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BURSTING STRENGTH AND PILLING PROPERTIES OF WEFT KNITTED FABRICS MADE FROM CONVENTIONAL RING AND COMPACT SPUN YARN

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ABSTRACT

Rashid MR, Ahmed F, Azad AK (2011) Bursting strength and pilling properties of weft knitted fabrics made from conventional ring and compact spun yarn. *J. Innov. Dev. Strategy* 5(3), 81-86.

Compact Spinning is a new version of ring spinning and distinct features of these yarns are their high strength and elongation values and low hairiness. 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 of those fabrics were investigated and compared with each other before and after dyeing processes. When the results were studied, it was observed that higher bursting strength was found in all knitted fabrics made from compact yarn. Compact yarn based knitted fabrics showed fewer tendencies to pilling compared to knitted fabrics made from conventional ring yarn.

Key words: *compact yarn, bursting strength, pilling and weft knitted fabric*

INTRODUCTION

Garment is one of the basic human needs, always has been and always will be. Research & developments are in progress to improve the quality of garments. The immediate raw material for garment is fabric. More or less all fabric characteristics depend on their yarn structure which affect on fabric properties and therefore, on garments.

Conventional ring yarns have always been considered as a quality reference among all the yarns produced by other new spinning system in textile industry. However combed ring yarns are not faultless. Conventional ring yarn still shows hairiness, neps which later cause problems especially in knitted fabrics. Efforts are been made and as a result of studies on improvement of the performance and components of ring spinning machines, Compact spinning system has been developed. Compact or Condensed yarns made from this spinning system have very low hairiness and neps than combed ring yarn.

Compact yarns are uniformly oriented and having better tenacity, elongation and hairiness properties. The better tenacity properties of compact yarn provide opportunities to work with lower twist coefficients result in an increase in production rate and also better handling properties of end product (Goyal and Naik, 2007). Many textile scientists have studied factors that have an effect on pilling and abrasion resistance (Ahmed and Slater, 1999). Baird stated that washing increases pilling tendency and speed (Baird *et al.* 1996). Ozdil compared knitted fabrics from spun yarns with classics ring spun yarns and reported that knitted fabric from compact yarns demonstrated better pilling performance (Ozdil *et al.* 2005). Beltran stated that the pilling tendencies of woolen jersey and rib knit fabrics can be predicted by looking at fibre thread and fabric properties using artificial neural networks (Beltran *et al.* 2006) In this research work was carried out to investigate the bursting strength and pilling 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 study, 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 is 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

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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		30/1 Ne		20/1 Ne	
	Ring Yarn (Combed)	Compact	Ring Yarn (Combed)	Compact	Ring Yarn (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 places/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.

Bursting Strength

The bursting strength of the single jersey, rib and interlock knitted fabrics was tested with bursting Tester (MESDAN, Germany) according to ISO 13938-1:1999; Hydraulic method for determination of bursting strength (EN ISO 13938-1, 1999). In this test the sample specimen was clamped over the expansive rubber diaphragm and pressure in the fluid increased at a constant rate that the specimen bursts with 20±3 seconds. The reading was noted in KPa. Detail values of Bursting Strength for all Knitted Sample are given in table 5. Digital picture of Bursting strength tester (Mesdan) and Martindale tester (SDL) are given in Fig. 1 and 2.

Fig. 1. Bursting Strength Tester (MESDAN, Germany)

Fig. 2. Martindale Pilling Tester (SDL, England)

Table 5. Detail values of Bursting Strength for all Knitted Sample

Sample		Avg. Bursting Strength in Pressure (KPa)		Avg. Time to Break (Second)	
Sample Type		Combed	Compact	Combed	Compact
Grey Sample	40/1 Single Jersey	444	503	17.46	19.75
	30/1 Single Jersey	625	643	21.7	22.02
	40/1 1X1 Rib	553	617	21.22	21.63
	30/1 1X1 Rib	669	697	21.8	22.70
	40/1 Interlock	650	670	21.21	22.06
	30/1 Interlock	698	710	21.2	22.50
Bleached Sample	40/1 Single Jersey	433	500	18.42	22.75
	30/1 Single Jersey	550	621	18.42	19.55
	40/1 1X1 Rib	515	564	19.27	19.98
	30/1 1X1 Rib	576	682	17.06	18.87
	40/1 Interlock	633	634	19.48	22.56
	30/1 Interlock	667	672	22.45	23.10
Dyed Sample	40/1 Single Jersey	429	445	19.22	20.22
	30/1 Single Jersey	525	592	20.78	21.30
	40/1 1X1 Rib	510	525	20.80	21.37
	30/1 1X1 Rib	530	640	19.80	22.54
	40/1 Interlock	605	625	21.86	22.40
	30/1 Interlock	650	663	17.82	21.52

Pilling resistance

Martindale Tester was used to find out pill formation of the fabrics as per Swiss Standard (Swiss standard, SN 198 525). Fabrics were mounted the Martindale tester and the face of the same fabric for a specific number of movements. For all the samples standard 125, 500 and 2000 revolutions were given and the fabrics were assessed for there grades. Then the fabrics compared with the pilling standard photographs for measuring pilling grades and values were given Table 6. According to swiss standard Pilling rating standards are: 1- Severe formation of pills, 2-Obious pilling, 3-Moderate pilling, 4-weak pilling, 5-No or very weak pilling.

Table 6. Detail values of Pilling resistance for all Knitted Sample

Sample Type			For 125 cycles	For 500 cycles	For 2000 cycles
Grey Sample	40/1 Single Jersey	Combed	4-5	4	2-3
		Compact	5	4-5	3-4
	30/1 Single Jersey	Combed	4	3	3
		Compact	4-5	3-4	3-4
	20/1 Single Jersey	Combed	3-4	3	2-3
		Compact	4	4	3-4
	40/1 Rib	Combed	4	3	2
		Compact	4-5	3-4	2-3
	30/1 Rib	Combed	4-5	3-4	3
		Compact	5	4-5	3-4
	20/1 Rib	Combed	4-5	4-5	3-4
		Compact	5	5	4
	40/1 Interlock	Combed	4	3	1
		Compact	4-5	3-4	1-2
	30/1 Interlock	Combed	3-4	4	2
		Compact	4-5	4-5	2-3
	20/1 Interlock	Combed	4-5	4	3
		Compact	5	4-5	3-4
Bleached Sample	40/1 Single Jersey	Combed	4-5	4	3
		Compact	5	4-5	3-4
	30/1 Single Jersey	Combed	4-5	3	2-3
		Compact	5	3-4	3
	20/1 Single Jersey	Combed	3-4	3-4	3
		Compact	4	4	3-4
	40/1 Rib	Combed	4-5	4	3
		Compact	5	4-5	3-4
	30/1 Rib	Combed	4	3	2-3
		Compact	4-5	3-4	3
	20/1 Rib	Combed	4-5	4-5	3-4
		Compact	5	5	4
	40/1 Interlock	Combed	4	3	1-2
		Compact	4-5	3-4	2
	30/1 Interlock	Combed	4	3	1
		Compact	4-5	3-4	1-2
	20/1 Interlock	Combed	4	4	3-4
		Compact	4-5	4-5	4
Dyed Sample	40/1 Single Jersey	Combed	4-5	4	2-3
		Compact	5	4-5	3-4
	30/1 Single Jersey	Combed	4-5	4	2-3
		Compact	5	4-5	3
	20/1 Single Jersey	Combed	4-5	4-5	4
		Compact	5	5	4-5
	40/1 Rib	Combed	4	3-4	2-3
		Compact	4-5	4	3
	30/1 Rib	Combed	4	3-4	2-3
		Compact	4-5	4	3
	20/1 Rib	Combed	4-5	4	4
		Compact	5	4-5	4-5
	40/1 Interlock	Combed	3-4	3	1-2
		Compact	4-5	3-4	2
	30/1 Interlock	Combed	3	2	1
		Compact	3-4	2-3	1-2
	20/1 Interlock	Combed	4	4	3-4
		Compact	4-5	4-5	4

RESULTS AND DISCUSSION

Bursting strength

The Bursting characteristics of single jersey, rib and interlock knitted fabrics (40/1 and 30/1 Ne) made from Suessen EliTe compact and ring in different stages (grey, bleach and dyed) have been studied. Fig. 3 represents the bursting characteristics of knitted fabrics made from ring and compact spun yarns. In this figure it was clearly showed that the bursting strength of single jersey knitted fabrics were noticed lower values when compared to rib and interlock fabrics; it is because of the structure and lower tightness factor and aerial density. Bleached and dyed fabrics had shown the lower bursting strength than Grey fabric (Ning and Zeronian, 1993). The knitted fabrics made from compact yarns were shown the higher bursting strength due to higher yarn breaking strength. It is due to integration of fibres and uniform fibre arrangement which led to better fibre strength exploitation than the fabrics from ring yarn for all derivatives. All knitted fabrics from 20/1 Ne. need more strength to burst which is beyond the capacity of the equipment (Bursting Strength Tester; MESDAN, Germany).

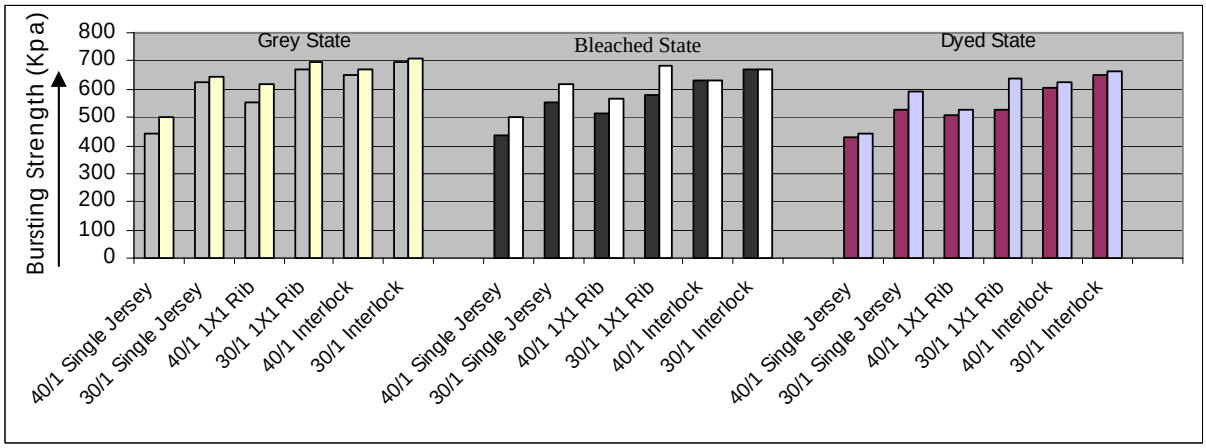


Fig. 3. Bursting strength of Knitted fabrics

Effect of pilling resistance

Pilling is a fabric-surface fault characterized by little 'pills' of entangled fiber clinging to the cloth surface and giving the garment an unsightly appearance (Lee *et al.* 1995). Pills are small knots or balls of mixture of large number of small fibres accumulated at the surface of the fabric and entangled by the mild frictional action during processing or wearing. They are soft but firmly held on the surface of the material. The pilling characteristics of single jersey, rib and interlock knitted fabrics made from conventional ring and Suessen EliTe compact spun yarns with different count such as 40/1, 30/1 and 20/1 Ne. have been studied and their pilling grades are given in Table 6. Pilling resistance after 2000 cycles are shown in Fig. 4, 5 and 6 in different stages (Grey, bleached and dyed).

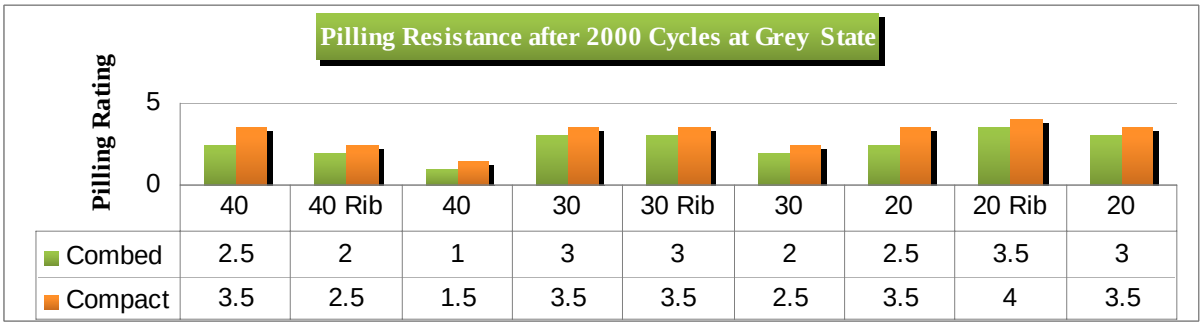
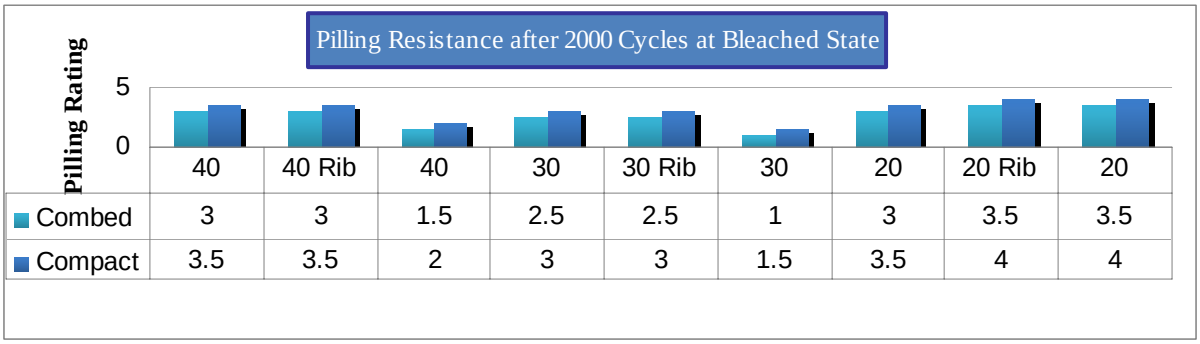
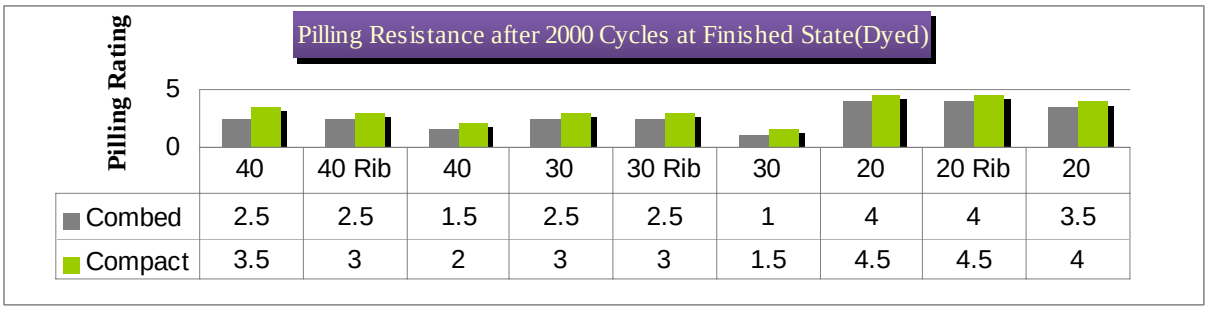


Fig. 4. Pilling resistance of Grey Knitted fabrics after 2000 cycles



	40	40 Rib	40	30	30 Rib	30	20	20 Rib	20
Combed	3	3	1.5	2.5	2.5	1	3	3.5	3.5
Compact	3.5	3.5	2	3	3	1.5	3.5	4	4

Fig. 5. Pilling resistance of Bleached Knitted fabrics after 2000 cycles



	40	40 Rib	40	30	30 Rib	30	20	20 Rib	20
Combed	2.5	2.5	1.5	2.5	2.5	1	4	4	3.5
Compact	3.5	3	2	3	3	1.5	4.5	4.5	4

Fig. 6. Pilling resistance of Dyed Knitted fabrics after 2000 cycles

It was established that yarn production technique (Compact or conventional ring) had an important influence on pilling tendency. In Fig. 4, 5 and 6 it was clearly shown that Elite compact spun yarn knitted fabrics have shown higher pilling grades than the fabrics produced with ring yarns due to low hairiness values of compact yarns. Again pilling resistance of fabric is better in finer count and bleached & dyed state. Knitting structure had a significant effect on pilling tendency of the fabric and interlock knitted fabrics showed high pilling tendency with regard to rib and single jersey fabrics (Alston 1992).

CONCLUSION

It was established that knitted fabric made from compact yarn have better physical properties than the fabric made from conventional ring (combed) yarn from the viewpoint of hairiness, neps, Unevenness, strength and elongation etc. Compact yarn based fabric have better bursting strength and pilling resistance which means they are more durable than conventional ring (combed) yarn based fabric. So knitted fabrics made of compact yarn can be used to make high quality garments with higher productivity.

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REFERENCES

Ahmed M, Slater K (1999) Modern method of Ring spinning system, *Journal of Text. Ins.*, 80, 279-284.

Alston PV (1992) Cotton spinning technology. *Textile Research Journal*, 62(3), 105-108.

Baird ME, Hatfield P, Morris GJ (1996) Method of compact spinning. *Journal of Textile Institute*, 47, 181-201.

Beltran R, Wang L, Wang L, Wang X (2006) Flax spinning technology. *Journal of Textile institute*, 99(2), 129-139.

EN ISO 13938-1 (1999) Spinning Technology.Part-1: Hydraulic method for determination of bursting strength and bursting distension.

Goyal A, Naik R (2007) The ring vs. compact spun yarns, Modern Textiles, 4(1), 56-58.

Lee W, Dhingra RC, Lo TY, Abbas MS (1995) The ring vs. Flax spun yarns. *Journal of federation of Asian professional Textile Associations*, 3, 50-58.

Ning P, Zeronian SH (1993) Compact spinning technology. *Textile Research Journal*, 63(1), 33-43.

Ozdil N, Ozdogan E, Demirel A, Oktem T (2005) Fibres & Textiles in Eastern Europe, 13(2), 39-43.