Comparative Analysis of Fabrics Made from Eli-Twist and Other Doubled Yarns

Saatish Lavate[#1] and Aadhar Mandot[#2] P.V. Kadole[#3]

[#1, 3] *D.K.T.E'S Textile and Engineering Institute, Ichalkaranji, Maharashtra, India*
[#2] *Dept. of Textile Engg, The M. S. University of Baroda, Vadodara, Gujarat, India*

Abstract

In today's competitive world, dimensioned product quality at competitive price is of utmost importance and weavers are not an exception from this. The yarn quality plays a crucial role in fabric forming departments of new high speed weaving technologies in terms of machine performance and fabric quality. The conventional spinning technology delivers the yarn with higher irregularity and more hairiness resulting in loss of productivity and deterioration in quality in subsequent processes. Many modifications have taken place in Ring spinning technology such as condensed spinning, value adding attachments and EliTwist

EliTwist produces a two-ply yarn with identical direction of twist in both yarn legs as well as the final yarn. It has all the advantages of condensed spinning and yarn doubling during spinning and weaving. But, the acceptance in the spinning industry is not in proportion to the advantages offered by this technology.

In the present study, fabric samples were produced by using double yarns manufactured by three different methods like viz: (i) combed compact double yarn, (ii) regular combed doubled yarn and (iii) EliTwist yarns. The yarn and fabric properties of samples made by these three technologies are compared. The EliTwist yarn shows better characteristics compared to the fabrics made by combed compact doubled and combed doubled yarns.

I. INTRODUCTION

In EliTwist Spinning compacting and twisting of a yarn are done in one single operation. They are basically Compact Ring Double Yarns, in which doubling takes place in the ring frame and yarn is single wound. [1] EliTwist yarns are highly regular having very smooth and closed yarn surface. This circular yarn cross-section and high regularity is due to considerably reduced fiber loss during spinning, which leads to extremely low hairiness, high breaking strength and elongation. Also it has maximum work capacity, very high yarn slippage; abrasion resistance, very low pilling tendency and low twist coefficients. Manufacturing costs reduced up to about 50% compared with conventional twisted yarn. In winding no restrictions in splicing and high winding speeds are possible. Weaving preparatory benefitted with less fly generation with less ends-down on warping machines, thus higher warping efficiency, less sizing ingredients by 30 to 50% or even elimination of sizing agent in most applications. In weaving Higher efficiency on the looms with 40% less warp end-breaks, 30% less weft end-breaks, Higher production by 10 to 15%, less pollution on the looms and less singeing as well as 5% less dye absorption.

Final Products with higher strength of the fabric, less pilling , better luster, clearer prints, clearer weaving structure with well-defined contours, better hand and development of totally new products is possible [2,3,4].

When the properties of ring doubled yarn and Elitwist yarn were compared, Elitwist yarn is showing better uniformity characteristics with significantly higher tensile strength. It was also observed that the number end breakages while weaving were lowest with Elitwist yarn as compared with ring doubled yarn (5). It is reported that the weavability of compact yarn is much better than the ring yarn irrespective of twist. Also pointed out that compact yarns require less size add-on (6). Observation found that warp breaks have reduced as a result of the improvements in strength. In weaving, mills have gone to the level of 350 thread-count in single width looms and 800 thread count in wider width looms. This means that there is high level of packing of yarns in both in warp, and weft ways. It has been pointed out that compact yarns are ideally suitable for fibres having high thread count to improve weaving efficiency as it will reduce yarn to yarn friction and yarn to metal friction at reed and healds due to lower levels of hairiness. There is a saving in sizing cost since 12% size pick up is enough for compact yarn with a clear difference of 6% in comparison to a normal yarn (7).

II. MATERIAL AND METHODS

The materials used for the project is 100% cotton, and the three different types of yarns are manufactured. The yarns were dyed and softened for checking further effects. The yarn particulars are:

Table I - Yarn Samples

Sr.	Type of Yarn	Yarn Count
1	EliTwist (S1)	$2/40^s$ Ne
2	Combed compact TFO doubled (S2)	$2/40^s$ Ne
3	Combed TFO doubled (S3)	$2/40^s$ Ne

Six different fabrics, three from grey yarn and others from dyed yarn were produced on sample weaving machines with following particulars.

Table II - Fabric Particulars

Sr.	Type of Yarn	Yarn Count
1	Warp count	$2/40^s$Ne
2	Weft count	$2/40^s$Ne
3	EPI	60
4	PPI	40
5	Denting order	2/dent
6	Weave	3/1 Twill

All the samples were tested for different properties as per ASTM standards listed in table 3.

Table III - Fabric Responses

Sr.	Fabrics Properties	Standards
1	Fabric Weight (GSM)	ASTM D37762
2	Fabric thickness	ASTM D17773
3	Tensile Properties	ASTM D5034
4	Abrasion	ASTM D4966
5	Pilling Test	ASTM D3512
6	Air Permeability	ASTM D7377
7	Water Vapour Transmission rate	ASTM E-96

III. RESULTS AND DISCUSSION

A. Fabric Responses

After collecting suitable sample size of fabrics, the tests were conducted as per respective standards in standard atmospheric conditions and the results are shown in table 4 and 5.

B. Tensile Characteristics

From the Table 4 which shows the data regarding tensile properties of all three different samples. It is seen that, EliTwist fabric samples show better values both in warp and weft direction for same fabric construction. This is due to stronger yarn, the fabric produced from EliTwist yarn is also strong. There is no statistical significant difference between grey and dyed samples for all three techniques.

Table IV - Fabric Tensile Chracteristics

Fabrics/ Properties	Breaking Force (Kgf)				Elongation (%)			
	Grey		Dyed		Grey		Dyed	
	Warp	Weft	Warp	Weft	Warp	Weft	Warp	Weft
EliTwist	41.14	19.71	39.79	21.04	11.51	10.03	10.49	9.46
Combed Compact	32.95	17.05	35.01	22.07	9.91	9.41	10.16	9.42
Combed	31.66	17.38	32.07	18.98	9.48	8.78	8.93	8.94

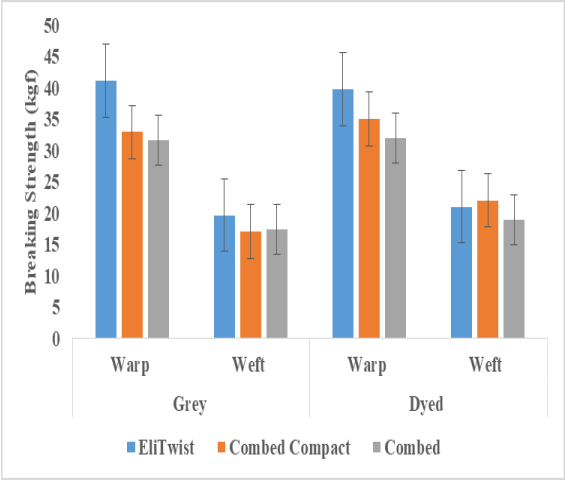

Figure 1. Fabric breaking strength

From figure Table 5, we can see that fabric manufactured using Elitwist is strongest amongst rest of the fabric samples followed by combed compact and combed doubled yarn fabrics. The reason behind this is that Elitwist spun yarns have the highest strength and yarn strength is fully exploited in the fabric. The yarn strength has very good correlation with fabric strength both in warp and weft direction as well as grey and dry state. Irrespective of yarn type all the fabrics show lower strength in weft direction than that of warp direction. This can be attributed to lower thread density on weft direction. As it reduces the load-bearing component, the tensile strength in the warp direction and weft direction varies significantly.

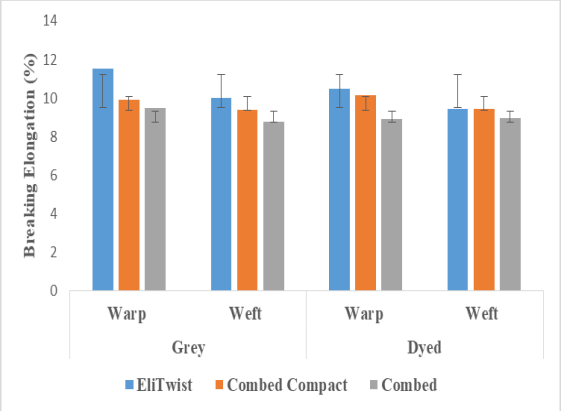

Figure 2. Fabric breaking elongation

Yarn elongation property is reflected in fabric elongation. Fabric produced from EliTwist yarn shows higher elongation at break as compared to the other two samples, both in warp and weft directions as well as for grey and dyed samples. Elongation in warp direction is on the higher side to that of weft direction in both states.

Abrasion resistance and pilling tests were conducted as per the respective standards but none of the samples were abraded or deformed after 10000 cycles and no pills were formed on the surface of the fabrics even after 18000 cycles. All the samples showed strong resistance to abrasion and pilling. This is due to combing, compact yarn structure and less hairy surface.

Looking at the results in table 4, there is No significant difference between the fabrics GSM values of the samples produced from the yarns of the three different technologies. Apart from it has been observed that, actual count produced by combed compact and comber double yarn is finer than yarn produced by Eli twist method, which might have influenced the areal density of fabric and hence GSM of fabric manufactured with Elitwist method is on higher side. It has also been observed that dyed fabrics shows lower GSM compared to grey fabrics.

Fabric thickness shows a similar trend as that of GSM values. The dyed samples are of lower thickness to that of grey samples. EliTwist and combed compact double yarn a fabric significantly differs from that of combed double yarn fabrics.

Table V - Fabric particulars

Sr. No.	Fabric Properties	EliTwist Yarn Fabrics		Combed Compact Yarn Fabrics		Combed yarn Fabrics	
		Grey	Dyed	Grey	Dyed	Grey	Dyed
1	Fabric weight (GSM)	122	116	121	111	118	112
2	Fabric thickness (mm)	0.53	0.47	0.53	0.47	0.48	0.49
3	Porosity	86.82	82.73	85.04	84.52	83.89	84.98
4	Fabric cover Factor	18.19	17.68	17.92	17.61	17.66	17.41
5	Air Permeability ($cm^3/cm^2/sec$)	273	255	152	170	109	161
6	Water Vapour Transmission Rate ($g/(d*m^2)$)	1057	1046	1090	1011	1044	1046

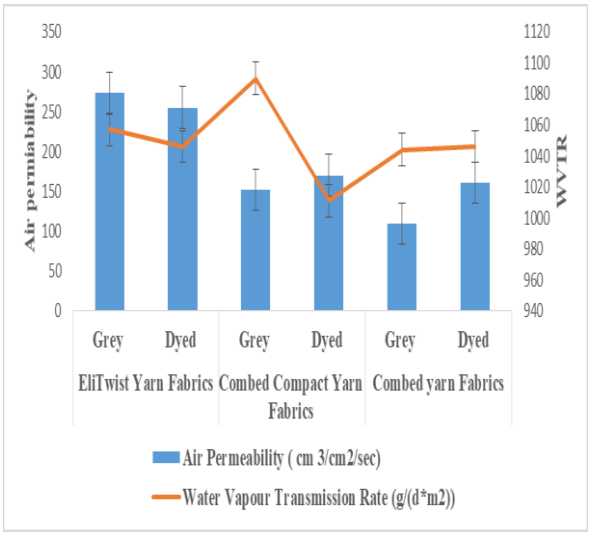

Figure 3.Fabric Air permeability and WVTR

Air permeability is a critical parameter of clothing, as it contributes to the comfort level of the wearer. It influences the flow of the vapour from the human body to the environment and the flow of fresh air to the body. It is dependent on the cloth cover, areal density, and packing fraction of the yarn and other parameters.

From Table 4 we can see that, the air permeability and WVTR of fabric manufactured with Elitwist yarn is highest followed by combed Compact yarn fabrics. Whereas, a fabric manufactured with combed yarn exhibits least air permeability. Air permeability is mainly affected by parameters such as, porosity of constituent of yarns and fabric

thickness, fabric cover. Since the fabric structure is the same for all fabric samples, the fabric thickness, porosity and cover will affect the air permeability of the woven fabrics. Fabric thickness depends on the yarn type as well as yarn diameter. Thus the parameters which could affect the air permeability in this study are the yarn type and fabric thickness. Combed, combed compact yarns offer higher resistance to compression pressure. Yarns manufactured with Elitwist system have close packing which increases the net gap in between two adjacent threads. Also, fabrics of these yarns are thinner than other yarns with low hairiness. There is a significant effect of yarn type on air permeability value both in grey and dyed state.

In spite of higher air permeability, water vapour transmission properties in grey and dyed state of EliTwist and regular combed doubled yarn fabric samples show no much change whereas reverse trend is observed in case of combed compact yarn fabrics. Fabric of combed compact yarn has higher water vapour transmission in grey and lower in dyed samples.

IV. CONCLUSIONS

Fabric produced from three different technologies. The aforementioned interpretations and findings could lead to following important conclusions:

- Fabric weight and thickness is on the higher side for EliTwist yarn both in grey and dyed form. In all cases dyed fabrics showing reduced areal density as well as thickness. Air permeability test and moisture management properties are more in case of fabric manufactured from Elitwist yarn as compared to the other samples.
- Fabric tensile characteristics are good in case of fabrics produced from EliTwist yarns in both warp and weft direction as compared to other fabric samples in both the grey and dyed samples.
- The resistance to the abrasion and pilling is very high in all the fabrics. No much weight loss and pill formation is observed.
- Overall trends show that EliTwist fabrics are of superior characteristics in terms of mechanical, surface and functional properties. However, wet processing has influence on several yarn

REFERENCES

[1] https://www. suessen. com / fileadmin / suessen / products /EN/ ring- spinning / elitecompactset-v5/brochures-

[2] Stalder H. and Rusch A. (2002), '*Successful compact spinning process'*, Intl.Textile Bulletin., Vol.48, No.1, pp.42-43.

[3] Product leaflets from https://www.suessen.com: https://www.suessen.com/fileadmin/suessen/products/EN/ring-spinning/elitecompactset-v5/brochures-leaflets/EliTe_CompactSet_V5_slp.0100NE_06.12.pdf

[4] Product Leaflets from https://www.suessen.com

[5] Binternagel T. (2000), '*New potential in downstream processing of COM 4 yarns'*, Meliand Textilber., Vol.80, pp.702-707 (E34-E35).

[6] Scheibe H. and Knecht R. (2001), '*Requirement of compact yarn on the winding process',* Meliand Textilber., Vol.81, No.4, pp.237-240 (E58- E60).

[7] Behera B.K. Hari P.K. and Ghosh S. (2003), '*Weavability of compact yarn*', Meliand International., Vol.9, pp.311-314.

[8] Dr.D.Mathiyalagan, "*Anti Microbial Fabrics Manufacturing using the BenzalKonium Chloride in Antimicrobial Fabric Finishing",* SSRG International Journal of Pharmacy and Biomedical Engineering, Vol-1,Iss-1,2014.

[9] Subramanian S.N, "*An Investigation of the Structure and Properties of Jet Ring Spun and Other Types of Compact Yarns, PhD thesis",* Faculty of Technology, Anna University: Chennai, November 2005.

[10] Textile Bulletin. Vol.48, No.1, pp.42-43.

[11] Artzt P. (2003), '*The effect of different spinning processes on yarns'*, ITB, Vol.49, pp.40-43.

[12] Furter R. (2003), '*Experience with quality management of compact yarns*', Meliand Intl., Vol.9, No.1, pp.20-22.

[13] Textile Res., Vol.27, No.12, pp.362-368.

[14] Kanthimathinathan A. (2005), '*Compact spinning process: A Bird's eye view on the systems and benefits in post-spinning process'*, Proc. of National Conf., IYQM, BIT, Sathyamangalam. India.

[15] Sudhakar P. and Gobi N. '*Analysis of comfort and low stress mechanical properties of ring and compact yarn knitted fabrics',* Proc. of National Conf., IYQM, BIT, Sathyamangalam, India 2005.

[16] Ozdil N., et.al. '*A comparative study of the characteristics of compact yarn-based knitted fabrics'*, Fibers & Textiles in Eastern Europe, Vol.13, No.2 (50), pp.39-43, 2005.