# Effect of Yarn Structure on Yarn and Fabric Properties Produced using Eli Twist Yarn and TFO Yarn – A Comparative Study

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*Abstract*— Denim is a worldwide popular form of fabric worn by both the genders, all age groups including children, teenagers, adults and old aged persons as well. More than a fashion commodity it has evolved in to a regular wear. Denim garments are preferred due to its typical characteristic, ease of wear, does not require ironing, durable and most suited for travel wear and rough use. The classical form of denim (3/1 twill) which used to be the worn by the work men is still popular, though lot of modifications and value additions have been carried out in the yarn and weaves. Earlier open end yarn was commonly used due to cost economic factors. Further Ring yarn, doubled yarn and its variations were tried to get the required flatness, sheen and appearance. Among the doubled yarn prepared by TFO (Two for one) the popular counts are 2/20s, 2/30s & 2/40s. Now these counts were preferred for manufacturing value added trousers, due to its aesthetic feel and lusture. These doubled yarn merge well with the modified weaves like dobby designs. Cotton Weft yarn with elastane and slubs are in demand by the market. Elastane weft with slubs and fancy patterns add up to the beauty of the fabric. Further enhancement of appearance and feel is made possible by suitable processing route like desizing which makes the fabric softer and absorbant. Mercerizing treatment adds up the lustre and feel of the fabric. Now to optimize the cost factor without affecting the quality and working performance during the manufacturing process, we have adopted the use of Elite compact yarn as an alternate to the conventional, lengthy and costly TFO yarn. Compact doubled yarn has superior characteristics due to the speciality of yarn formation (narrow spinning triangle) and the structure. The advantages are less hairiness, better yarn strength; lesser U% and imperfections /km. The 2/32s TFO yarn is preferred by the garment customers due to its unique structure, better smoothness, better sheen, higher lusture, and clean appearance in the fabric. The TFO yarn was replaced in warp with 2/32s Elite compact yarn and compared for its performance at all the stages of spinning and package stage. Further studies were carried out at all the Denim preparatory, fabric manufacturing and fabric processing sequence like warping, dyeing & sizing (slasher), weaving, processing (singeing, desizing, mercerizing, finishing) and final fabric stage. The fabric characteristics were compared (FTD) for all the physical parameters like dimensional stability (warp wise and weft wise shrinkage, bow and skew), width, gsm, tensile & tear strength (warp & weft wise), stretch recovery, growth. Crocking fastness (dry & wet), washing fastness, Drape co-efficient, pilling, abrasion, stiffness, air permeability etc. Chemical parameters like Indigo gpl, Indigo shade %, pH, Barium Activity no, Desizing Efficiency, Colour fastness to washing were also tested and compared.

***Key words:*** Eli Twist, TFO (Two for One Twister)

## I. INTRODUCTION

The open end yarn was commonly used for manufacturing the denim fabric due to cost economic factors. Further Ring yarn, doubled yarn and its variations are made popular due to its appearance and any other properties.

Earlier the doubled yarn prepared by TFO (Two for one) which are very lengthy and cost affecting process for producing the double yarn. Now a days this technique are replaced by the adopting the use of Elite compact spinning. Which are manufacturing compact double yarn with superior characteristic?

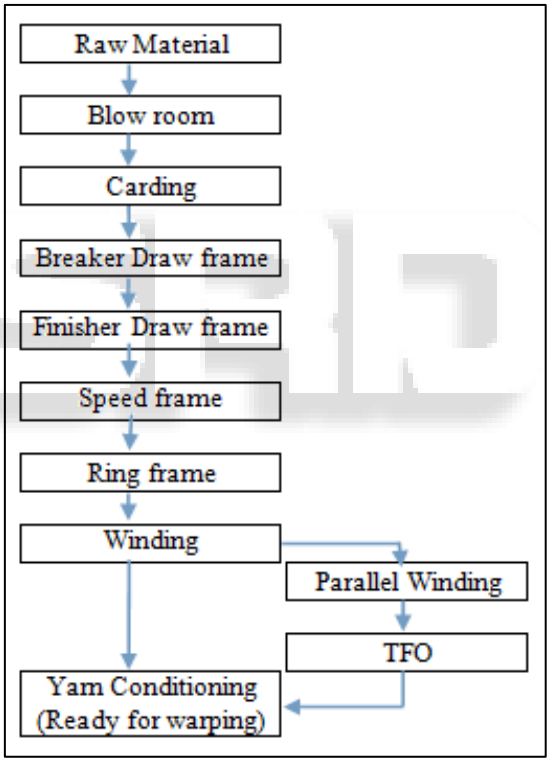



Fig. 1: Sequence of Denim Yarn Manufacturing

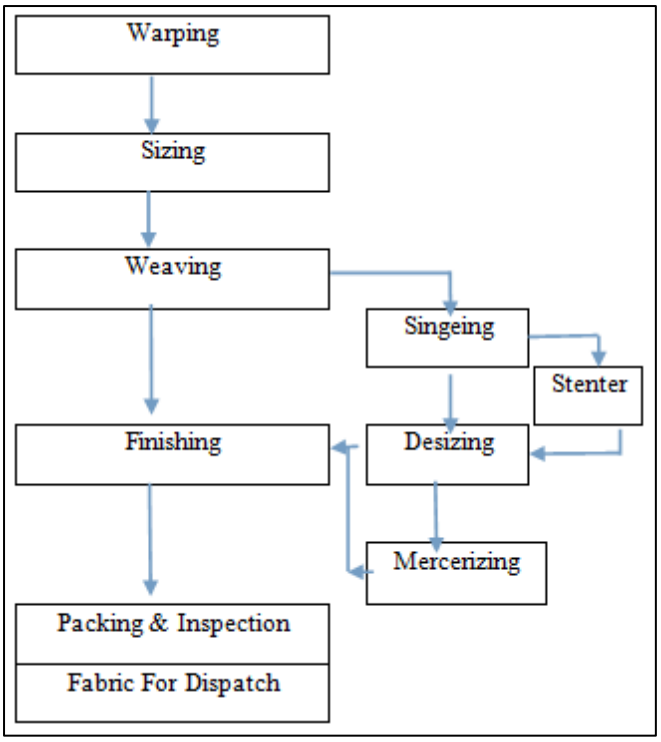



Fig. 2: Sequence of Denim Fabric Manufacturing.

In this work the double yarn samples have been manufactured by using of A) Suessen Elite Compact Spinning technique and B) TFO. The process of both techniques is as shown in fig. 1.

*A. Suessen Elite Compact Spinning*

An alternating approach to produce compact yarn is given by Suessen under the name Elite Compact Spinning. The drafting system is followed by condensing zone, which consists of profile tube, the lattice apron and delivery top roller. The delivery top roller is driven by front top roller via a small gear. The profile tube is closely embraced by a lattice apron driven by delivery top roller. The profile tube is under negative pressure produced by suction unit. Profile Tube has an oblique slot extending up to the clamping point between profile tube and delivery top roller.[6 & 7]

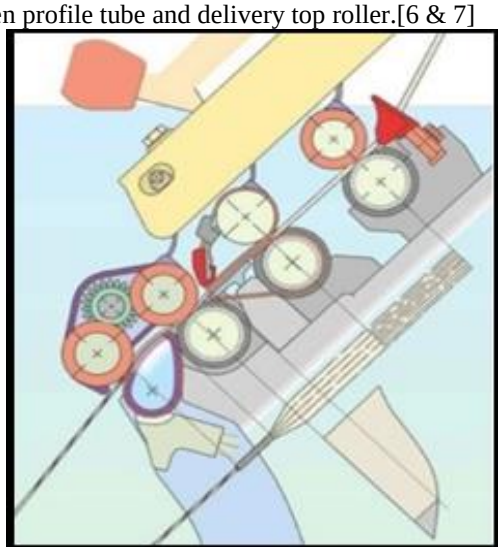


Fig. 3: Side View of Suessen Elite Drafting System,

Fig. 4: Passage of Roving Double Feeding,

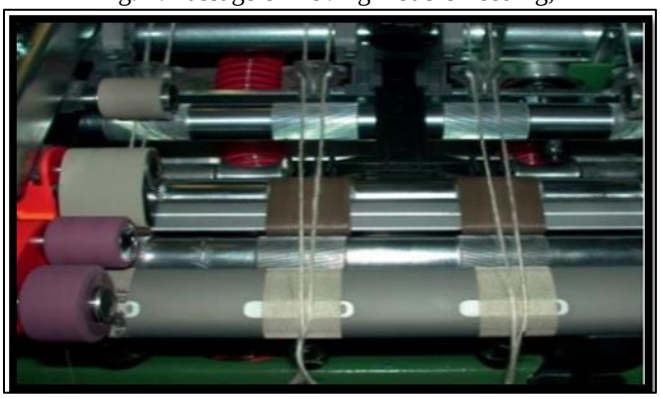


Fig. 5: Top view of drafting System.

The fibres emerging from the drafting system are gripped by the airflow created by vacuum and lattice apron and transported towards the oblique edge of the slot and consequently condensed. At the delivery clamping line the fibre strand has achieved optimum condensation. After the clamping line, twist is imparted to an ideally straightened fibre strand, with individual parallel and optimally condensed fibres without protruding hair. In addition, a slight draft is also applied to enhance consolidation that causes further reduction in the width of the strand during yarn formation.

Different types of suction slots are available for coarser and finer counts, carded and comber yarn as well as synthetic fibres. It is important that the suction force is8+ identical for all spinning positions. For this purpose, suction pumps are installed and driven by a motor. Each suction pump covers fixed number of spinning positions. Suessen offers different Compact Spinning systems for different application.[11]

The Eli Twist Spinning Method combines compact spinning and twisting of yarn in one single operation. It produces two-ply yarn with identical direction of twist in both yarn legs. The twisting triangle is very small and the ends-down rates are very low even at high spindle speeds.[10].

Fig. 6: Microscopic view of 2/32s Eli Twist yarn Structure

The yarn with the made up of this technique have superior yarn strength, Evenness as a result of doubling, low hairiness values, smooth surface and good abrasion resistance.

The advantages of use this techniques for producing the double yarn are Compact spinning and twisting in one operation, Significant production increase on ring spinning and winding machine, Spindle speed and ends-down achieve the level of single compact yarns spun in the same yarn count. The microscopic structure of the eli twist yarn are as shown in above fig.

The main application of Eli Twist Yarn are High-grade shirts and trouser fabrics, Light gabardine fabrics, for knitwear etc. The main advantages of use of this techniques is there are no restriction regarding use raw materials; fibre blends for achieving the criteria of different applications.

*B. Two For One Twister (TFO):*

The yarn material to be passed is fed into the bobbin pot which is held still on the rotating spindle top by magnetic force. The yarn is guided from the package into the thread brake either over the twisting flyer or over the feeding aids. It then runs through the hollow axle of the spindle top and emerges from the thread duct of the storage disc. The first twist is given to the yarn between the thread brake and storage disc outlet in the hollow axis of the spindle and the second twist is applied between the storage disc outlet and balloon thread guide in the balloon. The twisted yarn is finally deflected over the deflection thread guide and overfeed roller traverse thread guide and wound onto a tube in the form of cheese or cone held in a bobbin frame between two bobbins plates.[9]

Some other important operational parameters like improvement in yarn quality, type of spindle drive, delivery package weight and feed package weight ratio, doubled yarn twist and single yarn twist ratio, etc. are also important.The two for one twister is suitable for twisting natural and man-made fibre like viscose and synthetic yarn with a maximum speed of 10500 rpm equivalent to 21000 effective turns/min.

Fig. 7: Microscopic view of 2/32s TFO yarn Structure.

The speed will vary according to material and count of yarn being processed about 500 gm. and about 1000 gm. Feeding material in this type is supplied to spindle directly up to cone or cheese as knot free yarn with the required no. of twist inserted.[.8].

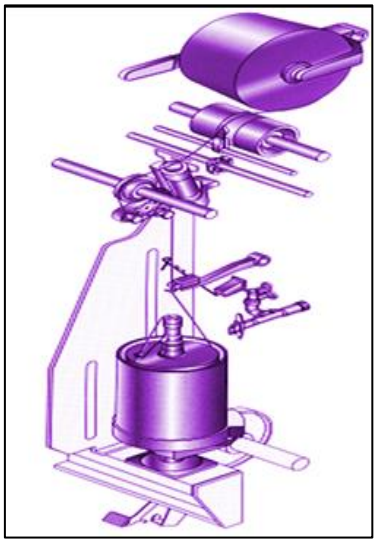


Fig. 8: Passage of yarn in TFO machine.

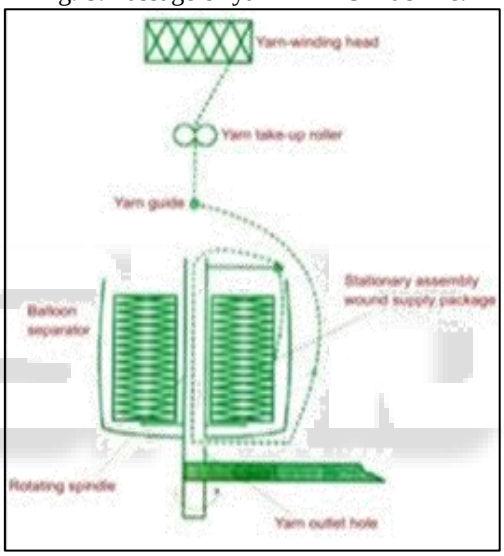



Fig. 9: Schematic Diagram of yarn passage in Two for One twister.

The advantages of using TFO are: It have high delivery speeds, elimination of rewinding, low end breakage rates, better and softer handle than that of rotor-spun yarn, yarn character similar to that of ring-spun yarn. The microscopic view of TFO yarn are as shown in fig. But if have disadvantages like low yarn strength, High tendency to snarl, increasing unevenness and imperfections with increasing spinning speed, and further reduction in yarn strength.

## II. MATERIALS & METHODOLOGY

The raw material used for this study are mixing of 4 different types of cotton verities with different proportions as shown in Table 1 and the properties of mixed cotton are given in Table 2.

| Cotton | Mixing % |
|---|---|
| S-6 | 54 |
| Mech | 10 |
| MCU 5 | 10 |
| J 34 | 26 |

Table 1: Cotton Variety & Mixing %:

| UHML mm | STR g/tex | MIC | SF% | UI | TRASH % |
|---|---|---|---|---|---|
| 29.4 | 29.4 | 4.2 | 7.7 | 82.2 | 3.1 |

Table 2: Properties of Mixed Cotton

The samples of both the types of yarn TFO and Eli twist yarn has been tested for the different properties like yarn CSP, U%, Imperfection, Hairiness, Elongation, RKM value for the comparative analysis of yarn. Further also studied the warp breakage during warping and both the yarn performance on the weaving stage.

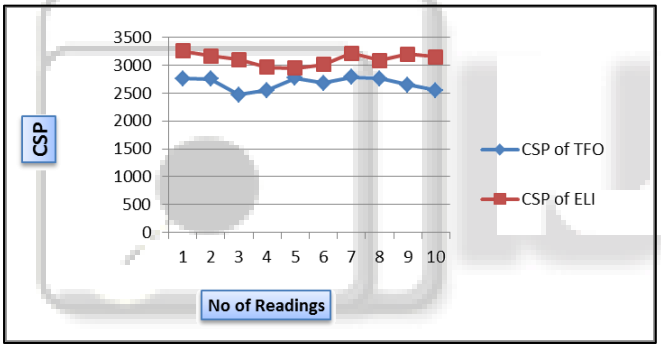
## III. Results & Discussion

The same count i.e 2/32s Ne and same material yarn produced by the using TFO and Eli twist spinning method. and testing the various yarn properties for both the yarn TFO as well as Eli Twist. The comparison of both the yarn results is as given below:

### *A. YARN CSP:*

| Properties | CSP of 2/32s TFO | CSP of 2/32s Eli |
|---|---|---|
| AVG | 2673.2 | 3109.1 |
| MIN | 2469 | 2944 |
| MAX. | 2784 | 3254 |
| SD | 113.0 | 107.2 |
| CV% | 4.2 | 3.4 |
| CORREL. | 0.20 | |

Table 3: CSP of 2/32S TFO Yarn & 2/32s Eli Twist Yarn



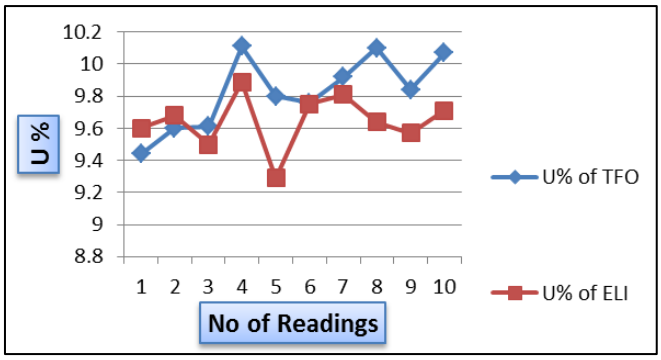

Graph 1: Trend analysis of CSP 2/32s TFO yarn & 2/32s ELI Twist yarn

As shown in graph 1 The Average CSP of 2/32s ELI yarnis Higher by 22% Compared to the CSP of 2/32s TFO yarn.

### *B. YARN U%:*

| Properties | U% of 2/32s TFO | U% of 2/32s Eli |
|---|---|---|
| AVG | 9.825 | 9.644 |
| MIN | 9.44 | 9.29 |
| MAX. | 10.11 | 9.89 |
| SD | 0.22 | 0.16 |
| CV% | 2.34 | 1.75 |
| CORREL. | 0.40 | |

Table 4: U% OF 2/32S TFO Yarn VS 2/32S ELI Twist Yarn



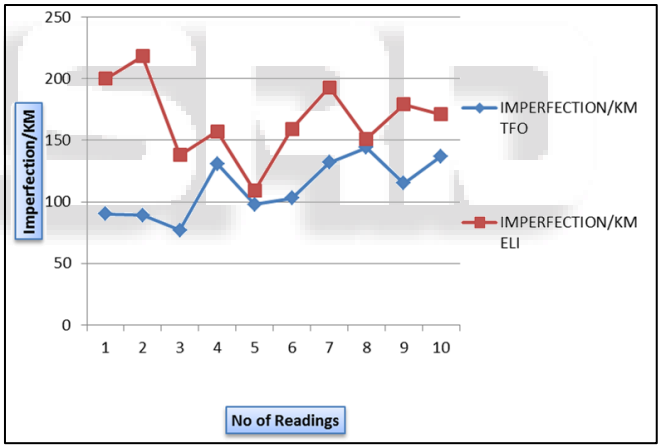

Graph 1: Trend analysis of U% 2/32s TFO yarn & 2/32s Eli Twist Yarn

As shown in Graph 2 Avg U% of 2/32s ELI yarn is better compared to 2/32s TFO yarn(As shown in Graph 2.).

### *C. Yarn Imperfection/Km:*

| Properties | Imperfection/Km 2/32s TFO | Imperfection/Km 2/32s Eli |
|---|---|---|
| AVG | 112.4 | 166.18 |
| MIN | 76.5 | 98.4 |
| MAX. | 144 | 218 |
| SD | 22.95 | 34.21 |
| CV% | 20.42 | 20.58 |
| CORREL. | -0.09 | |

Table 5: Imperfection of 2/32s TFO Yarn VS 2/32s ELI Twist Yarn




Graph 3 Trend analysis of Imperfection 2/32s TFO yarn & 2/32s Eli Twist yarn

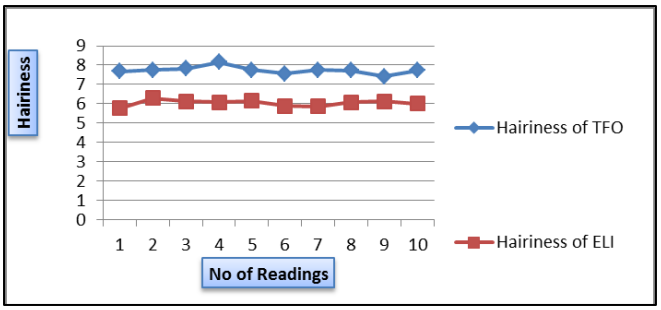
As shown in Graph 3 Imperfection/km of 2/32s TFO yarn is lower compared to 2/32s ELI yarn.( Lower by 36%).

### *D. YARN HAIRINESS:*

| Properties | Hairiness of 2/32s TFO | Hairiness of 2/32s Eli |
|---|---|---|
| AVG | 7.72 | 6.03 |
| MIN | 7.42 | 5.76 |
| MAX. | 8.16 | 6.29 |
| SD | 0.18 | 0.15 |
| CV% | 2.45 | 2.61 |
| CORREL. | 0.17 | |

Table 6: Hairiness of 2/32s TFO Yarn VS 2/32s ELI Twist Yarn



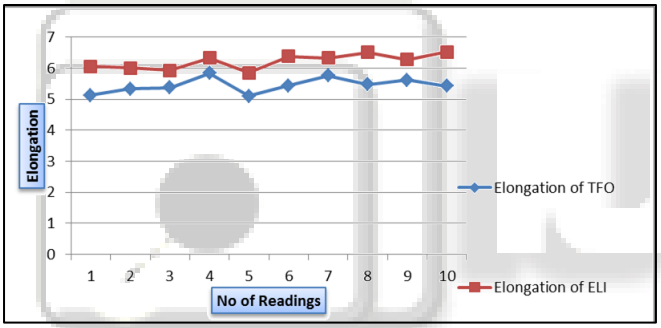

Graph 4: Trend analysis of Hairiness of 2/32s ELI yarn Vs 2/32s TFO yarn.

As shown in Graph 4 Hariness of 2/32s ELI yarn is lower by 28% compared to 2/32s TFO yarn.

*E. YARN Elongation:*

| Properties | Elongation of 2/32s TFO | Elongation of 2/32s Eli |
|---|---|---|
| AVG | 5.446 | 6.215 |
| MIN | 5.1 | 5.85 |
| MAX. | 5.83 | 6.52 |
| SD | 0.24 | 0.24 |
| CV% | 4.42 | 3.89 |
| CORREL. | 0.59 | |

Table 7: Elongation of 2/32s TFO Yarn VS 2/32s ELI Twist Yarn



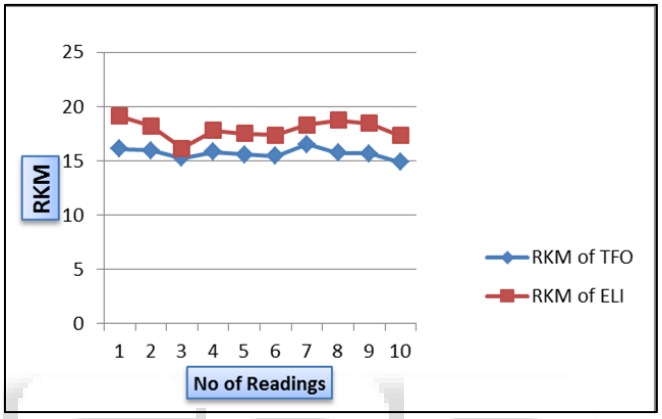

Graph 5: Trend analysis of Elongation of 2/32s ELI yarn Vs2/32s TFO yarn.

As shown in Graph 5 Average Elongation % of 2/32s ELI yarn is higher by 14% compared to the 2/32s TFO yarn.

*F. YARN RKM:*

| Properties | RKM of 2/32s TFO | RKM of 2/32s Eli |
|---|---|---|
| AVG | 15.70 | 17.90 |
| MIN | 14.87 | 16.14 |
| MAX. | 16.52 | 19.11 |
| SD | 0.45 | 0.86 |
| CV% | 2.91 | 4.81 |
| CORREL | 0.66 | |

Table 8: RKM of 2/32S TFO Yarn VS 2/32S ELI Twist Yarn




Graph 6: Trend analysis of RKM of 2/32s ELI yarn Vs2/32s TFO yarn.

As shown in Graph 6 Average RKM (g/tex) of 2/32s ELI yarn is higher by 14% compared to 2/32s TFO yarn.

*G. Classimat Faults/Lac Metres*

| Classimat faults/lac metres | | | |
|---|---|---|---|
| Category | Fault Classes | 2/32s Eli (Faults Per 100 km) | 2/32s TFO (Faults Per 100 km) |
| Objectionable Faults | A4,B4,C3,C4,D3,D4 | 0 | 0 |
| category 1 | A1,A2,A3,A4,B1,B2,B3,B4,C1,C2,C3,C4,D1,D2,D3,D4 | 51 | 37 |
| category 2 | E,F,G | 0 | 0 |
| category 3 | H1,H2,I1,I2 | 1 | 47 |
| category 4 | L2,A1,A2,A3,A4,B1,B2,B3,B4,C1,C2,C3,C4,D1,D2,D3,D4,E,F,G,H1,H2,I1 | 52 | 84 |

Table 9: CLASSIMAT Test Results of 2/32s ELI Twist Yarn VS 2/32s TFO Yarn

Classimat Objectionable faults are nil in both 2/32s Eli yarn and 2/32s TFO packages (Shown in Table 9).

ABCD faults are higher in 2/32s Eli yarn compared to 2/32s TFO yarn by 37%.

Long thin faults are very high in 2/32 TFO yarn where as thin faults are almost nil in 2/32s Eli yarn.

*H. WARPING BREAKS STUDY:*

| Warping Breaks Study | | |
|---|---|---|
| Count | 2/32 ELI | 2/32 TFO |
| Set length | 35000 | 35000 |
| Ends | 520 | 520 |
| Speed | 600 | 600 |

| Causes of yarn breaks | No. ofBreaks | No. of Breaks |
|---|---|---|
| Weak end | 2 | 0 |
| Cut end | 2 | 5 |
| Splice failure | 3 | 3 |
| Slough off | 1 | 1 |
| Cut cheese | 1 | 2 |
| Entanglement | 1 | 2 |
| Tail end | 1 | 0 |
| Fluff | 0 | 1 |
| Foreign matter | 1 | 1 |
| Total breaks | 12 | 15 |
| Breaks/10 lac.mtr | 0.66 | 0.82 |

Table 10: Cause Wise Breaks at Warping.

Warping breaks/milionmetres are higher in the case of 2/32s TFO yarn by 25% compared to 2/32s Eli yarn (Shown in Table 8).

*I. Colour Analysis of Dyed Yarn (Hunter Lab)*

| ID | L* | a* | b* | dL* | da* | db* | dE* | dE CMC |
|---|---|---|---|---|---|---|---|---|
| TFO indigo liq (3%) STD | 13.1 | 4.4 | -8.2 | 13.1 | 4.4 | -8.3 | | |
| ELI indigo lig (3%) | 14.1 | 4.1 | -10.4 | 0.99 | -0.3 | -2.2 | 2.4 | 2.4 |

Table 11(A): Colour Analysis of Dyed Yarn At 1% Indigo Shade

| ID | L* | a* | b* | dL* | da* | db* | dE* | dE CMC |
|---|---|---|---|---|---|---|---|---|
| TFO indigo liq (3%) STD | 13.1 | 4.4 | -8.2 | 13.1 | 4.4 | -8.3 | | |
| ELI indigo lig (3%) | 14.1 | 4.1 | -10.4 | 0.99 | -0.3 | -2.2 | 2.4 | 2.4 |

Table 11(B): Colour Analysis Of Dyed Yarn At 3% Indigo Shade.

As Shown in Table 11(A) & 11(B) Keeping 2/32s TFO yarn as Standard the shade depth was compared. The 2/32s Eli yarn was observed to be lighter in both at indigo shade 1% & 3% possibly due to the yarn structure(Shown in Fig.6 & 7).

*J. % GAIN IN YARN STRENGTH & %LOSS IN ELONGATION AFTER SIZING*

| Sized Yarn | | | | | | |
|---|---|---|---|---|---|---|
| Set no. | Sort no | Count | | BrkStr (gms) | Elong % | Tenacity (Rkm) |
| 6190 | 41-232456 | 2/32s TFO | Avg | 771.42 | 5.19 | 20.91 |
| | | | Min | 706.23 | 4.55 | 19.41 |
| | | | Max | 820.78 | 5.7 | 22.24 |
| 7191 | 41-230456 | 2/30s Elite | Avg | 856.24 | 5.37 | 21.74 |
| | | | Min | 781.93 | 4.65 | 19.85 |
| | | | Max | 909.43 | 6.21 | 23.09 |
| Grey Unsized Yarn | | | | | | |
| Count | | BrkStr (gms) | Elong % | Tenacity | % Gain in Str | % Loss in Elong |
| 2/32s TFO | Avg | 553.73 | 6.39 | 15.01 | 39.31 | 18.78 |
| | Min | 470.15 | 5.3 | 12.74 | 50.21 | 14.15 |
| | Max | 619.57 | 7.13 | 16.79 | 32.48 | 20.06 |
| 2/30s Elite | Avg | 648.31 | 6.86 | 16.46 | 32.07 | 21.72 |
| | Min | 576.74 | 5.88 | 14.64 | 35.58 | 20.92 |
| | Max | 736.61 | 8.02 | 18.7 | 23.46 | 22.57 |

Table 12: % Gain in Yarn Strength & %Loss in Elongation after Sizing

As shown in Table 10 Yarn Strength is enhanced after Sizing by the ideal Selection of size recipe Residual elongation % is maintained by proper control of stretch % (to be minimum)

*K. PERFORMANCE AT WEAVING*

| Looms breaks study report (Average Per Hour) Total observation 10 loom hours | | |
|---|---|---|
| Loom No | 1530 | 1529 |
| Sort No | 41230456 | 41232456 |
| Warp | 2/32 ELI | 2/32 TFO |
| Weft | 10 slublyc + 10 lyc | 10 slublyc + 10 lyc |
| Reed Pick | 100/54 | 100/54 |
| Rpm | 935 | 930 |
| Set No | 7191 | 6190 |
| Warp Tension | 3500 | 3500 |
| Warp Breaks/Hour | | |
| Missing End | | |
| Cross End | 1 | 1 |
| Slack End | | 1 |
| Cut End | 1 | 1 |
| TotalWarp Breaks/Hour | 2 | 3 |
| Weft Breaks | | |
| Weak Place | | |
| Long Pick / H2 | 1 | 1 |
| Mechanical Stop | | |
| Ele.Fault | | |
| Total Weft Breaks/Hour | 1 | 1 |
| Grand Total/Hour | 3 | 4 |
| Efficiency | 90.50% | 88.00% |

Table 13: Cause Wise Report of Warp Breaks & Weft Breaks at Weaving.

As shown in Table 13 Average warp stops/hr was lower and loom efficiency % is higher by 25% during the weaving for the quality with 2/32s Eli warp [3].

*L. PHYSICAL PROPERTIES OF FABRIC*

Fabric Parameters:-Both the fabric Finished were tested for the physical properties and compared [1].

As expected warp tensile strength was higher in 2/32s Eli quality (higher by 7.5%) Shown in Table 14-15-16.

Similarly warp tear strength was higher in Eli quality (higher by 6.8%)

Other parameters (Like Dimensional stability, Skew, Color fastness, Crocking Fastness) more or less similar since the fabric construction, Where Weft yarn used wereof same.

Other Fabric parameters like Drape, Abrasion, Pilling, Stiffness, Air permeability did not differ significantly(Shown in Table 15)[2].

| Aarvee Denims & Export LTD. | | | | | |
|---|---|---|---|---|---|
| Denim Fabric Specification Sheet | | | | | |
| Sample Details | | 41-230456(2/32s Eli Yarn) | | 41-232456(2/32s TFO) | |
| Yarn composition | Warp | 100% Cotton | | 100% Cotton | |
| | Weft | 96% Cotton, 4% Elastane | | 96% Cotton, 4% Elastane | |
| Yarn spinning | Warp | 2/32s Eli | | 2/32s TFO | |
| | Weft | Cotton/elastane | | Cotton/elastane | |
| Fabric composition | | 98% cotton, 2% Elastane | | 98% cotton, 2% Elastane | |
| Weave | | Dobby | | Dobby | |
| Total Width | | 142.8 Cm | 56.22" | 144 Cm | 56.69" |
| Cuttable Width | | 140.8 Cm | 55.43" | 140.2 Cm | 55.20" |
| Dyeing Style | | Dynamic Blue | | Dynamic Blue | |
| Finishing Name | | Flat Finish | | Flat Finish | |
| Actual Weight(oz/sqyd | | 11.15 | | 10.91 | |

Table 14: Test Report of Denim Fabric Parameters: 2/32s Eli Twist (Sort No: 41-230456) & 2/32s TFO (Sort No: 41-232456)

| Sample Details Sort No. | | | | 41-230456 (2/32s Eli Yarn) | 41-232456 (2/32s TFO) |
|---|---|---|---|---|---|
| Physical parameter | | Testing Method | UOM | Result | Result |
| Weight | | ASTM D 3776(unwashed) | gr/m^2 | 378 | 378 |
| Weight | | ASTM D 3776(washed) | gr/m^2 | 457 | 457 |
| Dimensional Stab.to Wahing | Warp | AATCC 135(3 HL wash) | % | 2.7 | -3 |
| | Weft | | | 14.6 | 13.5 |
| Skew | A | LS & Co. Method 2(HJ line)(skew) | % | 2.15 | 0.99 |
| | B | | | -2.15 | -0.49 |
| Skew Movement in Washing | A | LS & Co. Method 2(HJ line) (skew movement) | % | 0.16 | -0.17 |
| | B | | | -1.32 | 1.17 |
| Tensile Strength Test(after wash) | Warp | ASTM D5034 | Kg | 69.75 | 65 |
| | Weft | | | 54.65 | 50.8 |
| Tear Strength Test(after wash) | Warp | ASTM D1424 | G | 5184 | 4864 |
| | Weft | | | 5376 | 5184 |
| Elongation(warp wise) | | ASTM D 3107 | % | N/A | N/A |
| Stretch | | ASTM D3107 MODIFIED (Stretch) | Tolerance % | 28 | 26.4 |
| Growth | | ASTM D 3107 MODIFIED (Growth) | % | 3.2 | 2.8 |

Table 15: Test Report of Denim Fabric Physical Parameters: 2/32s Eli Twist (Sort No: 41-230456) & 2/32s TFO (Sort No: 41-232456)

As Shown in Table 15 Dimentional Stability to washing of Both Fabric is Significant Different. Skew of the fabric also not significant different. Tensile Stength also tested and shown in Table 15 better Tensile Strength in 2/32s Eli twist yarn fabric and Tear Strength also better compared to 2/32s TFO yarn fabric.

| Sr.No | Test Parameters | Units | Test Method | Test Results of 2/32 Eli | Test Results of 2/32 TFO |
|---|---|---|---|---|---|
| 1 | Drape Coefficient | % | IS 8357 | 91.6 | 94 |
| 2 | Fabric Abrasion(Martindale) | -- | ISO 12947-2 | No specimen breakdown Observed | No specimen breakdown Observed |
| | | | ISO 12947-3 | Mass Loss : 1.78% | Mass Loss : 2.81% |
| | | | ISO 12947-4 | Change in Color : 2-3 | Change in Color : 2-3 |
| 3 | Pilling(Pill Box) | Rating | ISO 12945-1(18,000 Rev) | 4-5 | 4-5 |
| 4 | Air Permeability | $l/m^2/sec$ | ISO 9237 | 25.9 | 29.8 |
| | | | Pressure : 100 Pa | | |
| | | | Test Area : 20 $cm^2$ | | |
| 5 | Bending Length | Cm | ASTM D 1388* | | |
| | (Stiffness) | | | | |
| | Warpwise | | | | |
| | Face | | | 6.2 | 6 |
| | Back | | | 3.6 | 3.4 |
| | Weftwise | | | | |
| | Face | | | 3.2 | 2.7 |
| | Back | | | 4.4 | 3.8 |

Table 16: Test Report of Fabric Surface Characteristics (2/32s ELI & 2/32s TFO)

As shown in Table 16 Other Fabric parameters like Drape, Abrasion, Pilling, Stiffness, Air permeability did not differ significantly Compared both the Fabric same construction [2].

## IV. CONCLUSION

Same Cotton Mixing was used for Spinning both the 2/32s Eli yarn & 2/32s TFO yarn counts. 2/32s Eli twist yarn parameters were better in terms of CSP ,U%, Hairiness, Rkm and Elongation % compared to 2/32s TFO yarn. The working performance at the post spinning stage were also comparable with 2/32s Eli yarn quality performing better at warping and weaving.

The fabric appearance in the case of 2/32s TFO fabric sort was cleaner in the grey fabric stage. Since denim fabric is converted in to garment and subjected to different chemical washes like Enzyme wash , bleach wash and heavy bleach wash this difference is not significant. There is significant advantage with 2/32s Eli yarn in the cost, benefit of Rs.25/-lesser compared to 2/32s TFO yarn. (Market price of 2/32s Eli Carded yarn/kg=Rs.200/-whereas 2/32s TFOCarded yarn price /kg= Rs.225/-) The cost benefit of yarn and performance of 2/32s Eli yarn preparatory and weaving therefore has a better edge over the 2/32s TFO in terms of yield and fabric realization..

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