	1	13.12
2	Siro	14	13.75	7.1	8.95	5.66	9.05	9	11.34
	Compact		13.8	7.03	8.86	4.8	9.14	8	11.92
	Siro Compact		13.9	6.82	8.59	4.32	9.23	5	12.91
3	Siro	16	15.78	7.5	9.45	5.73	9.0	14	11.24
	Compact		15.61	7.44	9.37	4.87	9.07	12	11.81
	Siro Compact		15.7	7.26	9.15	4.37	9.18	9	12.79
4	Siro	18	17.87	7.91	9.97	5.91	8.87	14	11.16
	Compact		17.87	7.62	9.60	5.02	8.95	14	11.72
	Siro Compact		17.74	7.39	9.31	4.51	8.99	11	12.68
5	Siro	20	19.46	8.04	10.13	6.02	8.78	41	11.09
	Compact		19.85	8.34	10.51	5.11	8.86	22	11.64
	Siro Compact		19.84	7.99	10.07	4.59	8.9	22	12.59
6	Siro	22	21.7	8.47	10.67	6.17	8.71	69	11.06
	Compact		21.77	8.41	10.60	5.24	8.77	63	11.6

Sl	Type of Yarn	Count	Actual count	Unevenness (U%)	CVm %	Hairiness	Elongation	Imperfection Index (IPI)	strength (CN/TEX)
1	2	3	4	5	6	7	8	9	10
	Siro Compact		21.81	8.17	10.29	4.77	8.82	37	12.55
7	Siro	24	23.63	8.63	10.87	6.32	8.67	83	11.04
	Compact		23.68	8.47	10.67	5.37	8.75	72	11.57
	Siro Compact		23.65	8.06	10.16	4.89	8.79	54	12.51

5.1 Unevenness (U%) Graph Analysis:

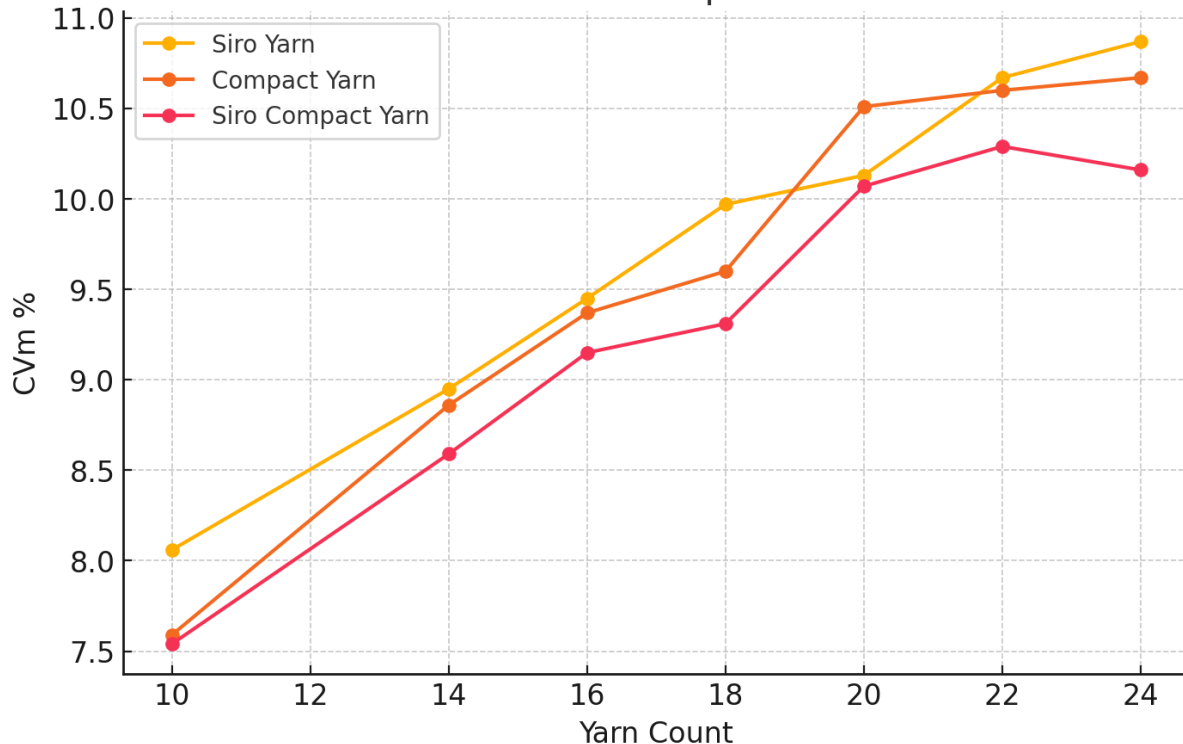


The graph is comparing three types of yarn that is described below:

- Siro Yarn
 - Compact Yarn
 - Siro compact Yarn
- Unevenness (u%) of Siro compact yarn is lowest it indicate Siro Compact yarn is most even compare than siro and compact yarn and with the increasing of count 10>14>16>18>20>22>24 the unevenness % is increasing so we can say the finer yarn is more uneven than coarser yarn.
 - Unevenness (u%) of compact yarn is lower than siro compact yarn and higher than siro Yarn. So we can say compact Yarn is more even than siro Yarn and uneven than siro compact Yarn. with the increasing of count 10>14>16>18>20>22>24 the unevenness % is increasing so we can say the finer yarn is more uneven than coarser yarn.
 - Unevenness (u%) of Siro yarn is highest than siro compact yarn and compact yarn. So we can say Siro Yarn is more Uneven than compact Yarn and siro compact .with the increasing of count 10>14>16>18>20>22>24 the unevenness % is increasing so we can say the finer yarn is more uneven than coarser yarn.

5.2 CVm % Graph Analysis:

CVm % Comparison



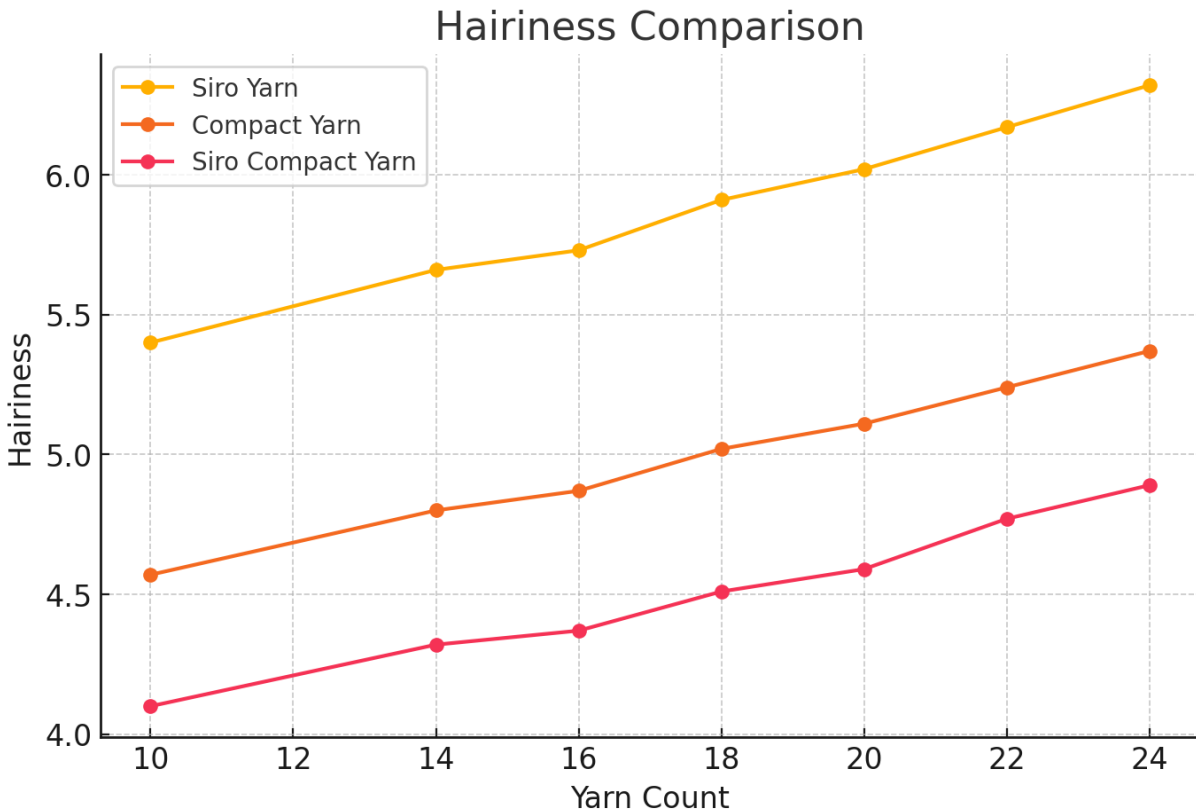
CVm means co-efficient of variation of mass percentage it means mass evenness of a yarn. If CVm% is more it occurs more uneven. If CVm% is less it occurs more uniform yarn. Also means how much the thickness of Yarn changes

The graph is comparing three types of yarn that is described below:

- Siro Yarn (orange colour)
 - Compact Yarn (red orange line)
 - Siro compact Yarn (pink line)
- CVm% of Siro compact yarn is lowest it indicates Siro Compact yarn is smallest amount of variability of thickness so it is most even compare than siro and compact yarn and with the increasing of count 10>14>16>18>20>22>24 the CVm% is increasing so we can say the finer yarn is more variability of thickness or means more uneven than coarser yarn.
- CVm% of compact yarn is lower than siro compact yarn and higher than siro Yarn. So we can say compact Yarn is more even than siro Yarn and uneven than siro compact Yarn. with the increasing of count 10>14>16>18>20>22>24 the CVm% is increasing so we can say the finer yarn is more uneven than coarser yarn.
- CVm% of Siro yarn is highest than siro compact yarn and compact yarn. So we can say Siro Yarn variability of thickness more so it is more Uneven than compact Yarn and Siro compact .with the increasing of count

10>14>16>18>20>22>24 the CVm% is increasing so we can say the finer yarn is more uneven than coarser yarn.

5.3 Hairiness graph



Hairiness is the quantity and length of fibers ends and loops emerging on the body of the Yarn. Hairiness can cause a number of consequences it is more. It caused increased entanglement, reduce Yarn strength and negative impact of appearance of fabric. It also hinder knitting and weaving.

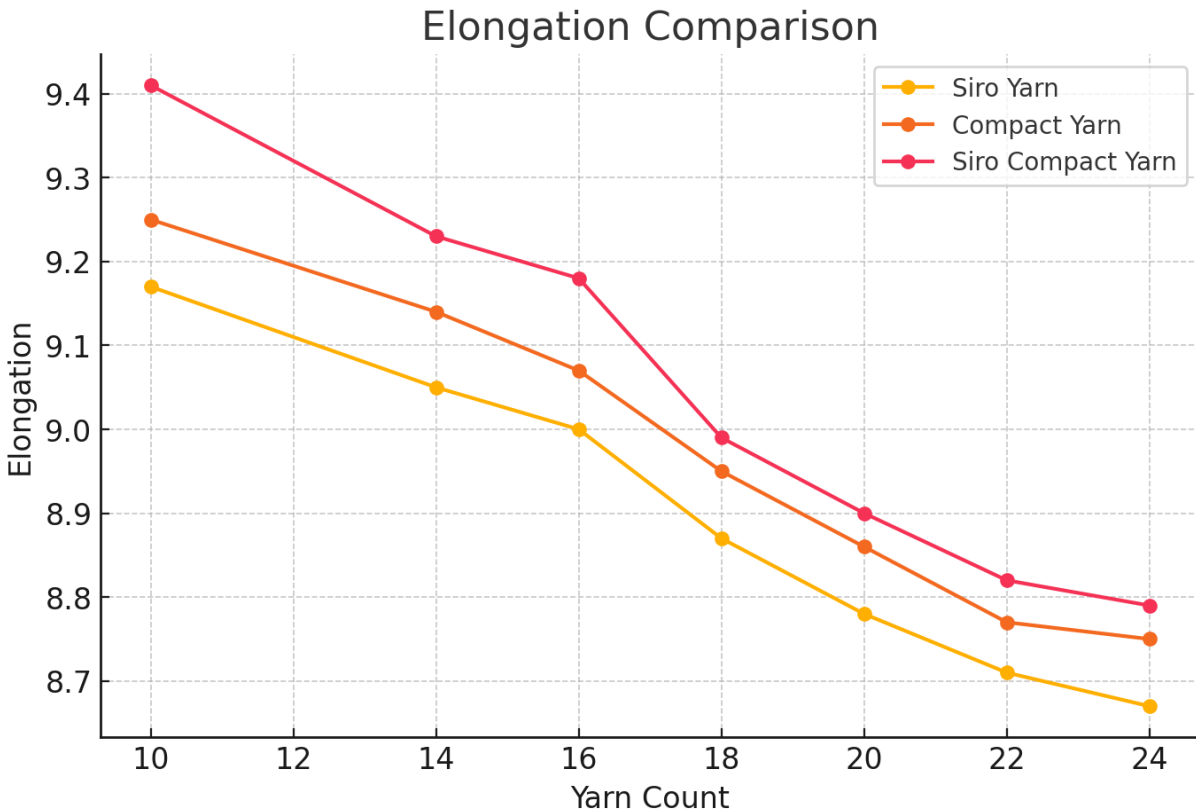
The graph is comparing three types of yarn that is described below:

- Siro Yarn
 - Compact Yarn
 - Siro compact Yarn
- Hairiness of Siro compact yarn is lowest it indicate Siro Compact yarn is less hair sticking out and makes smoother Yarn. Makes good appearance endues. with the increasing of count 10>14>16>18>20>22>24 the Hairiness is increasing so we can say the finer yarn is hair sticking out and makes rough Yarn. coarser yarn is less hairy than finer yarn.
- Hairiness of compact yarn is lower than siro compact yarn and higher than siro Yarn. So we can say compact Yarn is more hairy than Siro compact

Yarn and less hairy than siro Yarn. with the increasing of count 10>14>16>18>20>22>24 the Hairiness is increasing we can say the finer yarn is hair sticking out and makes rough Yarn. coarser yarn is less hairy than finer yarn.

- Hairiness of Siro yarn is highest than siro compact yarn and compact yarn. So we can say Siro Yarn is more rough and less soft than siro compact yarn and compact yarn. variability of thickness more so it is more Uneven than compact Yarn and siro compact .with the increasing of count 10>14>16>18>20>22>24 the Hairiness is increasing so we can say the finer yarn is hairy sticking out and makes rough Yarn. coarser yarn is less hairy than finer yarn.

5.4 Elongation Graph Analysis:



Elongation means the ability of a yarn to stretch under tensile load before breaking. It is measured as a percentage of its original length. Controlled elongation improves comfort, strength, and durability. Excessive elongation can cause deformation and instability of the yarn. It also hinders knitting and weaving.

The graph is comparing three types of yarn that is described below:

- Siro Yarn (orange colour)
- Compact Yarn (red orange line)
- Siro compact Yarn (pink line)

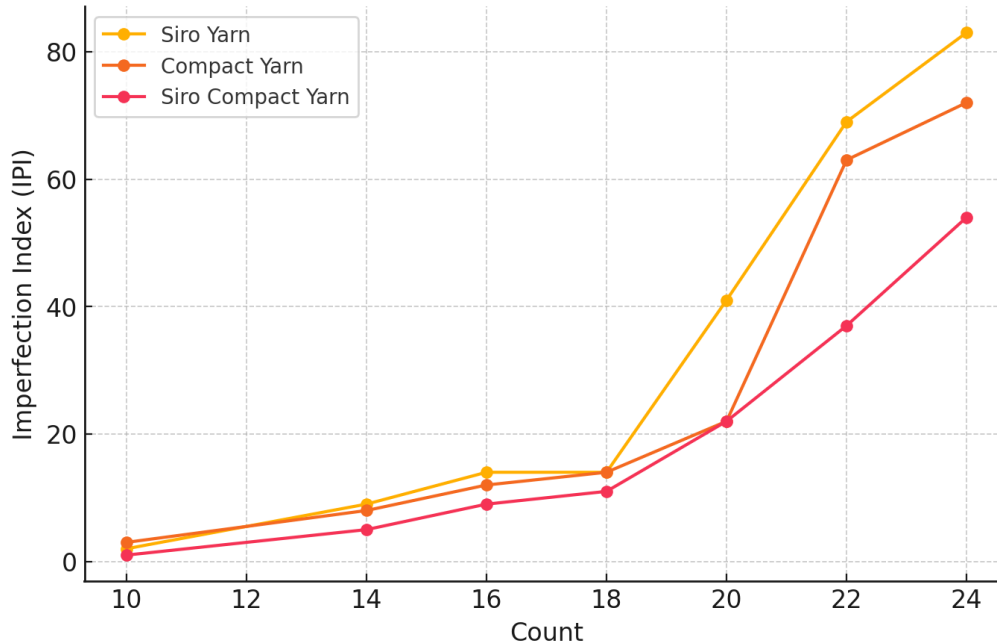
➤ Elongation of Siro compact yarn is highest than siro and compact yarn. It indicates Siro Compact yarn is elongated significantly before break. With the increasing of siro compact yarn count 10>14>16>18>20>22>24 the Elongation is decreasing. So we can say the finer yarn Elongation is less.

Coarser yarn Elongation is higher than finer yarn.

- The compact yarn elongation is lower compare than siro compact yarn and siro Yarn. Hence we can say compact Yarn stretch capacity is less than siro compact Yarn and more stretch capacity compared to siro Yarn. with the increasing of compact count 10>14>16>18>20>22>24 the Elongation is decreasing, So we can say the finer yarn Elongation is less. Coarser yarn Elongation is higher than finer yarn.
- Siro yarn has shorter elongation as compared to compact yarn and Siro compact yarn. So we can say Siro Yarn stretch capacity is less than siro compact Yarn and compact Yarn. with the increasing of siro Yarn count 10>14>16>18>20>22>24 the Elongation is decreasing, So we can say the finer yarn Elongation is less. Coarser yarn Elongation is higher than finer yarn.

5.5 Imperfection Index (IPI) Graph Analysis::

Imperfection Index (IPI) from Column 9 vs Count for Different Yarn Types



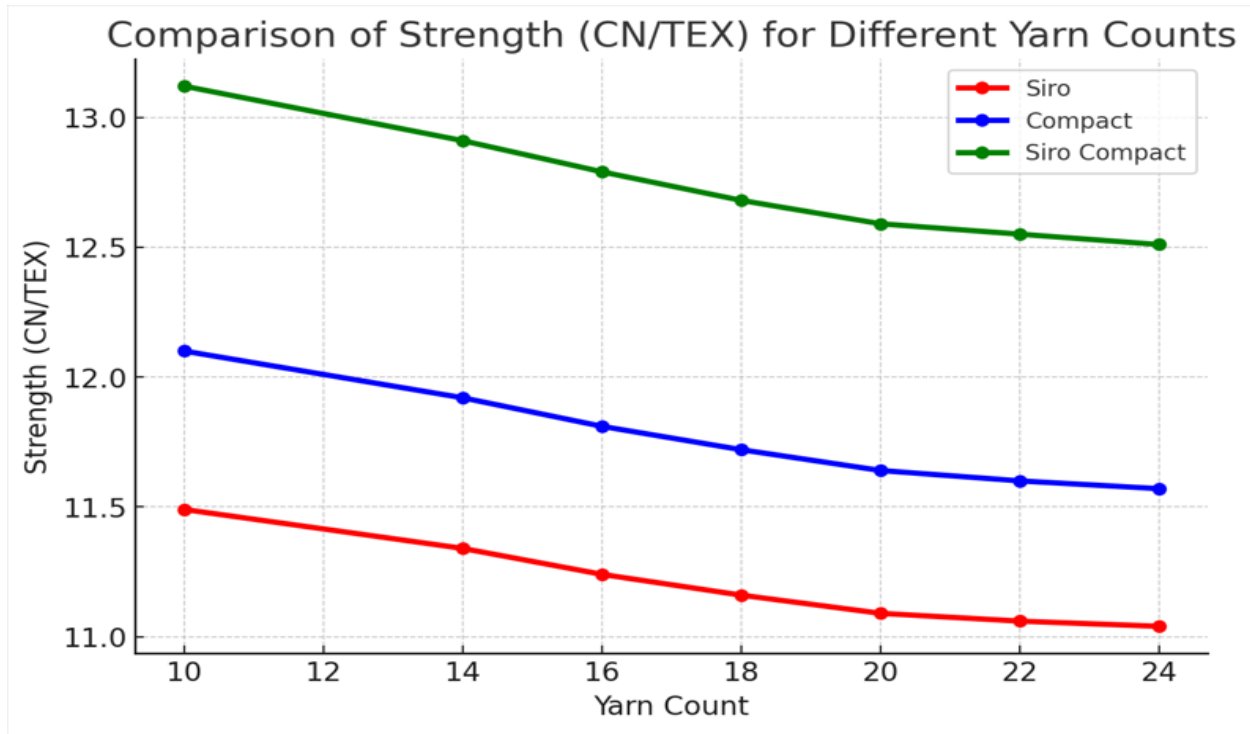
Imperfection Index (IPI) is a quality parameter used in spinning industry to indicate overall defect or unevenness. It is total number of Yarn defects per kilometer of yarn.
 $IPI = \text{Thick} + \text{Thin} + \text{Neps (per km)}$

If IPI is less it can lead to better quality Yarn and this yarn lead to high-performance and premium-grade fabrics. If IPI is more it can lead to Poor yarn and this poor Yarn lead to low quality fabrics.

The graph is comparing three types of yarn that is described below:

- Siro Yarn (orange color)
 - Compact Yarn (red orange line)
 - Siro compact Yarn (pink line)
- Imperfection Index (IPI) of Siro compact yarn is lowest it indicate Siro Compact yarn is less thick place, thin place & neps in the Yarn. Which means the yarn is smoother and more uniform. With the increasing of count 10>14>16>18>20>22>24 the Imperfection Index (IPI) is increasing so we can say the finer Siro compact yarn is more thick place, thin place & neps in the Yarn Which means the yarn is less smoother and less uniform .and this yarn leads to low performance yarn . coarser yarn IPI is less.
- Imperfection Index (IPI) of compact yarn is higher than siro compact yarn it indicate is more thick place, thin place & neps in the Yarn Imperfection Index (IPI) of compact yarn is lower than siro yarn it indicate is less thick place, thin place and neps in the Yarn. with the increasing of count of compact yarn 10>14>16>18>20>22>24 the Imperfection Index (IPI) is increasing we can say the finer yarn contain more thick place, thin place and neps in the Yarn compared than coarser yarn.
- Imperfection Index (IPI) of Siro yarn is higher than Siro compact and compact yarn it indicate it has more thick place, thin place & neps in the Yarn with the increasing of count of Siro yarn 10>14>16>18>20>22>24 the Imperfection Index (IPI) is increasing we can say the finer yarn contain more thick place, thin place & neps in the Yarn compared than coarser yarn.
- The reasons of more IPI: When Siro spinning uses two roving's, it improves the alignment of fibers, but it doesn't control the direction of the fibers as well as Compact systems do. Because of this, more mistakes are visible in the yarn.

5.6 Strength (CN/TEX) graph:



Strength means maximum load of a yarn can withstand before break. Unit is CN/TEX. Higher strength of a yarn leads to Higher Durability, Fewer Breakages During Weaving/Knitting, and Better Fabric Performance. And low strength Frequent Breakage During Processing, Poor Fabric Quality. Low strength yarn also hinders knitting and weaving.

The graph is comparing three types of yarn that is described below:

- Siro Yarn
- Compact Yarn
- Siro compact Yarn

Strength of Siro compact yarn is highest than siro yarn and compact yarn. it indicate Siro Compact yarn leads to Higher Durability, Fewer Breakages During Weaving/Knitting, and Better Fabric Performance..with the increasing of siro compact yarn count 10>14>16>18>20>22>24 the Strength is decreasing. So we can say the finer yarn Strength is less than.

Coarser yarn .

- Strength of compact yarn is lower than siro compact yarn and higher than siro Yarn. So we can say compact Yarn performance is better from siro Yarn but not good compared to siro compact Yarn. with the increasing of compact count 10>14>16>18>20>22>24 the Strength is decreasing, So we can say the finer yarn Strength is less than Coarser yarn .
- Strength of Siro yarn is less than compact yarn and Siro compact yarn. So we can say Siro Yarn makes Poor Fabric Quality fabric compared than compact and siro compact yarn. With the increasing of siro Yarn count 10>14>16>18>20>22>24 the Strength is decreasing, So we can say the finer yarn Strength is less than Coarser yarn.

Summary:

The study results highlight that Siro Compact yarn provides better evenness, uniformity, less hairiness, higher elongation, fewer imperfections and greater strength than either Compact or Siro yarns. Because of its unique spinning process, Siro Compact yarn has reduced fiber irregularities and hairiness which leads to superior results in yarn and fabric.

It was found that when Australian 100% cotton fiber is selected with the correct fineness and fiber length, Siro Compact yarn ensures the best end product with enhanced mechanical and structural properties.

CHAPTER SIX

6. Conclusion

This thesis examines a detailed comparison among Siro yarn, Compact yarn and Siro Compact yarn produced from Australian 100% cotton fiber with a fineness of 4.5 microns and an average fiber length of 28.8 millimeter. Key parameters examined during the investigation were unevenness (U%), coefficient of variation of mass (CVm %), hairiness, elongation, imperfection index (IPI) and tensile strength (CN/TEX).

The tests clearly show that Siro Compact yarn always provides the highest quality in each of the tested areas. The product is lowest in UE and CVm %, so it achieves the best yarn uniformity with less variation in mass. Having all fibers the same ensures that fabrics appear the same way and perform better.

The Siro Compact yarn was less hairy, because it had fewer distinct fiber ends, than the Compact and Siro yarns. Fewer hairs on the yarn can make your shirts comfier, smoother and less likely to pill. The results from hairiness testing indicate that the Siro Compact spinning process almost completely removes fiber ends from the yarn.

It was found that Siro Compact yarn has greater stretch ability and returns to its initial form better than Compact yarn before it breaks, with Siro yarn showing a moderately good performance. Its improved elongation shows that Siro Compact yarn is stronger and flexible which is useful in both industrial and practical applications.

Imperfection index also justified the quality advantage of Siro Compact yarn as it contained the lowest number of thin places, thick places and neps. Fewer imperfections mean a lower cost to achieve a better yarn, less breaking threads during the loom process and a nicer styling.

Results from strand tensile testing, together with imperfection analysis, indicate that Siro Compact yarn is stronger in tension thanks to tight fiber alignment during production. The durability and long life of the final material products depend greatly on this strength advantage.

The outstanding results of Siro Compact yarn mainly result from the combination of the Siro spinning technique and compact spinning technology. Because of this method, the fibers are easier to control, hairiness is reduced and the yarn becomes both strong and uniform. The Siro Compact yarn has better yarn quality and mechanical properties than either Compact yarn or conventional Siro yarn.

Using Australian cotton demonstrates that Siro Compact yarn is the best quality for making top-performance textile materials. Improving fabric quality, fewer defects and increased mechanical features should encourage manufacturers to use Siro Compact spinning in their cotton yarn production.

Future Directions:

Based on the comparative study of Siro yarn, Compact yarn and Siro Compact yarn with Australian 100% cotton fiber, several new areas for research and development are strongly advised.

1. Working with Further Fabric Types and Mixed Fabric Blends

See how Siro Compact yarn performs compared to Egyptian or Pima cotton, as well as when it is blended with comillimeteron synthetic blends like cotton-cotton. Doing so will allow Siro Compact spinning to be useful for trial fibers from various raw materials.

2. The Effects of Differences in Fiber Length and Refininied in Yarn

Evaluate the influence of fiber fineness and length variations on the quality of Siro, Compact and Siro Compact yarns. These studies could lead to better understanding of how spinning factors can support desired fiber properties.

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