"A comparative study between lycra integrated slub (LIS) yarn and normal slub yarn produced in same ring spinning frame"

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ABSTRACT

This project work focused on the comparative study between the lycra integrated slub (LIS) yarn and normal slub (NS) yarn. The core spun method was introduced in the Slub mechanism for producing lycra integrated slub yarn. The experiment and test results indicate that the strength, unevenness, elongation percentage, hairiness of normal slub yarn were significantly affected by introducing lycra as core component. The yarn properties were compared with those of 100% cotton ring slub yarn. Lycra integrated slub yarn showed lower unevenness, imperfection and strength values than that of normal slub yarn. The insertion of lycra in the core of normal slub yarn has increased elongation percentage of yarn. The liveliness of lycra affected the hairiness properties of lycra integrated slub yarn, showed lower hairiness value than that of normal slub yarn.It is worth mentioning that core slub yarn had improved physical properties compared to 100% cotton ring-Slub yarn.

Keywords: Core Spun Slub yarn, Cotton- Lycra core yarn, Strength, U%, Hairiness, Elongation%

1. Introduction

Slub yarn, as one of the fancy yarns, is now increasingly used for almost all kinds of textile products, such as denim garments, shirts and upholstery, due to its unique style and bamboo-like profile. To date, a variety of methods are available for producing slub yarns, like ring spun slub yarns and rotor spun slub yarns. The intermittent acceleration of the drafting rollers by controlling stepper motors in ring spinning, causing constantly varying degrees of draft to form randomly distributed slubs (thick places) in the yarn [1]. On the other hand, lycra is a lightweight, synthetic fiber that is used to make stretchable clothing such as sportswear. It is made up of a long chain polymer called polyurethane, which is produced by reacting polyester with a diisocyanate. The polymer is converted into a fiber using a dry spinning technique. First produced in the early 1950s, lycra was initially developed as a replacement for rubber. Although the market for lycra remains relatively small compared to other fibers such as cotton or nylon, new applications for lycra are continually being discovered [5]. The manufacture of core spun yarn is one of the most important developments in the textile industry. The use of core yarns is mainly aimed at improving the strength, comfort, durability, aesthetics, and other functional properties of the final yarn. Core yarn structure consists of two components: one form the central axis or core of the yarn and the other is the covering part, better known as the sheath. Continuous multifilament yarn is generally used as a core while cotton staple fibres are used to cover the filaments. Core spun yarn shows some improved characteristics over 100% cotton yarn or 100% filament yarns. Core spun yarn was preferred to blended staple spun yarn in terms of strength and comfort. Phenomenal improvements in durability and aesthetic properties were observed in core spun yarn compared to cotton spun yarn. As the cotton was wrapped over lycra filament, improvements were observed in yarn properties like moisture absorption, heat resistance, air permeability, and depth of shade in dyeing compared to synthetic yarns. The tensile strength of yarn was increased by the presence of Lycra filament at the core, which was the main load carrier when we compared it with cotton yarn [17]. This article reports on the results of investigation of lycra integrated slub(LIS) yarns made from using lycra filament as core component and cotton as sheath material manufactured in ring spinning systems.The yarn properties were compared with those of 100% cotton ring-slub yarn. It is observed that core slub yarn had improved physical properties compared to 100% cotton ring slub yarn in many aspects such as strength, elongation, hairiness, U%, CV%, and yarn imperfections.

2. Experimental Techniques and Method

2.1 Slub Yarn

The yarn that is spun intentionally to achieve thick and thin sections alternating regularly or irregularly shape, in terms of length and diameter.

2.2 Production of Slub in Ring Frame

Slub Yarn is a yarn containing thick places of different thickness and length that is achieved by programmed acceleration of back and middle rollers in case of ring spinning and the feed roller in case of rotor spinning [1], In ring frame slub yarns could be produced by modifying ring spinning frame, such that the intermittent acceleration of back and middle rollers of ring spinning, at the same time maintaining the front roller at a constant speed. This controlled acceleration produces variation in the count of the base yarn will cause varying degrees of draft to be applied [2].

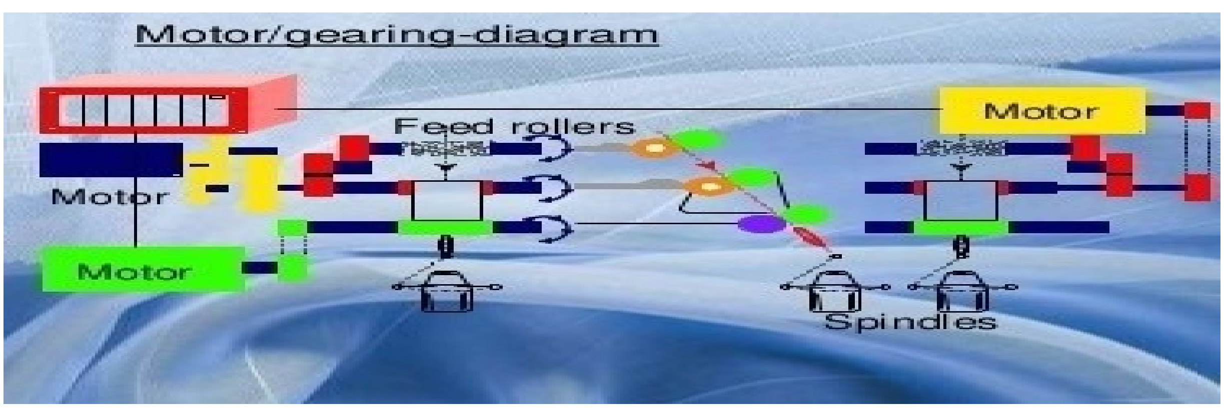

Fig-01: Gearing Diagram of Slub Attachment in Ring Frame.

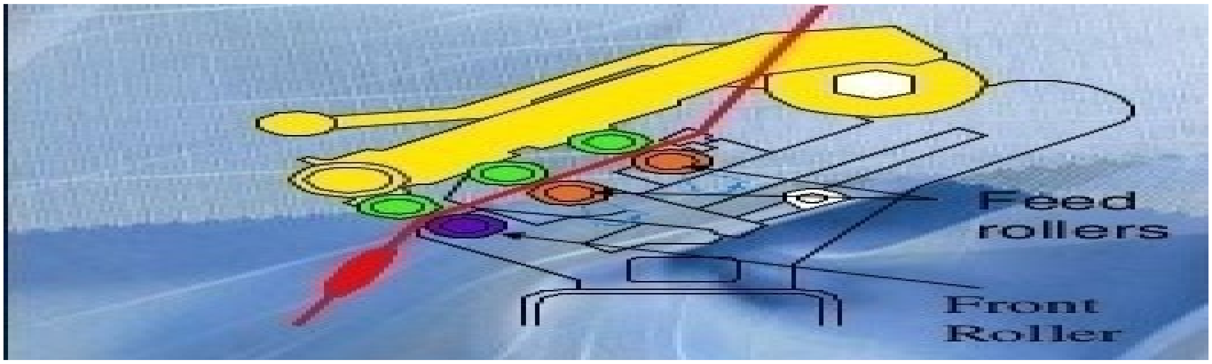

Fig-02: Drafting Arrangement for Slub Yarn in Ring Frame.

2.3 Spandex or Lycra

Spandex is a synthetic polymer. Chemically, it is made up of a long-chain polyglycol combined with a short diisocyanate, and contains at least 85% polyurethane which is produced by reacting a polyester with a diisocyanate. It is an elastomer, which means it can be stretched to a certain degree and it recoils when released. In fact, spandex fibers can be stretched to almost 500% of their length. These strands are composed of two types of segments: long, amorphous segments and short, rigid segments. When a force is applied to stretch the fibers, the bonds between the rigid sections are broken, and the amorphous segments straighten out. This makes the amorphous segments longer, thereby increasing the length of the fiber. When the fiber is stretched to its maximum length, the rigid segments again bond with each other. The amorphous segments remain in an elongated state. This makes the fiber stiffer and stronger. After the force is removed, the amorphous segments recoil and the fiber returns to its relaxed state [5-7].

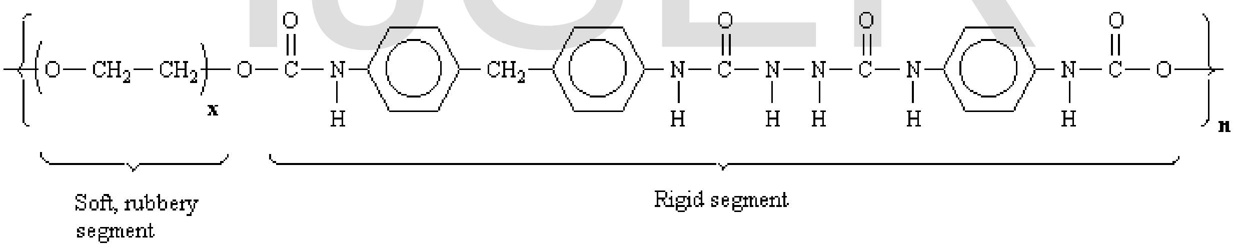

Fig-03: Chemical Structure of Spandex.

2.4 Core Spun Yarn

Core-spinning is a process by which fibers are twisted around an existing yarn, either filament or staple spun yarn, to produce a sheath– core structure in which the already formed yarn is the core. Core-spun yarns are two-component structure with Core and sheath. Generally continuous filament yarn is used as core and the staple fibers used as sheath covering. One of the most common types of core-spun yarns is the elastomer core-spun yarn, which involves a core of elastomeric fiber such as polyurethane fiber with a covering of staple fibers [9].

2.5 The Manufacturing Process of Core Spun Yarn in Ring Frame with diagram

A core spinning attachment in ring spinning is shown in Fig-04. To spin core spun yarns, a feeding device for the core filament must be installed on the ring spinning machine. The core filament passes the yarn guide and is fed directly into the front roller, while the wrapping fiber strand passes the back, middle and front roller successively. Finally the wrapping fiber strand meets the core filament in the front nip. They pass the yarn carrier and are twisted and wound by the combined action of ring and traveller. After the wrapping fiber strand leaves the front nip, tension on the strand will decrease. However, tension on the core filament is always high from the front roller to the winding position. Therefore, the fiber strand wraps around the core filament and a compound yarn is produced [8-10].

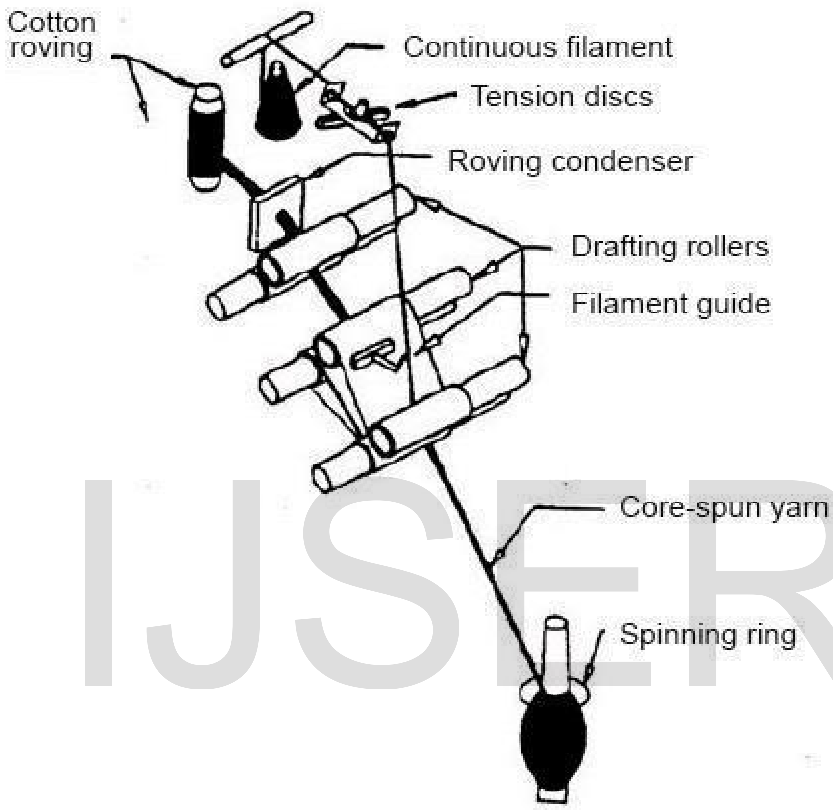

Fig-04: Core Spun Yarn Production by Ring Frame.

2.6 Structure of Core Spun Yarn

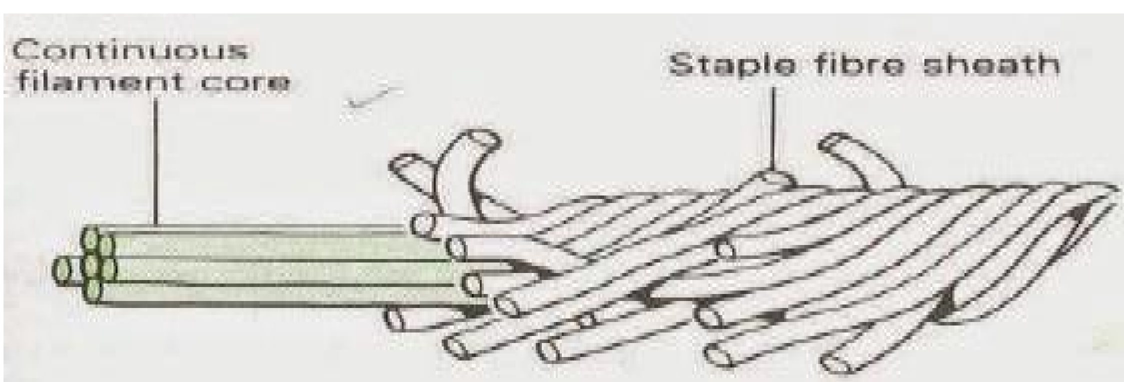

Fig-05: Core Yarn has two parts: 1. Sheath & 2. Core.

3. Material Data and Experimental Results

3.1 Material Date

Core forming filament Lycra was used with fineness of 20 denier. Parameters for Lycra are as follows:

Table-01: Lycra Specifications.

Filament	Fineness	Tenacity (cN)	Elongation %
Lycra	20D	17.6	560

Thus, the two components viz. cotton & Lycra are combined together to form the desired yarn. The produced yarn had the following parameters:

Table-02: Yarn Parameters.

Yarn count (Ne)	TPI	TM	Lycra%
30(20D) Ne	24.81	4.53	10.9

3.2 Slub Data

Table-03: Slub Parameters.

Slub Attachment	Slub length	Interval Length	Slub Diameter	Negative Slub	Slub in per Meter
Amsler	40mm	400mm	1.9 times of normal yarn.	0.4 times of normal.	2.5

3.3 Experimental Results

3.3.1 Uster Statistic 5

Table-04: Uster 5 test repot (Average Report)

Test Parameters	Lycra Integrated Slub Yarn (Core-Slub)	Normal Slub Yarn
U%	19.442	22.232
CV%	27.532	30.014
Thin(-50)	64.2	253.8
Thick(+50)	1864.6	2261.8
Neps(+200)	788	1157.4
IPI	2716.8	3673
Hairiness	5.074	5.336

3.3.2 Mesdan Lea Strength Tester (Bundle Yarn)

Table -05: Bundle Yarn Strength Tester report (Average Report)

Test Parameters	Lycra Integrated Slub Yarn (Core-Slub)	Normal Slub Yarn
Max Force(N)	300	366.4
CV% of Max Force	5.60	4.93
Elongation %	15.59	9.12
CV% of Elongation %	11.29	2.87
CLSP(Ne*lb)	2035.186	2459.941
CV% of CLSP(Ne*lb)	5.50	4.94

3.3.3 Mesdan Lea Strength Tester (Single Yarn)

Table-06: Single Yarn Strength Tester report (Average Report)

Test Parameters	Lycra Integrated Slub Yarn (Core-Slub)	Normal Slub Yarn
Max Force(N)	3.30	2.78
CV% of Max Force	7.60	9.31
Elongation %	4.16	3.34
CV% of Elongation %	1.35	11.32
Tenacity (cN/tex)	16.57	14.49
CV% of Tenacity (cN/tex)	9.31	5.07

4. Results Analysis

4.1Yarn Strength

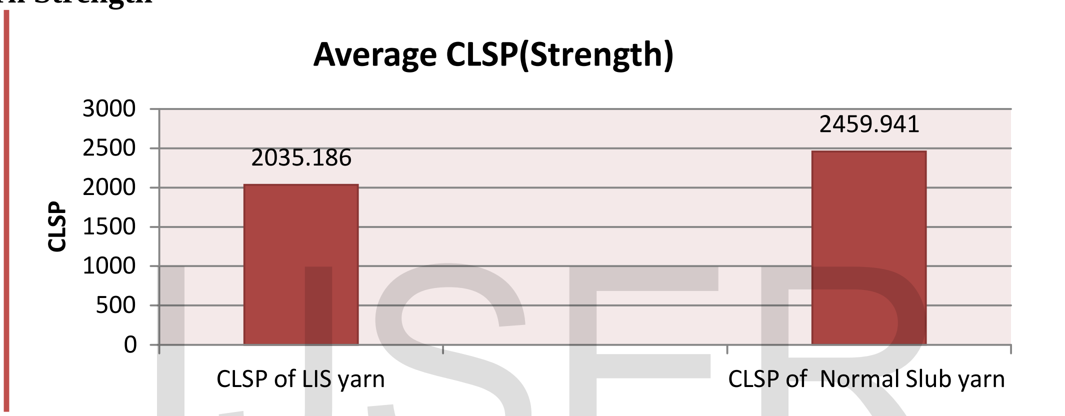

Fig-06: Bar Diagram for CLSP of LIS yarn and Normal Slub yarn.

From the bar diagram, it is seen that the CLSP (strength) of lycra integrated slub yarn(LIS) is lesser than that of the normal slub yarn. It may be explained in such a way that the fibers placed in the yarn core undergo the maximum stress during tensile loading. In core-spun yarns, since the core filaments are located straight and parallel to yarn axis, it was expected that the core filament was broken before the sheath part. Because the core filament had no twist [11-13]. As a result, yarn CLSP value of lycra integrated slub yarn has been decreased.

4.2 Yarn Unevenness

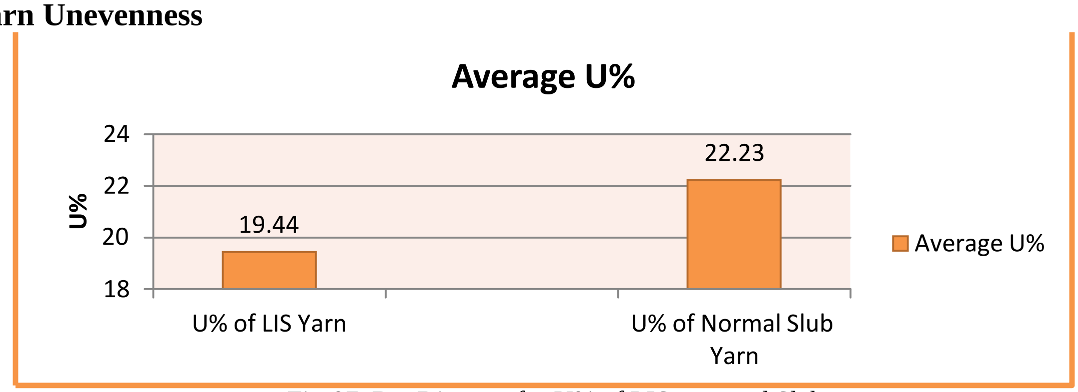

Fig-07: Bar Diagram for U% of LIS yarn and Slub yarn.

From the bar diagram, it is seen that the U% of Lycra Integrated Slub Yarn (LIS) is lesser than that of normal Slub Yarn. It is may be happened due to core spun yarn is more even as compared to normal ring yarn, because of the fiber disposition of the filament & the sheath material contributes to the lower unevenness percentage of core spun yarn. By reducing cotton content in the yarn body by introducing filament in its structure, the unevenness percentage of core spun yarn is decreased. This effect is due to less binding fibers in the sheath of the yarn. Overall the core spun yarn is more even or less unevenness percentage as compared to the yarn made from conventional ring frame in the given resultant count [15-16]. And slub yarn itself uneven yarn, So, the evenness of lycra integrated slub yarn is better than that of the normal slub yarn.

4.3 Yarn Hairiness

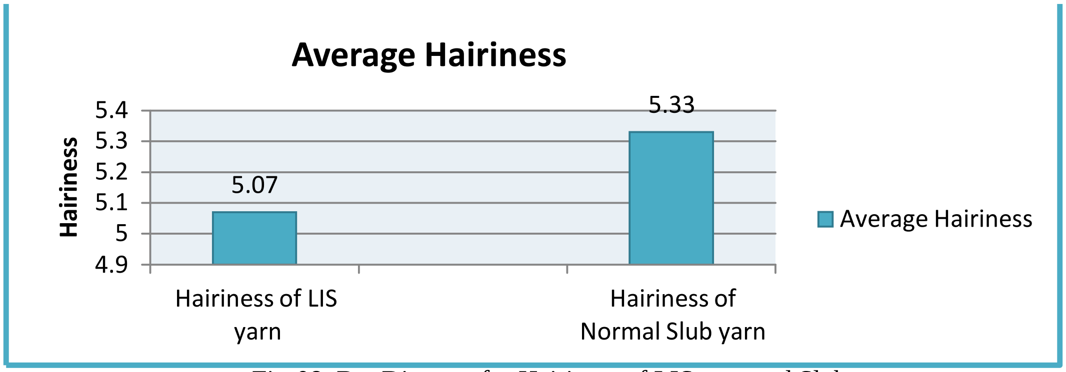

Fig-08: Bar Diagram for Hairiness of LIS yarn and Slub yarn.

From the bar diagram, it is seen that the hairiness value of lycra integrated slub yarn(LIS) is lesser than thatof the normal slub yarn. Hairiness is a measurement for the amount of fibers protruding from the main structure of the yarn. Here less Hairiness value indicate lower protruding fibers.In ring spun slub yarn, its core and sheath layers are formed from same fiber. Here some of the fibres have an end in the core of the yarn, partially gripped by the fibers in the central zone, and other emerge to the surface. During twisting of yarn, the fibres at the sides develop tension and cause the fibres at the core to displace and migrate. But as soon as the fibres emerge out of the nip of the roller, tension falls and the fibres become incapable of binding themselves to the yarn and stick out of the surface as protruding ends and forms hairs on the surface of the yarn [17]. The structure of Slub yarn is similar to the Ring-Spun yarn and the base portion of slub yarn shows the similar characteristics that of ring spun yarn in term of hairiness. The core yarns showed fewer protruding ends and loops than equivalent cotton single yarns, because the number of staple fibers present in the core yarns was lower than that in the equivalent cotton single yarns [18]. Finally, it can be said that the hairiness value has been decreased in lycra integrated slub yarn because of above mentioned technical explanations.

4.4 Elongation of Single Yarn

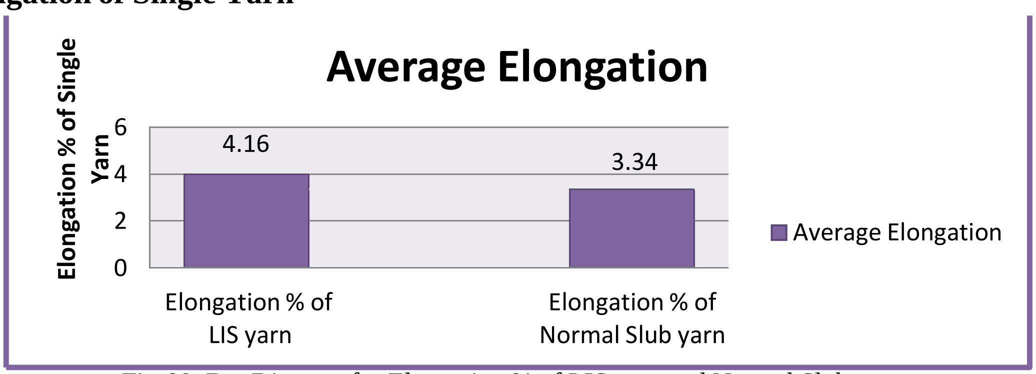

Fig-09: Bar Diagram for Elongation % of LIS yarn and Normal Slub yarn.

From the bar diagram, it seen that the Elongation % of lycra integrated slub (LIS) yarn is higher than that of the normal slub yarn by which it is also indicated that the elastic recovery of LIS yarn is more than normal slub yarn. It may be due to the introducing of filament at the core increase the elongation percentage of the core slub yarns. Same results found by Pramanik et al

[19]. When a filaments was introduced at the core, yarn elongation was increased by 20%to 80% for ring core yarn compared to 100% cotton yarn. This was because of the introduction of filaments at the core which was considered to provide high elongation of the yarn compared to 100% cotton fibers [19].

5. Conclusion

In this report, we are try to develop a new a type of yarn namely, Slub Core Spun Yarn, were Slub and Core Spun mechanism combined together. Were we used Lycra as a core materials and Cotton as a sheath material. By this experiment we get new type of yarn which have good improvement in physical characteristics and yarn qualities compare with those two different mechanism. This yarn shows some characteristics which we can't get individually from those two mechanism.

5.1 The strength of core slub yarn depend on core filament and core-sheath ratio, here strength of core-slub yarn is lower than that of normal slub yarn.

5.2 The U% of core slub yarn depend on the fibres content in the sheath layer of the core-slub yarn, here unevenness percentage of core-slub yarn is lower than that of normal slub yarn.

5.3 The Hairiness of core slub yarn depend on the fibres content in the core and sheath layer materials and number of staple fibres in core of the core-slub yarn, here hairiness of core-slub yarn is lower than that of normal slub yarn.

5.4 The Elongation % of core slub yarn depend on the filament introduced in the core of the core-slub yarn, here elongation percentage of core-slub yarn is higher than that of normal slub yarn.

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