SIRO YARN A CRITICAL REVIEW

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ABSTRACT

Siro Yarn is made with a process of Siro Spinning or Elitwist spinning. In this, the yarn is made into 2 ply on the ring spinning machine. Siro Yarns are available in Carded, Combed, Carded Compact and combed Compact. In the early of 1980s, Commonwealth Scientific International Research Organization (CSIRO) introduces siro yarn with superior yarn properties. CSIRO prepared siro yarn by introducing two parallel rovings with a predetermined spacing in the drafted zone of conventional ring spinning system Traditionally, two-fold yarns have been used for weaving because they are stronger, and the twisting operation binds the surface fibers into the yarn structure so that it is smoother and more resistant to abrasion during weaving. Properties of spun yarns are mainly affected by fiber properties and yarn structure. Yarn structure is principally influenced by the spinning system. In fact, each spinning system tends to produce a distinctive yarn structure. Recent refinements in spinning technologies have yielded significant improvement in yarn structure.

Keyword – *Siro yarn, Compact spinning, yarn structure, abrasion resistance*

1. Introduction

Siro Yarn is made with a process of Siro Spinning or Elitwist spinning. In this, the yarn is made into 2 ply on the ring spinning machine. Siro Yarns are available in Carded, Combed, Carded Compact and combed Compact. In the early of 1980s, Commonwealth Scientific International Research Organization (CSIRO) introduces siro yarn with superior yarn properties. CSIRO prepared siro yarn by introducing two parallel rovings with a predetermined spacing in the drafted zone of conventional ring spinning system Traditionally, two-fold yarns have been used for weaving because they are stronger, and the twisting operation binds the surface fibers into the yarn structure so that it is smoother and more resistant to abrasion during weaving. Properties of spun yarns are mainly affected by fiber properties and yarn structure. Yarn structure is principally influenced by the spinning system. In fact, each spinning system tends to produce a distinctive yarn structure. Recent refinements in spinning technologies have yielded significant improvement in yarn structure. Siro, solo and compact spinning are the new spinning systems to have made a breakthrough until recently. The SiroSPUN™ process adapted some of the self-twist discoveries of CSIRO to the ring spinning technology of the worsted system, and combined spinning and doubling in the one operation. The technology maintains two separate strands during the spinning process, and this allows a number of fibre-binding mechanisms to operate before the strands are twisted about each other. SiroSPUN™ is especially suited to the production of lightweight trans-seasonal fabrics, and a significant proportion of the world's worsted spinning installations have been converted to this cost-saving and innovative CSIRO technology. The SiroSPUN™ process, a special spin-twisted yarn can be produced directly on the ring-spinning machine. In this process, two rovings are led in parallel through the drafting system, separated by two specially developed condensers, and drafted separately. The twist is introduced as for a normal single yarn by means of ring and traveller. The roving strands, which are drafted parallel, are combined after passing the front rollers at the exit from the drafting system, with some twist being produced in the individual strands right up to the nip point. Once past the front roller of the drafting system, the two strands are combined producing a twofold-like yarn. The yarn has uni-directional twist like a singles yarn but the fibers are bound sufficiently for the yarn to survive weaving. Compact-Siro spun yarn

combines the advantages of the compact and Siro spinning processes. Compact-Siro spinning improves the compactness and strength of yarn, while reducing its unevenness].

2. BENEFITS OF SIROSPUN

- Reduces wool spinning costs by avoiding one stage
- The main advantage of the SiroSPUN™ process is a reduction in spinning costs for pure fine wool weaving yarn. On average, SiroSPUN™ technology lowers the processing costs of spinning by 56 per cent.
- SiroSPUN™ reduces cost by combining spinning and two-folding, allowing a twofold-like yarn to be produced in one step
- Siro yarns are superior in yarn characteristics and have an edge over the normal yarns of equivalent count spun from both a single roving feed and double roving feed

3. COLLECTION OF LITERATURE

Sun & Cheng [1] produced Siro yarns with 9 mm spacing of roving guides and found that Siro yarns were stronger than single yarn at all twist multipliers. This, according to them was due to strand twist.

Su et al [2]measured the drafting force, which is an important parameter correlated to twin-yarn properties, of twin-spun yarns and found that with increase in roving spacing, the drafting force increased.

Salhotra [3] while producing Siro yarns with 38 mm and 1.5 denier Viscose stated that with reduction in draft employed, there was substantial decrease in irregularity. The strand of ribbon being narrow with lower draft, the yarn packing coefficient improved. As the strength of Siro yarns depends little on migration, the proportion of fibre-rupture being higher with finer yarns, the tenacity is expected to improve.

Cheng [4] stated that higher spreading width improves blend uniformity and lowers the colour difference, thus improving dyeing uniformity.

Gupte & Chiplunkar [5] found that with increase in roving spacing, the yarn strength increased, whereas hairiness reduced. They also found that in some instances, the strength of Siro yarn was even greater than doubled yarns of equivalent count.

Sarvanan [6] blended cotton fibres with long staple strands of silk and polywool. He mentioned that with lower spindle speeds, it was possible to spin Siro yarns. He found that when short staple cotton component was added, yarn hairiness increased; however tensile properties of the yarn were more affected by major fibre component.

Beceren et al [7] focused on dimensional and selected physical properties of plain jersey fabrics made from viscose Siro yarns.

Sawney et al [8], Dhawan reported about 14% higher strength with Siro yarns whereas Dhawan & Salhotra [9] stated that yarn quality improves with increase in spacing; attains an optimum value and thereafter deteriorates with further increase in spacing.

Dhawan & Jai Prakas [10] reported that DRF yarns, at optimum spacing, were slightly superior to normal doubled yarns.

Su, X, Gao, K.P.S Cheng [11,12] revealed that the compact-Siro spinning is a relatively recent technology that integrates compact and Siro spinning, in which two rovings are separately fed into the drafting assembly in parallel. They are then slightly twisted after agglomeration in the suction area, after which they converge at the junction point.

Lamb and Junghani [13] compared wool yarns made by the Sirospun system with similar ones and found that the index of irregularity of the Sirospun yarns was between those of conventional two-fold and Plyfil (air-jet) yarns. Investigation was carried out on how the tensile and related properties of Siro yarns, spun from two separated rovings of different types of materials, were affected by the twist factor and draft. Comparison on Siro yarns and two-fold yarns of the same linear density and twist factor revealed that the former was better in tensile strength and related properties. The Siro yarns are believed to be able to bear extra tension during manufacturing processes such as weaving and knitting.

M. L. Regar[14] finds the the effect of roving spacing on the fibre packing density of siro yam in comparison to that of ring spun yam has been studied. The packing density of both the yams over the yam cross-section is not uniform. In siro yarn, it is more near the yarn axis and less towards the outer surface of yam in comparison to that of ring-spun yam. But the packing density of siro yarn is greater than that of ring-spun yam, which is one of the causes for the higher strength of siro yam. In a staple yarn, the composition, distribution and arrangement of fibres can influence its properties. Arrangement and distribution of fibres in a yarn being spinning system dependent, any change in the system causes variation in product performance. Here, an attempt has been made to investigate the fibre distribution in Eli-Twist yarn and it comparison with that of ring spun TFO and SIRO yarn. Yarns of three compositions from cotton and polyester were produced on Eli-Twist, TFO and SIRO spinning systems. Three different counts (39.4, 29.5 and 23.6 tex) from each composition were produced maintaining 40 twist factor for each. Fibre distribution, yarn cross-section, average packing density and number of fibre in yarn cross-section in Eli-Twist yarn were measured and compared with conventional ring spun TFO and SIRO yarn. Migration index helped in identifying the location of fibre in blended yarn. In the polyester–cotton yarn, polyester had a preferential tendency to predominate near the core. Average packing density in Eli-Twist yarn was found to be higher than that of ring spun yarn.

S. M. Ishtiaque [15] Compact-Siro spinning technology is the combination of both Compact and Siro-spinning. It is conducted on a compact ring frame by feeding two rovings at the same time. As compact spinning system minimizes the size of the spinning triangle, the yarn properties are better in comparison to conventional ring yarns. Yarn properties further improve with compact siro system

Banu Nergis finds [16] that Compact-Siro spinning technology is the combination of both Compact and Siro-spinning. It is conducted on a compact ring frame by feeding two rovings at the same time. As compact spinning system minimises the size of the spinning triangle, the yarn properties are better in comparison to conventional ring yarns.

Palaniswamy et.al [17] in their work found that the folded yarns are better in quality than single yarns because in single yarns in order to improve their strength and appearance some kind of sizing material is applied but in case of folded yarns sizing can be eliminated. The folded yarns get desired strength and appearance due to the folding of two single yarns which make them to bind each other completely reducing the hairiness of the resulting yarn and increase its abrasion resistance property.The effect of roving spacing on the fibre packing density of siro yam in comparison to that of ring spun yam has been studied. The packing density of both the yams over the yam cross-section is not uniform. In siro yarn, it is more near the yarn axis and less towards the outer surface of yam in comparison to that of ring-spun yam. But the packing density of siro yarn is greater than that of ring-spun yam, which is one of the causes for the higher strength of siro yam

Yilmaz and Ibrahim et.al [18] reported that regarding the yarn properties, Siro spinning process is especially better with regard to its tensile properties while conventional plying process attracts attention with mainly lower yarn hairiness and also other yarn properties. Concerning the differences in single and Siro-spun yarn properties, the yarn hairiness was found to be less than singles and plied yarns

Ishtiaque et al.[19] studied the structure features of Siro-spun yarn and observed that the fiber packing density is not uniform across the yarn cross-section and it is not maximum at the core. The maximum packing density occurs at 1/3rd of the yarn radius from the yarn axis. Siro yarns are more compact near the yarn axis as compared to ring spun yarns. The total packing density of normal ring yarn is less than that of siro yarn. The cross-section of siro yarns show a close resemblance to that of single ring-spun yarn compared to conventional double yarn.

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Wang et al. [20] studied the causes of the increase in strength, the unevenness, and the decrease in hairiness for the compact siro yarn through a systematic theory analysis.

Lu et al. [21] evaluated the results of different suction slots by fuzzy mathematics and selected the suction installation by which yarns with the best comprehensive performances are spun.

Mansour and Tawfik [22] studied on the technology of Siro-spun spinning and its working principle by comparing yarn strength level of Siro-spun yarns and ring-spun yarns.

H.Meena et.al [23] finds the productivity, quality and comfort aspects of Siro spun wool-cotton blended Khadi fabrics are reported in this experimental research. The technology of Siro spun yarn is also successfully introduced in New Modal (NM) Charkha for producing woolen Khadi Siro yarn. The physical, low-stress mechanical and comfort properties of wool-cotton Siro fabrics were studied. Siro spun yarn of AM: JKC (75:25) was bulkier, more even with lower imperfections and hairiness. The tenacity and elongation of Siro spun yarns have an increasing trend with the increasing proportion of Australian Merino wool in the wool-mix

Chenchen Han et.al [24] in their work finds that compact-siro spun with lattice apron combines compact spinning and siro spinning, and is widely put into practice. In this paper, compact-siro spun models with the parallel shaped slots, oblique parallel shaped slots and V-shaped slots were simulated. Based on the airflow data in the condensing zone, the geometrical model of single fiber is built, and then the trajectory of single fiber can be got. The morphological changes and movement process of fiber strands in the flow field of condensing zone were verified by the comparison experiments of yarn morphology, hairiness, tensile and evenness properties. The results showed that the V-shaped slot achieved the optimal agglomeration effect and yarn performance. The theory analysis gives foundation and explanation for the experiment, and also provides a theoretical basis for optimizing the properties of compact-siro yarn in production practice.

Regar et.al [25] in their work made an attempt to compare the properties of Eli-Twist yarn with Siro yarn. Three yarns with three selective compositions using cotton and polyester are produced on both Eli-Twist and Siro spinning systems. Yarns of three counts(39.4, 29.5 and 23.6 tex) from each composition have been produced maintaining 4.2 TM for all. Unevenness, hairiness, tensile strength, breaking extension, diameter, abrasion resistance and coefficient of friction of yarns are measured and then compared.Eli-Twist yarns are found more uniform with less protruding fibres on the surface. It also produces stronger and more extensible yarn. Higher abrasion resistance and low coefficient of friction may widen the application field of Eli-Twist yarn

Demet Yılmaz et.al [26] ,in their study stated that an air nozzle was attached on to the sirospun spinning system and the system was called as siro-jet. Sirospun is a spinning system combining spinning and doubling in one operation and a yarn like a two fold is produced. The principle of the siro-jet system is based on the placement of the nozzle at the exit of drafting unit on sirospun spinning system and pressurized air was fed into the nozzle by the compressor during the spinning. At the end of the study, it was determined that siro-jet spinning system truly improves the yarn hairiness in comparison to sirospun spinning system.

Su Xuzhong [27] finds that the structure of Compact- Siro spun yarn by using a DZ3 video microscope, the horizontal structure of Compact-Siro spun yarn, Sirospun yarn, Compact yarn and Ring spun yarn were obtained. It is shown that compared with Compact single yarn, Compact-Siro spun yarn has a more compact and clear surface structure, a more uniform and smooth shape, and less hairiness. Then the cross section structure of Compact yarn and Compact-Siro spun yarn were obtained by using Hardy's Y172 thin cross-section sampling device and the DZ3 video microscope. It is shown that compared with Sirospun yarn, the cross-section of Compact-Siro spun yarn is smoother and closer to being circular.

Muhammad Qamar Tusiefet.al [28] in their research study was carried to analyse the quality of Siro-spun and two fold yarns under the influence of twist factor with special reference to their tensile properties. The results disclosed better tensile properties of yarn made from Siro spinning technique as compared to two plied yarn. This indicates the supremacy of Siro-spun yarn over two fold yarn. These findings enhance the fact that Siro spinning technique produces better quality yarn as compared to conventional ring spinning technique.

S.Sundaresan [29] In his research made an attempt to study the effect of strand spacing of SIRO yarn produced by using compact spinning system. Yarn was produced by 5 different strand spacing length with two different suction pressures. Various properties of these yarns were studied. The trials have been conducted by optimizing the distance between the two roving strands & varying the negative pressure applied in the suction zone.

Wen-Yan Liu [30] studied the parameters such as the angle in "V" area in Sirofil spinning system, the tension and torque of the filament and roving with different feeding spacing. The optimal strand-spacing of different spinning materials is, thus, recommended. The configuration, strength and elongation, hairiness and evenness of the yarn were studied experimentally. The theoretical results agreed very well with experimental data.

P. Soltani , M. S. Johari [31] studied the effect of strand spacing and twist multiplier on strength of Siro-spun yarns with reference to the yarn structural parameters. Of the various structural parameters for staple yarns, fiber migration has a crucial influence on the yarn strength, which in turn to a considerable extent is influenced by the strand spacing and twist multiplier. Achieving the objectives of this research, the yarns were produced from lyocell fibers at five strand spacing's and four different twist multipliers. Tracer fiber technique combined with image analysis were utilized to study the yarn migration parameters. Afterwards, the yarns were subjected to uniaxial loading by a CRE tensile tester. The findings reveal that, as strand spacing is increased, yarn tenacity increases up to strand spacing of 8 mm beyond which it reduces. Analysis of the results indicates that the higher tenacity values at the strand spacing of 8 mm can be attributed to the higher mean fiber position, higher migration factor, higher proportion of broken fibers and lower hairiness.

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Cheng V. Subramaniam and K.S. Natarajan [35] stated that higher spreading width improves blend uniformity and lowers the colour difference, thus improving dyeing uniformity. Studies the frictional properties of a series of siro spun yarns produced from cotton, polyester/cotton, and viscose. The coefficient of friction of the yarns has been measured using Howell's method where the two yams slide against each other at right angles. Yarn-to-metal friction has also been measured using a modified version of Howell and Mazur. The dependence of strand spacing and twist on the coefficients of yarn-to-yarn and yarn-to-metal friction has been examined, and the frictional coef ficient increases with increasing strand spacing and twist. The probable reasons for this behavior are discussed in terms of the nature of the yarn surfaces.

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EL SAYED, [42] studied the characteristics of cotton fabrics produced from siro spun and plied yarns. The use of sirospun yarns eliminates two processing stages in comparison with the two -fold yarns production process and consequently, reduces the cost of production. It is claimed that, it brings many advantages for yarn and fabric quality.

Armin Pourahmad and Majid Safar Johari [43] In their research, core-spun yarns with an acrylic sheath fiber and a nylon flat core have been produced on the Ring, Siro, and Solo spinning systems and the effects of some factors were investigated.

N. Gokarneshan , N. Anbumani & V. Subramaniam[44] This article investigates the influence of varying strand spacings in the case of siro or double rove yarns. Studies have been carried out on cotton, polyester and polyester–cotton yarns

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