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STUDY ON COLOR FASTNESS TO WASH & RUBBING, WHITENESS INDEX AND COLOR EFFICIENCY (K/S VALUE) OF WEFT KNITTED FABRICS MADE FROM CONVENTIONAL RING AND COMPACT SPUN YARN

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ABSTRACT

Rashid MR, Ahmed F, Azad AK (2012) Study on color fastness to wash & rubbing, whiteness index and color efficiency (k/s value) of weft knitted fabrics made from conventional ring and compact spun yarn. *Ins. Engg. Tech.* 2(1), 1-10.

The new compact spinning system appears to eliminate the spinning triangle problem in the ring spinning process. It is claimed to bring many advantages of yarn quality. In this research work cotton yarns, produced from same cotton blend were spun according to compact and conventional ring spinning principles in three different counts. Three different knitting structures single jersey, rib and interlock were produced from these yarns. The physical properties such as Color fastness to wash and rubbing, whiteness index and K/S value of those fabrics were investigated and compared with each other after bleaching and dyeing processes. When the results were studied, it was observed that better color fastness to wash and rubbing was found in all knitted fabrics made from compact yarn. Compact yarn based knitted fabrics showed higher whiteness index and K/S value compared to knitted fabrics made from conventional ring yarn.

Key words: *compact yarn, color fastness to wash and rubbing, whiteness index, k/s value and weft knitted fabric*

INTRODUCTION

It is established that one of the weakest points of the conventional ring spinning system is the spinning triangle. For this reason new approach known compact ring spinning was developed. In compact system a different yarn structure is produced. Most apparent features of those yarns are their high strength and elongation values and low hairiness (Artzt 2003). Many textile scientists have studied factors that have an effect on pilling and abrasion resistance stated that washing increases pilling tendency investigated that higher bursting strength, better pilling and abrasion resistance and good rubbing fastness was found the fabric made from compact yarn compared to knitted fabrics made from ring yarns. There are also some studies on color values of fabrics from ring spun and compact yarns stated that fabrics woven from compact yarns appear lighter in color(less saturated) and higher in lightness when compared with fabrics woven ring spun yarns having the same yarn count as the compact yarns also found that the knitted fabrics made with compact yarns show higher color strength (K/S) values that the knitted fabrics made with ring yarn (Mankodi and Chaudhari, 2003) and co-workers also found no statistically significantly difference in the color efficiency and rubbing fastness of the fabrics woven from compact and ring yarns(Stalder 1995).

In this research work was carried out to investigate the Color fastness to wash and rubbing, whiteness index and K/S characteristics of knitted fabrics using ring and compact spun yarn on various knit structures such as single jersey, rib and interlock.

MATERIAL AND METHODS

In this research work 100% cotton yarns of 40/1 and 30/1 and 20/1 Ne were spun according to combed and compact spinning methods from the roving produced by using the same cotton blend (CIS Uzbekistan cotton). The compact yarns were produced on suessen EliTe compact system and Toyota Rx-240 ring frame was used to produce the conventional yarn. The quality parameters of these yarns are given in Table-2. Experimental samples from these conventional ring (combed) and compact yarns were knitted into Single Jersey, Rib (1×1) and Plain Interlock fabric. Knitting Machine specification are given in Table-1.

Table 1. Knitting Machines specifications

Machine Specification	Single Jersey	Rib	Interlock
Manufacturer	Mayer & Cie	Mayer & Cie	Mayer & Cie
Country of origin	Germany	Germany	Germany
Machine Diameter	30”	40”	40”
Gauge	24	18	24

Table 2. Quality parameter of Conventional ring and Compact yarn made from 100% cotton fibres produced on Conventional ring (Toyota –Rx240) and Suessen Elite compact system

Test parameter	40/1 Ne Ring Yarn		30/1 Ne Ring Yarn		20/1 Ne Ring Yarn	
	(Combed)	Compact	(Combed)	Compact	(Combed)	Compact
Yarn count	39.89	39.7	29.95	29.92	19.83	19.8
Count CV%	0.35	0.6	0.61	0.55	0.93	0.65
Uster (Unevenness) U%	9.76	9.02	8.97	8.73	7.5	7.13
Uster CVm%	12.33	11.4	11.32	11.01	9.76	9
Thin places/km (-50%)	1	0	0	0	0	0
Thick laces/km(+50%)	24	14	12	5	4	2
Neps/km(+200%)	35	37	20	21	8	3
IPI	60	51	32	26	12	5
CSP	2549	2789	2411	2473	2722	2862
RKM(CN/Tex)	17.01	19.93	18.29	19.29	19.82	20.07
RKM CV%	11.56	9.08	7.13	9.75	5.91	9.24
Elongation%	4.6	4.81	4.21	4.62	5.03	4.86
Elongation CV%	8.66	8.63	8.06	11.2	5.92	10.62
TPI	23.74	23.19	20.28	19.46	16.59	16.38
Hairiness (H-index)	4.47	3.12	4.79	3.33	5.59	3.98
Hairiness (CVHb)%	3	3	2.2	3.3	3.4	2.3

Sample Preparation

All the grey fabrics of compact and ring spun yarn were processed in same bath to eliminate any variation during the process. Scouring and bleaching was applied to all the knitted fabrics in same bath as the first step to finishing process. The scouring and bleaching was done in the same bath with liquor ration 1:20 using Theis winch dyeing machine. The scoured and bleached fabrics were rinsed at 80^{o} C for 20 minutes. After drop the bath fabric were neutralization with peroxide killer and Acetic acid. After this all the fabrics were dyed with medium brand reactive dyes (red color) in Theis Winch dyeing machine. The scouring & bleaching and dyeing process condition are given in following Table-3 and 4.

Table 3. Scouring and Bleaching Recipe

Scouring and bleaching recipe	
Felosan RGN (Detergent)	0.7 g/l
Denquist HYN (Sequestering agent)	0.25 g/l
Windcrease WL (Anticreasing)	0.7 g/l
Soda ash Light (Alkali)	5 g/l
Hydrogen Peroxide (Oxidizing agent)	2.5 g/l
Setabiocal A_4 (Stabilizer)	0.5 g/l
Geizyme APB (Peroxide Killer)	0.5 g/l
Acetic Acid (Neutralizing agent)	1 g/l
Time	60 min
Temperature	98° C
Liquor ratio	1/20

Table 4. Dyeing Recipe

Dyeing Recipe	
Sarabid LDR (Leveling agent)	0.5 g/l
Setazol Red 3BS (Dyestuff)	%3.0 owf
Sodium Sulphate (Glauber salt)	80 g/l
Soda ash light (Alkali)	20 g/l
Liquor ratio	1/50
Temperature Time	60° C 60 min
After Treatment	
Cotoblance NSR (Soaping)	0.3 g/l
Acetic acid (Neutralizer) Time	0.8 g/l 45min

Fabric Testing

Following tests were carried out for all knitted fabric samples. The testing of knitted fabrics was carried out in the standard atmosphere conditions of 65% R.H. and 27^{o} C.

Color fastness to washing:

This means the resistance of color against the washing action. This is great importance to the consumer and there are several washing tests which are applied according to the purpose for which the material is intended. Color fastness is the resistance of color to fade or bleed by different agencies like- washing, light, perspiration, water, dry cleaning, rubbing, acid and alkali etc. ISO 105 C06: 1994: ISO washing (domestic) fastness test; test no. C2S was used to test color fastness to washing (ISO 105 C06: 1994). Figure-1 shows the Gyro wash machine. Washing recipe for this method is given below:

Washing recipe:

Detergent ---------- 4 gm/L
(ECE Non-phosphate detergent without OBA)
Sodium Perborate---------- 1 gm/L
Soda ash ----------1 gm/L
Liquor---------- 50 L
P^H ---------- 10.5±0.1
Temperature---------- 60^0 C
Time----------30 minutes
Steel ball----------25 pieces (6mm dia)

Fig. 1. Gyro Wash, James H. Heal & Co ltd
Ltd, England

Color fastness to rubbing:

It is the resistance of the color against the crocking or rubbing action. The fastness test to rubbing is widely used to evaluate the transfer of surface dye from the test fabric to a piece of wide cotton against which it is rubbed. The test can be carried out under dry or wet condition. ISO 105x12: 1993; Tests for color fastness part x 12: color fastness to rubbing was used to test the color fastness to rubbing (ISO 105x12: 1993).

Whiteness Index and K/S value:

The simplest objective method of evaluating the degree of whiteness calorimetrically is to measure the amount of white light reflected by the white object and correlate the reflectance with the whiteness. The whiteness index and color efficiencies (K/S) of the bleached and dyed fabrics were measured on the Datacolor, mode 650, and spectrophotometer.

Experimental Data: Color Fastness to wash (ISO 105 C06:1994)

Table 5. Shade change:

Sample Type		Rating	Fastness of Sample
40/1 Single Jersey	Combed	4	Good
	Compact	4/5	Good to Excellent
30/1 Single Jersey	Combed	4	Good
	Compact	4/5	Good to Excellent
20/1 Single Jersey	Combed	4/5	Good to Excellent
	Compact	5	Excellent
40/1 Rib	Combed	4	Good
	Compact	4/5	Good to Excellent
30/1 Rib	Combed	4/5	Good to Excellent
	Compact	5	Excellent
20/1 Rib	Combed	4/5	Good to Excellent
	Compact	5	Excellent
40/1 Interlock	Combed	4/5	Good to Excellent
	Compact	5	Excellent
30/1 Interlock	Combed	4/5	Good to Excellent
	Compact	5	Excellent
20/1 Interlock	Combed	4/5	Good to Excellent
	Compact	5	Excellent

Color fastness to wash (Staining):

Table 6. Color fastness to washing (Staining of mulifibre, single jersey)

	40/1 Single Jersey		30/1 Single Jersey		20/1 Single Jersey	
Sample Type	Combed	*Compact*	Combed	*Compact*	Combed	*Compact*
Multi-fiber samples	Grade	Grade	Grade	Grade	Grade	Grade
Di-acetate	2/3	3	3/4	4	3	3/4
Bleached Cotton	3/4	4	4	4/5	3/4	4
Poly amide	3	3/4	3/4	4/5	3/4	3/4
Polyester	4	4/5	4/5	5	4	4/5
Acrylic	4/5	4/5	4/5	4/5	4	4/5
Wool	4/5	5	4/5	5	4/5	5

Table 7. Color fastness to washing (Staining of mulifibre, Rib)

	40/1 Rib		30/1 Rib		20/1 Rib	
Sample Type	Combed	*Compact*	Combed	*Compact*	Combed	*Compact*
Multi-fiber samples	Grade	Grade	Grade	Grade	Grade	Grade
Di-acetate	2/3	3	3/4	4	3	3/4
Bleached Cotton	3/4	4	4	4/5	3/4	4
Poly amide	3	3/4	4	4/5	3/4	4
Polyester	4	4/5	4/5	5	4	4/5
Acrylic	4/5	5	4	4/5	4	4/5
Wool	4/5	5	4/5	5	4/5	5

Table 8. Color fastness to washing (Staining of mulifibre, Interlock)

	40/1 Interlock		30/1 Interlock		20/1 Interlock	
Sample Type	Combed	*Compact*	Combed	*Compact*	Combed	*Compact*
Multi-fiber samples	Grade	Grade	Grade	Grade	Grade	Grade
Di-acetate	3	3/4	3/4	4	3	4
Bleached Cotton	3/4	4	4	4/5	3	3/4
Poly amide	3/4	4	4	4/5	3/4	4
Polyester	4/5	5	4/5	5	4	4/5
Acrylic	4	4/5	4/5	4/5	4/5	5
Wool	4/5	5	4/5	5	4/5	5

Table 9. Data for Color Fastness to rubbing action (ISO 105x12:1993): For Shade Change:

Sample Name	Fabric Direction	Sample Type	Dry		Wet	
			Rating	Fastness of Sample	Rating	Fastness of Sample
40/1 Single Jersey	*Wales*	Combed	4	Good	3	Fair
		Compact	4/5	Good to Excellent	3	Fair
	Course	Combed	4	Good	3	Fair
		Compact	4/5	Good to Excellent	3	Fair
30/1 Single Jersey	*Wales*	Combed	3/4	Fair to Good	3	Fair
		Compact	4	Good	3/4	Fair to Good
	Course	Combed	4	Good	3/4	Fair to Good
		Compact	4/5	Good to Excellent	4	Good
20/1 Single Jersey	*Wales*	Combed	3/4	Fair to Good	2/3	Poor to Fair
		Compact	4	Good	2/3	Poor to Fair
	Course	Combed	4/5	Good to Excellent	3	Fair
		Compact	4/5	Good to Excellent	3/4	Fair to Good
40/1 Rib	*Wales*	Combed	4/5	Good to Excellent	4	Good
		Compact	4/5	Good to Excellent	4	Good
	Course	Combed	4/5	Good to Excellent	4	Good
		Compact	5	Excellent	4/5	Good to Excellent
30/1 Rib	*Wales*	Combed	4/5	Good to Excellent	4	Good
		Compact	4/5	Good to Excellent	4	Good
	Course	Combed	5	Excellent	4/5	Good to Excellent
		Compact	5	Excellent	4/5	Good to Excellent
20/1 Rib	*Wales*	Combed	3/4	Fair to Good	2/3	Poor to Fair
		Compact	4	Good	3	Fair
	Course	Combed	4/5	Good to Excellent	3/4	Fair to Good
		Compact	4/5	Good to Excellent	4	Good
40/1 Interlock	*Wales*	Combed	4/5	Good to Excellent	4	Good
		Compact	4/5	Good to Excellent	4	Good
	Course	Combed	4/5	Good to Excellent	4	Good
		Compact	4/5	Good to Excellent	4	Good
30/1 Interlock	*Wales*	Combed	4/5	Good to Excellent	4	Good
		Compact	4/5	Good to Excellent	4/5	Good to Excellent
	Course	Combed	4/5	Good to Excellent	4	Good
		Compact	5	Excellent	5	Excellent
20/1 Interlock	*Wales*	Combed	3	Fair	2/3	Poor to Fair
		Compact	4	Good	3	Fair
	Course	Combed	4/5	Good to Excellent	3/4	Fair to Good
		Compact	4/5	Good to Excellent	3/4	Fair to Good

Table 10. Staining: Detail values of Shade change for Color fastness to Rubbing

Sample Name	Fabric Direction	Sample Type	Dry		Wet	
			Rating	Fastness of Sample	Rating	Fastness of Sample
40/1 Single Jersey	*Wales*	Combed	4/5	Good to Excellent	3	Fair
		Compact	4/5	Good to Excellent	3/4	Fair to Good
	Course	Combed	4/5	Good to Excellent	3	Fair
		Compact	5	Excellent	3/4	Fair to Good
30/1 Single Jersey	*Wales*	Combed	4	Good	2/3	Poor to Fair
		Compact	4/5	Good to Excellent	3	Fair
	Course	Combed	4	Good	3	Fair
		Compact	4/5	Good to Excellent	3/4	Fair to Good
20/1 Single Jersey	*Wales*	Combed	4	Good	3/4	Fair to Good
		Compact	4/5	Good to Excellent	4	Good
	Course	Combed	4	Good	3	Fair
		Compact	4/5	Good to Excellent	4	Good
40/1 Rib	*Wales*	Combed	4/5	Good to Excellent	3/4	Fair to Good
		Compact	5	Excellent	4	Good
	Course	Combed	4/5	Good to Excellent	3/4	Fair to Good
		Compact	5	Excellent	4	Good
30/1 Rib	*Wales*	Combed	3/4	Fair to Good	4	Good
		Compact	4	Good	4/5	Good to Excellent
	Course	Combed	4	Good	4/5	Good to Excellent
		Compact	4/5	Good to Excellent	5	Excellent
20/1 Rib	*Wales*	Combed	4	Good	3	Fair
		Compact	4/5	Good to Excellent	3/4	Fair to Good
	Course	Combed	4	Good	2	Poor
		Compact	4/5	Good to Excellent	3	Fair
40/1 Interlock	*Wales*	Combed	4/5	Good to Excellent	3	Fair
		Compact	5	Excellent	3/4	Fair to Good
	Course	Combed	4/5	Good to Excellent	3/4	Fair to Good
		Compact	5	Excellent	4	Good
30/1 Interlock	*Wales*	Combed	4/5	Good to Excellent	2/3	Poor to Fair
		Compact	5	Excellent	2/3	Poor to Fair
	Course	Combed	4	Good	2/3	Poor to Fair
		Compact	5	Excellent	4/5	Good to Excellent
20/1 Interlock	*Wales*	Combed	4	Good	3	Fair
		Compact	4/5	Good to Excellent	3/4	Fair to Good
	Course	Combed	4	Good	2	Poor
		Compact	4/5	Good to Excellent	3	Fair

Table 11. Data of whiteness index

Fabric Type	Whiteness Index
40/1 S/J Combed	67.91
40/1 S/J Compact	69.2
40/1 Rib Combed	68.12
40/1 Rib Compact	68.8
40/1 Interlock Combed	70.92
40/1 Interlock Compact	70.98
30/1 S/J Combed	66.83
30/1 S/J Compact	68.84
30/1 Rib Combed	64.96
30/1 Rib Compact	66.75
30/1 Interlock Combed	71.28
30/1 Interlock Compact	71.93
20/1 S/J Combed	66.66
20/1 S/J Compact	67.23
20/1 Rib Combed	64.25
20/1 Rib Compact	66.02
20/1 Interlock Combed	68.81
20/1 Interlock Compact	68.94

Table 12. Data of K/S value

Fabric Type	K/S value
40/1 S/J Combed	16.305
40/1 S/J Compact	17.39
40/1 Rib Combed	16.293
40/1 Rib Compact	17.841
40/1 Interlock Combed	16.062
40/1 Interlock Compact	15.575
30/1 S/J Combed	17.282
30/1 S/J Compact	17.135
30/1 Rib Combed	17.616
30/1 Rib Compact	17.322
30/1 Interlock Combed	15.781
30/1 Interlock Compact	16.323
20/1 S/J Combed	16.736
20/1 S/J Compact	16.051
20/1 Rib Combed	17.693
20/1 Rib Compact	15.374
20/1 Interlock Combed	16.979
20/1 Interlock Compact	16.499

RESULTS AND DISCUSSION

Color Fastness to wash:

Color fastness to wash (Shade change and staining of multi fiber) are given in Table -5, 6,7and 8. In graph (fig. 2) showed that the shade changes for color fastness to wash for all knitted fabrics. It was clearly shown that in every structure (SJ, Rib and Interlock) of fabrics made from compact spun yarn showed better color fastness to wash. Slightly better color fastness to wash (Staining) was observed in fabrics made from compact yarn compared to conventional ring based knitted fabrics due to less hairiness, smooth fabric surface of compact yarn.

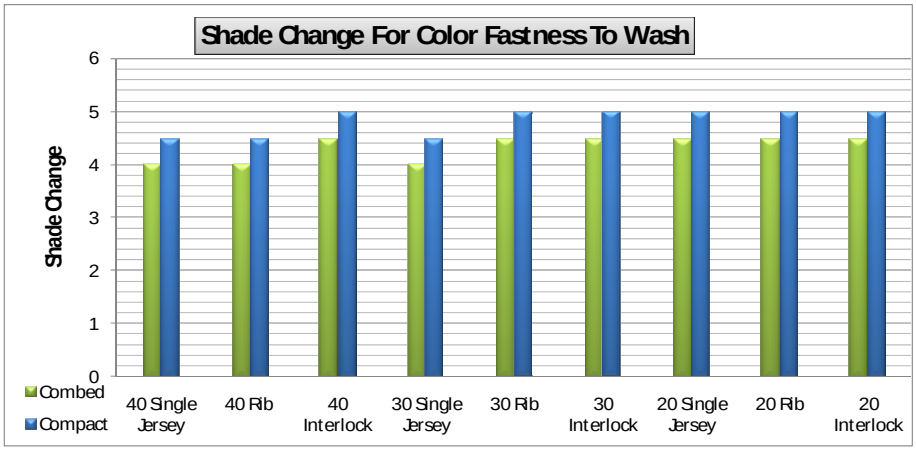


Fig. 2. Color fastness to washing (Shade change) of Knitted fabrics

Color Fastness to Rubbing:

Details values of Color fastness to rubbing are given in Table-9 and 10. From the graphical representation (Graph-3,4,5,6) it seems that compact based fabrics has better resistance to rubbing than conventional ring yarn based fabric. On the other hand staining rate in dry and wet condition of compact based knitted fabric show better result. It was observed that yarn production technique affect the rubbing fastness. Better rubbing fastness both dry and wet condition was found in compact yarn based knitted fabrics due to the smooth surface and lees hairiness.

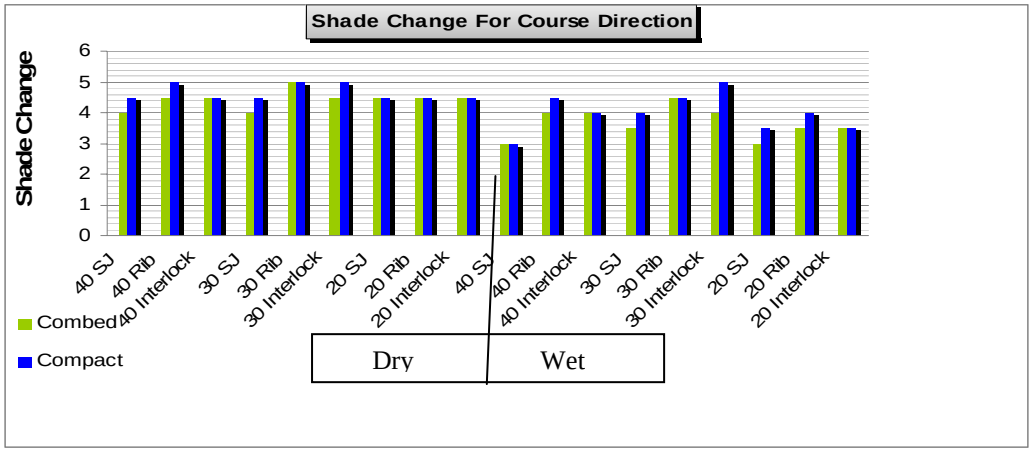


Fig. 3. Color fastness to rubbing (shade change, Course direction)

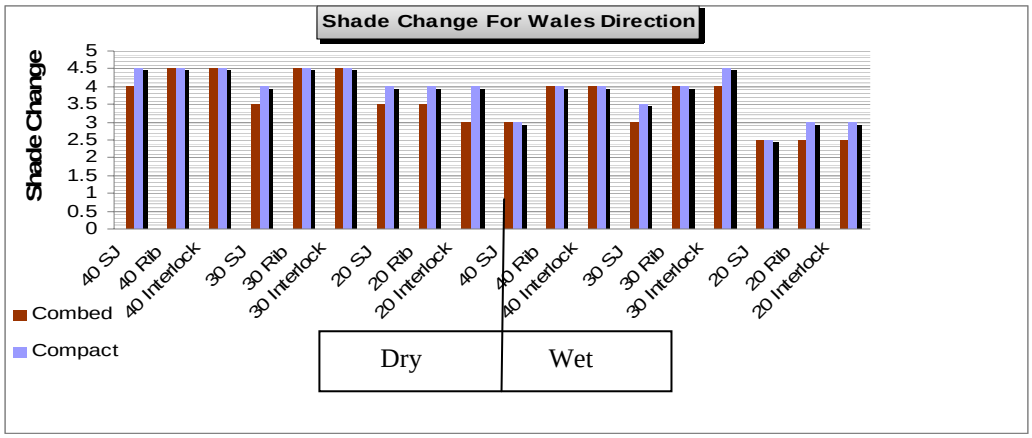


Fig. 4. Color fastness to rubbing (shade change, Wales direction)

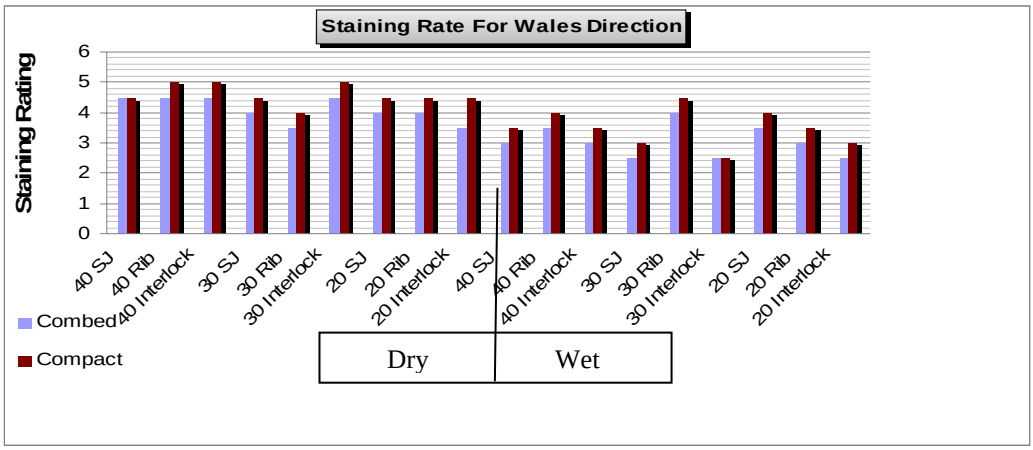


Fig. 5. Color fastness to rubbing (Staining for wales direction)

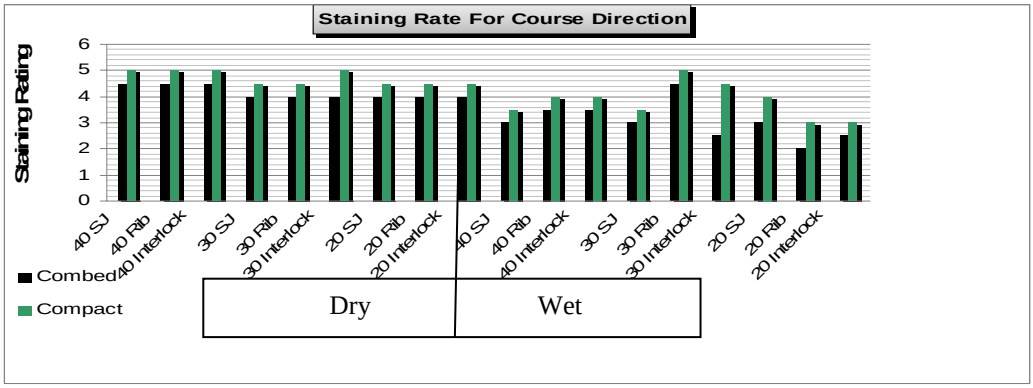
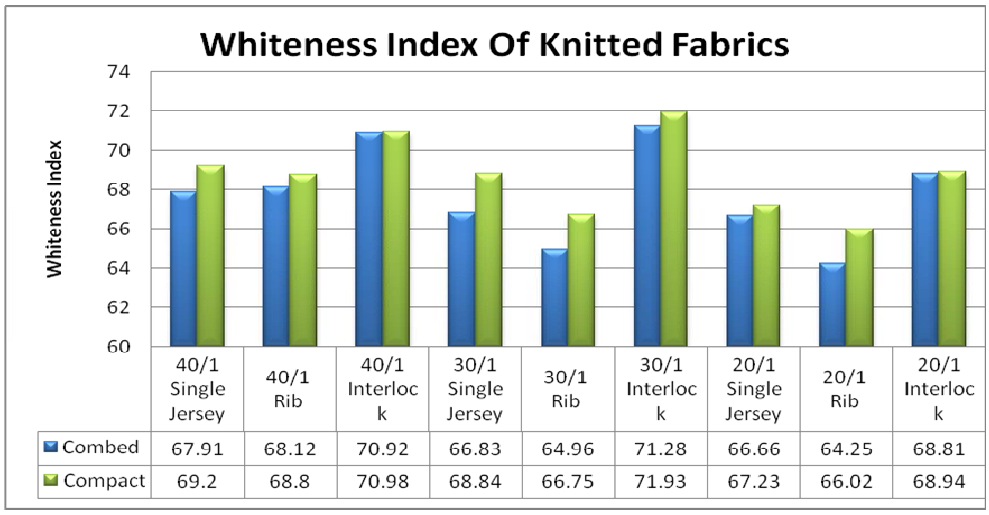


Fig. 6. Color fastness to rubbing (Staining for course direction)

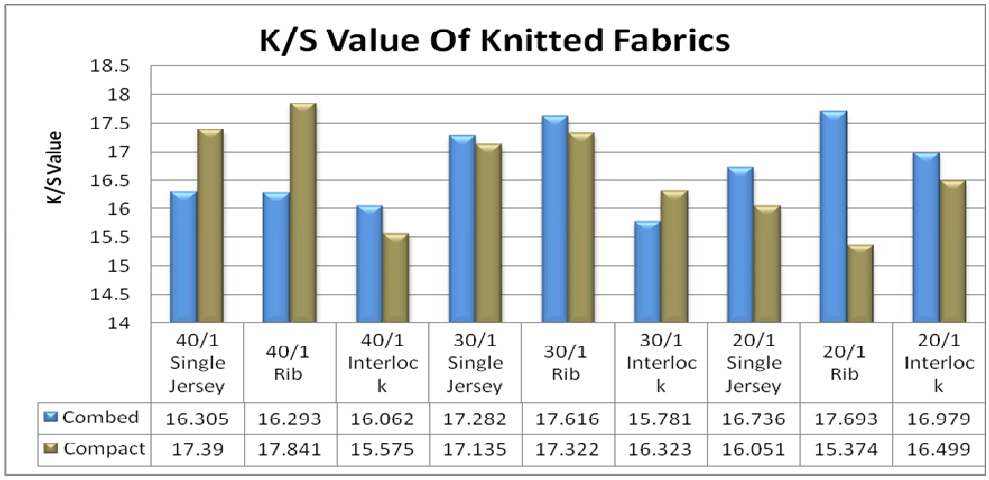
Whiteness index and K/S value:

Whiteness index and Color efficiency (K/S) values are given in Table-11 and 12. Figure-7 and 8 showed the whiteness index and K/S values of knitted fabrics. When the effect of yarn production technique was examined whiteness index of bleached fabrics made of compact yarn shown higher whiteness index value compared to conventional ring yarn based fabrics. Compact structure, lees hairiness and smooth surface had made this difference. So lower cost will be needed for bleaching of compact yarn based knitted fabrics.



	40/1 Single Jersey	40/1 Rib	40/1 Interlock	30/1 Single Jersey	30/1 Rib	30/1 Interlock	20/1 Single Jersey	20/1 Rib	20/1 Interlock
Combed	67.91	68.12	70.92	66.83	64.96	71.28	66.66	64.25	68.81
Compact	69.2	68.8	70.98	68.84	66.75	71.93	67.23	66.02	68.94

Fig. 7. Whiteness index of bleached knitted fabrics



	40/1 Single Jersey	40/1 Rib	40/1 Interlock	30/1 Single Jersey	30/1 Rib	30/1 Interlock	20/1 Single Jersey	20/1 Rib	20/1 Interlock
Combed	16.305	16.293	16.062	17.282	17.616	15.781	16.736	17.693	16.979
Compact	17.39	17.841	15.575	17.135	17.322	16.323	16.051	15.374	16.499

Fig. 8. K/S values of dyed Knitted fabrics

Except 40/1 interlock and 20/1 Rib the color efficiency (K/S) of knitted with compact yarns were slightly higher than fabrics with ring yarns. This means that the fabrics made from compact yarns were colored in a deeper shade (more saturated) when compared with fabrics made from conventional ring yarns. Accordingly the possibility of dyeing fabrics made from compact yarns at a reduced cost might be listed as another advantage of this spinning system along with other advantages such as reduced hairiness, higher strength, better appearance etc.

CONCLUSION

It was found that knitted fabric made from compact yarns were advantageous with regard to conventional ring yarns from the point of view yarn evenness, thin and thick places, neps, count variation, hairiness, breaking strength and elongation at break(%). Color fastness to wash and rubbing, whiteness index and K/S values were found to be higher in compact yarn based knitted fabrics with regard to fabrics knitted with conventional ring yarns. So knitted fabrics made of compact yarn can be used to make high quality garments with higher productivity. However it should be considered that the investment costs of compact spinning machines are higher than the conventional ring spinning machines.

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REFERENCES

Artzt P (2003) Possibilities of Improving the Efficency of Compact Spinning,Melliand Int. 8, 28-30.

ISO 105 C06: 1994: ISO washing (domestic) fastness test; test no. C2S

ISO 105x12: 1993 Tests for color fastness part x 12: color fastness to rubbing

Mankodi H, Chaudhari SB (2003) A new Advance in Spinning Technology, Textile Asia, 33-37.

Stalder H (1995) Compact spinning-eine Neue Generation von Ringspangarner, Melliand Textilber, 3, 119-123.