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Performance of Knitted Fabrics Produced from Fancy Yarns with Different Slub/Meter and Blend Ratio

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Abstract

Fashion; in a broader sense of the word imply satisfaction of consumer requests, throughout the ages establishes an essential and conditional part for all textile industry. For many years fancy yarns have been vital components of modern fashion and have been providing a higher contribution margin and reputation in the clothing sector. Demand for complex fabrics with unique and distinguishable features is growing, winning greater shares of the textile market.

The object of this study was to analyses the impact of slub fancy yarn parameters on the mechanical and physical properties of flat knitted fabrics. The impact of the slub yarn slub/meter and yarn blend ratio on the aforesaid properties of fabrics with fancy yarns was analyzed during the investigation. Single jersey, rib 1 x 1 and rib 3 x 1 structures were knitted with these slub yarns and results of different properties were statistically analyzed. Physical properties of knitted fabrics were measured such as fabric density, thickness value, water vapor transmission and air flow rate properties. As well, mechanical properties of produced samples were tested including friction resistance, pilling grade, bursting performance and stiffness and. It was found that the slub/meter had the most influence on all studied properties. The friction and bursting performance of the fabrics are improved through increasing the yarn slub/meter while, it decreases fabric pilling performance.

Keywords: Fancy yarn; Slub/meter; Stiffness; Water vapour permeability

Introduction

Fancy yarns give deliberate, decorative and also programmed effects of colors and shapes. They are applied to generate some variation in the aesthetic appearance of a fabric, where the superior beautiful merits of fabric produced from slub yarn are obtained by the inherent and obvious variables of the fancy yarn [1-3]. The quality of Slub yarns is very serious in knowing their textile application [4]. For the textile industry, the clothing, denim and upholstery fabrics are widely manufactured by using slub fancy yarn [5-7]. Studies of slub yarn are critically essential because fabrics woven from slub yarn have special properties [8].

Slub effect is achieved by the Random variations in the count of the yarn containing different thicknesses and lengths of thick place. Where, these slub shape is reached by changing the linear density of the yarn during the spinning process by adjusting the draft degree of the ring spinning frame [9], creating a wide range of beautiful appearance. These yarns are used in modern fabric to produce a natural, rustic and attractive character of the product [10]. A simple slub yarn structure is consists of two parts, the base and slub parts. The slub distance, slub length, slub twist, twist level, basic yarn count etc. which are considered as the slub yarn primary descriptive parameters, have an influence on the yarn elongation and strength properties [5-7]. Ilhan and Su studied the parameters affecting on the slub yarn elongation and breaking force. Generally, the strength of the yarn is influenced less by the yarn twist than by the increase of the number of fibers/yarn cross section. For that reason, the strength of the slub part is exceeding the basic yarn [11-13]. Moreover, some ways were applied and established to establish the geometrical parameters of slub yarns [8,14,15].

Also, these variations alter the comfort merits of the different produced fabrics. As a result, this yarn is used in many applications for different decorative and garments fabrics [11].

The slub yarn repetition pattern is designed by: thickness, slub length and slub distance of slub. To avoid the exceeding of basic yarn twist above the critical twist, it is preferable to adjust the slub length. Increased length of the slub leads to the increased twists of the basic yarn. It effects on the geometrical and physical properties of plain woven fabrics. Additionally, applying slub yarns in plain woven fabrics in the weft direction, increases fabric smoothness, bulkiness and tear strength in the warp direction. Increasing numbers of slubs per meter and slub thickness increases and decreases fabric stiffness respectively [16].

In the slub fancy yarn slub portions contain more hairiness compared with base yarn due to the high number of fibres/cross section [9]. At the beginning of the abrasion test, slub yarn variables have an influence on the fabric abrasion performance. Moreover, with the continuing abrasion cycle the yarn linear density has greatest influence and considered as the greatest important factor affecting the fabrics abrasion property [17].

A rib knitted structure produced from a bouclé yarn was too rigid and the yarn profile was hidden, while, for a single jersey, the yarn effect appeared looped and was on the fabric back [18].

Most of the former studies were focused on simulation and modelling of slub yarn fabrics [19,20]. Although there are many studies on the properties of single jersey and rib knit structures produced from conventional yarns, there is a gap in the studies that focus on

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studying the influence of slub yarn specifications on the resultant fabric properties. Therefore, in this research, slub/meter and polyester/cotton blend ratio of slub yarn were chosen as control factors for investigating the performance of slub yarn in single jersey, rib 1 x 1 and rib 3 x 1 knitted fabric structures.

Material and Methods

Material

In this research, Polyester/Cotton blended yarns of Ne 30/1 with blending ratios of 75:25, 50:50, 25:75 and 100:0% were used for knitting the single jersey, rib 1 x 1 and rib 3 x 1 fabric samples. Also, Polyester/Cotton blended yarn of Ne 40/1 with blending ratio 45:55% with different slub/meter was applied in this study for knitting the same last three structures. The properties of Greece cotton fibers are cleared in Table 1. Also, polyester fibers have tenacity and elongation values equal to 5.82 and 27.7% in turn. Furthermore, the properties of the yarns used to knit all fabric samples are given in Tables 2 and 3.

Fabric manufacture

The knitted fabric samples were produced on STOLL V-bed flat knitting machine with 10 gauge, CMS 433.6 ST model, 16 feeders number and total number of needles equal to 960. The loop length was adjusted at 0.56, 0.4946 and 0.535 cm for: single jersey, rib 1*1 and rib 3*1 structures respectively. The design of experiments and fabric properties considered in this paper is shown in Tables 4 and 5. During the knitting process all the other machine settings were kept exactly the same.

Methodology

The influence of slub yarn slub/meter, yarn blend ratio and knitted fabric structure on some mechanical and physical properties of the produced knitted fabrics was evaluated for significance using ANOVA single factor. The statistical analysis of the pilling performance of the fabric samples was not evaluated because of the subjective evaluation of this property.

Fabric testing

After putting the samples 72 hours in the standard conditions (Relative humidity = 65 + 2% - Temperature = 20 + 2 c'), the flat knitted fabrics properties were evaluated. The fabric count, thickness and fabric weight were tested according to standards ASTM D3775, ASTM D1777 and ASTM D3776 in turn. The bursting strength and stiffness of fabric was tested according to ASTM D6797 "ball burst method" and ASTM D4032. The resistance to bending or fabric stiffness is the maximum force necessary to pass the fabric over an orifice. The pilling performance was measured using ASTM D3512 "Random Tumble pilling test". The pilling performance is evaluated by comparison of the tested samples with standards board's visually. For evaluation of fabric friction, this test was measured according to standard test method B.S 3424 by using Shirley fabric friction. Additionally, the fabric water vapour and air permeability were measured using ASTM E96 standard and ASTM D737 respectively.

Results and Discussion

ANOVA single factor presented that, a significant difference is

Type	Length mm	Uniformity %	Strength g/tex	Elongation %	MIC	Rd %	+b	Trash Count	Maturity %
Greece Cotton	27.6	84	27.8	5.2	4.6	73.6	9.4	22	82

Table 1: Cotton fiber properties.

		Yarn raw material (polyester "p"/cotton "c")			
		25/75 % p/c	50/50 % p/c	75/25 % p/c	100 % p
Measured count (Ne)	Final yarn	26.79	27.03	26.36	26.15
	Base yarn	29.55	29.55	26.86	26.26
	Slub	12.8	12.847	14.07	13.13
Turns/inch	Final yarn	20.87	21.29	20.701	20.982
	Base yarn	30.445	28.49	30.03	26.64
	Slub	16.13	15.3	17.21	14.13
TP Measured Twist multiplier	Final yarn	4.03	4.094	4.032	4.1
	Base yarn	5.6	5.24	5.8	5.2
	Slub	4.5	4.27	4.58	3.89
Irregularity (CVm %)		3	1.9	0.8	2.2
B-Force (gf)	Final yarn	262.9	411.1	477.5	623.4
	Base yarn	169.07	269.92	412.88	493.85
	Slub	163.56	308.67	451.73	1562.5
Elongation (%)	Final yarn	6.12	9.01	10.08	10.43
	Base yarn	26.68	32.87	38.87	33.67
	Slub	19.97	19.61	18.87	15.24
Tenacity (RKM)	Final yarn	13.35	20.88	24.26	31.67
	Base yarn	8.46	13.46	20.59	24.68
	Slub	8.16	15.39	22.54	78.11
Thin places (-50% /km)		1354	129.8	476.3	214
Thick places (+50% /km)		2066	1860	1903	1882
Neps (+200% /km)		1565	453.3	575.3	258
Bulk (cm³/g)		30	35	36.25	36.8

Table 2: Yarns Properties of different polyester/cotton blends "Ne 30/1".

		Slub/meter (s/m)			
		0.52	1.236	1.763	2.665
Measured count (Ne)	Final yarn	38	37.26	35.8	31.32
	Base yarn	39.4	32.2	39.4	39.4
	Slub	13.63	13.9	15.4	14.184
Turns/inch	Final yarn	26.264	25.459	24.447	25.24
	Base yarn	35.434	34.9226	34.5	35.035
	Slub	16.863	16.79	19.49	15.86
TP Measured Twist multiplier	Final yarn	4.15	4.169	4.1	4.5
	Base yarn	5.645	6.687	5.49	5.58
	Slub	4.567	4.5	4.967	4.2
Irregularity (CVm %)		20.94	26.03	28.35	41.39
B-Force (gf)	Final yarn	243.5	241.3	258.4	261
	Base yarn	209.04	172.74	139.09	179.98
	Slub	178.76	160.4	142.86	198.33
Elongation (%)	Final yarn	7.66	6.47	7.57	7.33
	Base yarn	34.98	34.48	30.21	38.37
	Slub	20.13	28.78	23.57	25.55
Tenacity (RKM)	Final yarn	16.5	16.34	17.5	17.68
	Base yarn	13.97	11.52	9.28	12.03
	Slub	11.93	10.71	9.48	13.26
Thin places (-50% /km)		361.3	1315	581.3	3553
Thick places (+50% /km)		909.8	1505	1956	2801
Neps (+200% /km)		967.3	1618	991	1439
Bulk (cm³/g)		31.66	33.33	34.166	34.16

Table 3: Yarns Properties of different slub/meter for 45/55% polyester/cotton blend "Ne 40/1".

Sample Code	Yarn blend ratio (%)	Fabric structure	Wales/ cm	Courses/ cm	Weight (g/m²)	Thickness (cm)
10	25p/75c	Single jersey	7.3	10.0	180.5	0.0706
4	50p/50c		8.7	10.0	228.3	0.0854
1	75p/25c		9.0	9.3	206.0	0.0766
7	100%p		9.7	10.0	238.3	0.0888
11	25p/75c	Rib 1*1	10.0	13.3	289.5	0.1086
5	50p/50c		10.7	12.7	313.8	0.1046
2	75p/25c		11.0	12.7	299.3	0.1136
8	100%p		11.0	12.7	321.5	0.1062
12	25p/75c	Rib 3*1	11.7	11.3	269.5	0.1014
6	50p/50c		12.3	12.0	311.8	0.1124
3	75p/25c		12.3	12.0	311.3	0.1084
9	100%p		12.0	12.0	339.5	0.116

Table 4: Design of Experiments and fabric properties *produced from Ne 30/1–slub/meter 1.763.*

Sample Code	Slub Per meter	Fabric structure	Wales / cm	Courses / cm	Weight (g/m²)	Thickness (cm)
19	0.52	Single jersey	9.3	10.3	157.3	0.0634
13	1.236		8.3	9.0	154.5	0.065
22	1.763		8.3	9.7	161.3	0.07
16	2.665		7.3	10.0	176.8	0.0722
20	0.52	Rib 1*1	10.3	12.3	198.0	0.0782
14	1.236		10.3	12.3	199.8	0.0864
23	1.763		10.7	12.0	211.5	0.0878
17	2.665		10.3	12.3	250.3	0.1022
21	0.52	Rib 3*1	11.3	11.7	204.0	0.0788
15	1.236		12.3	11.7	223.0	0.085
24	1.763		10.3	11.7	224.8	0.087
18	2.665		12.0	11.7	258.8	0.0954

Table 5: Design of Experiments and fabric properties *produced from Ne 40/1 -* 45p/55c.

obtained for the impact of yarn slub/meter, yarn blend ratio polyester/cotton and the knitted fabric structure on all studied fabrics properties.

Friction resistance

Surface characteristics of textile materials are essential for all textile products from fabric production to the final product. When the influence of fabric structure is taking into concern after adjusting commercial loop length value, generally as presented in Figures 1 and 2, the single jersey fabrics are smoother than rib 3 × 1 rib and rib 1 × 1 structures. Decreasing yarn gaps in structure unit provides yarns to be closer to each other causing a decrease in the roughness level of fabric. Therefore, the single jersey structure leads to more decrease in fabric roughness compared with two rib fabrics. Accordingly, it can be noticed that rib 1 x 1 fabrics contain more gaps and has the highest roughness and least friction degree than rib 3 x 1.

Depending on the results illustrated in Figure 1, the level of friction of polyester fabrics is lower than cotton fabrics. Fabrics knitted from polyester yarns are expected to give lesa level of friction surface than those produced from cotton yarns [21].

Slub length is the most important factor influencing fabric abrasion performance. It is the main parameter influences the base yarn twist level. The twist of the base yarn increases with the increasing of slub length value which affects also the fabric abrasion resistance. Therefore, the increase of the yarn slub length heightens the twist of the base yarn above the critical twist and improves friction resistance [22], as cleared in Figure 2.

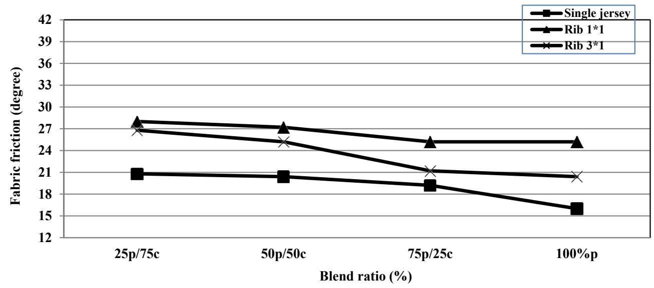

Figure 1: The relation between yarn blend ratio and fabric friction at different fabric structure.

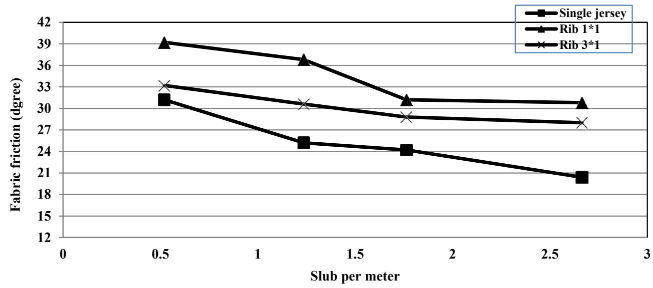

Figure 2: The relation between yarn yarn slub/meter and fabric friction at different fabric structure.

Furthermore, the variance analysis exhibits that significant difference is found in the test results achieved for all friction degree results where, as example Tables 6-8 show that the F-value is exceeds F-critical value.

Fabric pilling

During rubbing or wear, bundles of entangled fibers collected on the fabric surface which called pills. It is considered as a fabric defect and increases with the increase of using cotton/polyester blends. In spite of the somewhat more courses and wales density, the rib 3 x 1 knitted fabrics give substantially lower pilling grade than the single jersey fabric, Figures 3 and 4. The short cross lengths and more interlacings inside the single jersey knitted fabrics lessen the opportunity for the free yarns to appear on the fabric surface and cut down pilling.

For the rib 3 x 1 structure, the long float exposes more lengths of the fibers to the abrasion paper. As a result, this assisted the pilling of the fibers outside the yarn. Finally, it could be said that by the correct choose of the knitting structure, the pilling grade can be improved. Additionally, the pilling grade of rib 3 x 1 is lower than rib 1 x 1 which related to the exceeding loop length of the rib 3 × 1 giving it the opportunity to be more exposure for forming extra pills above its surface.

The influence of blend ratio on the fabric pilling tendency of polyester/cotton blends is clear in Figure 3. Fabric containing high percentage of polyester fibers has a low number of pills on its surface. High proportion of cotton fibers grows the pills on the fabric surface. Probably, higher short and loose fibers existing on cotton fabrics are simply formed into pills through pilling test [23].

It was found from Figure 4 that the high slub/meter promotes the fabric to accumulate more pills on its surface and harm its pilling grade, where more hairiness occurred inside the coarser places than fiber regions. Thick portion is likely to have more hairiness. So, for the slub

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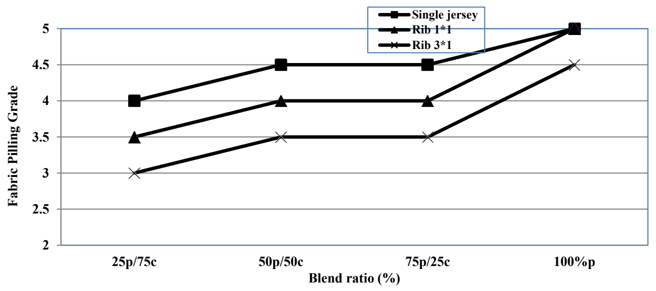

Figure 3: The relation between yarn blend ratio and fabric pilling grade at different fabric structure.

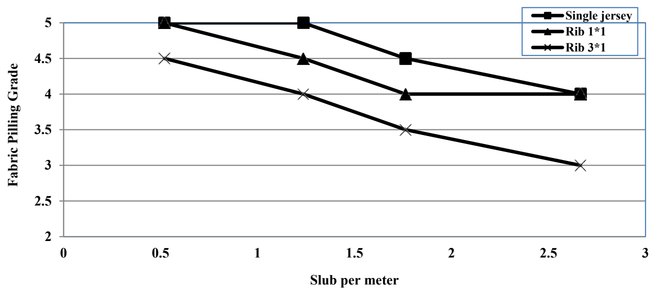

Figure 4: The relation between yarn slub/meter and fabric pilling grade at different fabric structure.

yarn, slub regions contain high hairiness level than base yarn due to the more fibers/yarn cross section.

Fabric bursting strength

ANOVA shows significant difference for all values of the fabric bursting strength [F > Fcritical], as cleared in some tables like Tables 9-11. Additionally, as it was expected, the highest bursting strength is in rib 1 x 1 structure, due to the long cross-lengths at the interlacing points and also the resulting elongation creating higher friction actions between yarns and as a result greater bursting strength. Single jersey and rib 3 x 1 structures follow with lower values, which are presented in Figures 5 and 6.

The highest bursting strength is cleared at fabrics produced from higher polyester fibers ratio and the lowest bursting strength at fabrics produced from higher cotton fibers ratio, which related to the cotton yarn has the least elongation as shown Figure 5.

A fabric produced from a blend having higher percentage of polyester fiber has a higher bursting strength than a fabric knitted from a blend having lower percentage of polyester. So also, in general, the value of the overall strength of a fabric having higher percentage of polyester is higher than that of a fabric having lower percentage of polyester. The bursting strength decreases sharply when the polyester content is decreased. The reason for such trend is that the polyester fiber has higher tenacity compared to the cotton.

Also, it is observed from Figure 6 that the knitted fabric bursting performance improves significantly with the growth in the length of the slub part. The reason may be caused by the increase in the fibre mass of slub portions inside the yarn. The strength value of the slub part is better than the basic yarn. Therefore, the increase of slub/meter inside the fancy yarn improves the resultant fabric bursting strength.

Source of Variation	SS	df	MS	F	P-value	F crit
Between Fabrics	71	3	23.667	394.44	3.33E-15	3.2389
Within Fabrics	0.96	16	0.06			

Table 6: ANOVA single factor data analysis for friction resistance "single jersey with different blend ratio".

Source of Variation	SS	df	MS	F	P-value	F crit
Between Fabrics	173.33	2	86.667	1857.14	1.12E-15	3.8853
Within Fabrics	0.56	12	0.047			

Table 7: ANOVA single factor data analysis for friction resistance "with different fabric structure–slub/meter 0.52".

Source of Variation	SS	df	MS	F	P-value	F crit
Between Fabrics	300.15	3	100.05	1231.38	3.99E-19	3.2389
Within Fabrics	1.3	16	0.081			

Table 8: ANOVA single factor data analysis for friction resistance "single jersey with different slub/meter".

Source of Variation	SS	df	MS	F	P-value	F crit
Between Fabrics	30133.75	3	10044.58	1607.133	4.77E-20	3.238872
Within Fabrics	100	16	6.25			

Table 9: ANOVA single factor data analysis for bursting strength "single jersey with different blend ratio"

Source of Variation	SS	df	MS	F	P-value	F crit
Between Fabrics	12743.33	2	6371.667	647.9661	5.96E-13	3.885294
Within Fabrics	118	12	9.833333			

Table 10: ANOVA single factor data analysis for bursting strength "with different fabric structure–slub/meter 0.52".

Source of Variation	SS	df	MS	F	P-value	F crit
Between Fabrics	60413.75	3	20137.92	1873.295	1.41E-20	3.238872
Within Fabrics	172	16	10.75			

Table 11: ANOVA single factor data analysis for bursting strength "single jersey with different slub/meter".

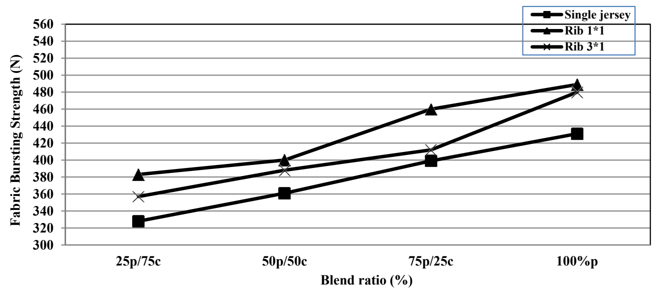

Figure 5: The relation between yarn blend ratio and fabric bursting strength at different fabric structure.

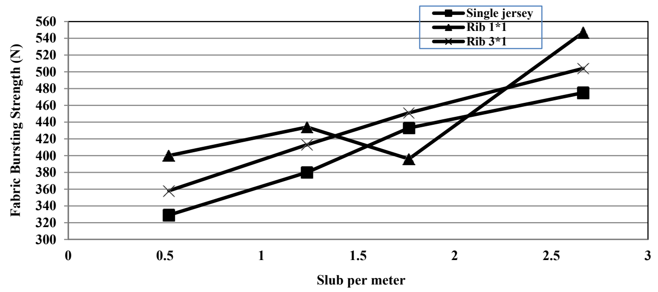

Figure 6: The relation between yarn slub/meter and fabric bursting strength at different fabric structure.

Fabric stiffness

Stiffness is one of the most famous parameter to assess fabric rigidity and hand that are necessary request for any end user. The level of fabric rigidity is associated to its characteristics like fiber type, yarn profile and fabric structure.

As presented in Figures 7 and 8, the single jersey fabric has less stiffness level than rib 1 × 1 and rib 3 × 1 structure. The single jersey structure is considered as a single knit fabric structure, while the other two rib structures are considered double knit fabric structure, so, the single jersey has a good flexibility merit giving it the opportunity to bend easily during the stiffness test. Additionally, rib 1 × 1 structure has more open gaps than rib 3 × 1 fabric which reflected in making it to be more elastic and as a result less stiff.

Also, for the same Figure 7, fabrics knitted from a blend having lower percentage of polyester are more flexible than others knitted from a blend having higher percentage of polyester. This is related to polyester fiber has higher tenacity and the fiber tenacity mainly determines the fabric stiffness level when the other parameters are the same [24]. Moreover, Figure 8 shows that fabric stiffness increased by the increase slubs per meter. The increase in the value of slub/meter, increase the tightness of the fabric construction which adds constraints on the movement of the yarns inside the fabric and increase its stiffness level.

In general, the variance analysis obviously clears that fancy yarn slub/meter, polyester/cotton blend ratio and fabric structure play an important role in influencing fabric stiffness of the studied samples where, as example Tables 12-14 show the F-value > F-critical value.

Fabric air permeability

The rate of the air passed over a unit area of tested fabric at a certain pressure in a unit time is called fabric air permeability which considered as an essential merit of fabric comfort [3]. Air permeability

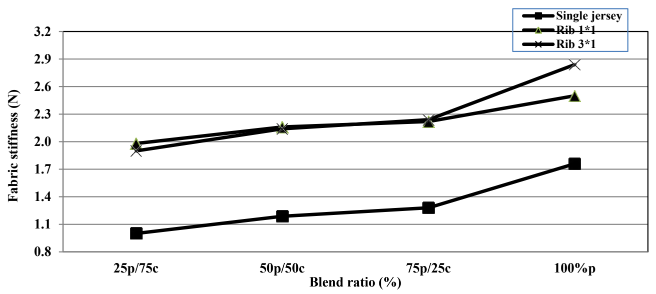

Figure 7: The relation between yarn blend ratio and fabric stiffness at different fabric structure.

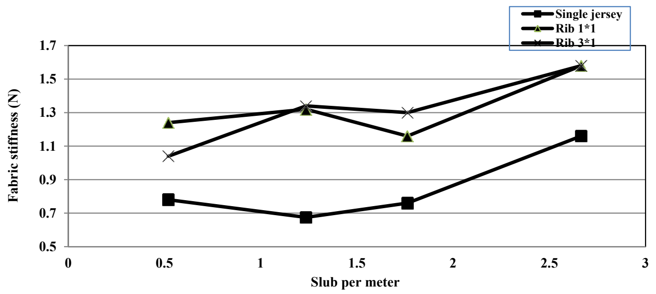

Figure 8: The relation between yarn yarn slub/meter and fabric stiffness at different fabric structure.

keeps the thermal balance of the wearer by allowing the air to transfer through the clothing especially after exercise or any other strenuous activity [25,26].

ANOVA displays significant difference in the all air permeability property for all flat knitted fabric samples [$F > F_{critical}$], as illustrated in some statistical analyses like Tables 15-17. Moreover, Figures 9 and 10 illustrates that single jersey knitted fabric gives high air permeability rate compared to the other 2 rib structures which have higher fabric courses density, thickness and g/m². Fabric g/m² and thickness have an inverse relationship with air permeability. Therefore, fabric volume/area and porosity increase with the increase of fabric g/m² and thickness. Thus, the air permeability decreases where the porosity represents as an essential factor in air permeability rate. The fabric air permeability is principally influenced by the fabric porosity and fabric structure. This is also related to the single knit category which the single jersey structure belongs to as mentioned before.

In addition to, the air permeability grows with the decrease in polyester fibers percentage inside the blend, which is due to the decrease in yarn diameter because of the known less density of polyester fiber. The other reason for the observed trend may be that the decrease in polyester percentage inside the yarn increases the fabric pore area, which reduces the resisting capability of the fabric against the flow of air through it [24].

The effect of yarn slub/meter on fabric air permeability rate is shown in Figure 10. The increase in the value of slub/meter, blocks

Source of Variation	SS	df	MS	F	P-value	F crit
Between Fabrics	1.6375	3	0.545833	34.65608	3.14E-07	3.238872
Within Fabrics	0.252	16	0.01575			

Table 12: ANOVA single factor data analysis for fabric stiffness "single jersey with different blend ratio".

Source of Variation	SS	df	MS	F	P-value	F crit
Between Fabrics	0.532	2	0.266	21	0.00012	3.885294
Within Fabrics	0.152	12	0.012667			

Table 13: ANOVA single factor data analysis for fabric stiffness "with different fabric structure – slub/meter 0.52".

Source of Variation	SS	df	MS	F	P-value	F crit
Between Fabrics	0.6895	3	0.229833	14.14359	9.18E-05	3.238872
Within Fabrics	0.26	16	0.01625			

Table 14: ANOVA single factor data analysis for fabric stiffness "single jersey with different slub/meter".

Source of Variation	SS	df	MS	F	P-value	F crit
Between Fabrics	16882.55	3	5627.517	714.6053	3.02E-17	3.238872
Within Fabrics	126	16	7.875			

Table 15: ANOVA single factor data analysis for air permeability "single jersey with different blend ratio".

Source of Variation	SS	df	MS	F	P-value	F crit
Between Fabrics	20456.13	2	10228.07	2087.361	5.54E-16	3.885294
Within Fabrics	58.8	12	4.9			

Table 16: ANOVA single factor data analysis for air permeability "with different fabric structure – slub/meter 0.52".

Source of Variation	SS	df	MS	F	P-value	F crit
Between Fabrics	6224.95	3	2074.983	488.2314	6.18E-16	3.238872
Within Fabrics	68	16	4.25			

Table 17: ANOVA single factor data analysis for air permeability "single jersey with different slub/meter".

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more the porous contained in the yarn, which therefore reduces the air permeability.

Fabric water vapor permeability

Generally, it should be equilibrium between the heat produced by the body and environment temperature [2]. Cloth can have the ability to carry evaporate the sweat away from the body skin during activities [27]. Fabric water vapor transportation is considered as the most essential features that contribute to human comfort. It is usually known as a measure of the water vapour mass that is conveyed over fabric unit area at particular conditions of temperature and pressure between two fabric sides.

This property is one of the vital factors in influencing fabric comfort where it expresses about the ability to remove perspiration. Single jersey fabric has the top value like its air permeability record, Figures 11 and 12. This fabric is able to permit the vapour to go through the fabric than the ribs fabrics. According to the results, this is related to single jersey fabric is less condensed where it has lower courses density, thickness and g/m^2 than other rib fabrics.

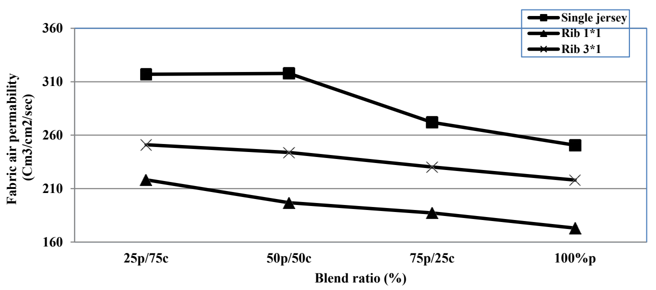

Figure 9: The relation between yarn blend ratio and fabric air permeability at different fabric structure.

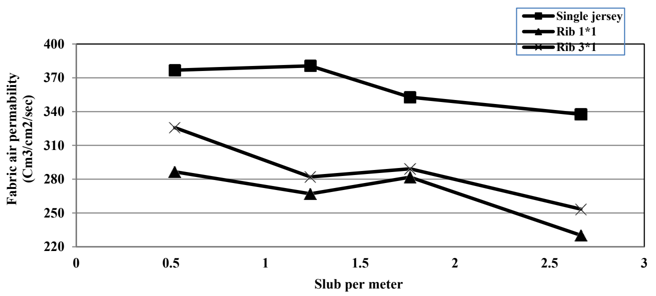

Figure 10: The relation between yarn slub/meter and fabric air permeability at different fabric structure.

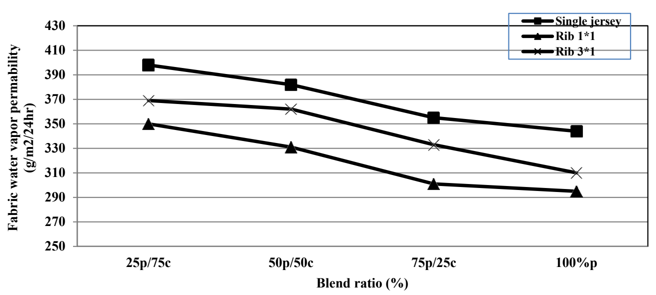

Figure 11: The relation between yarn blend ratio and fabric water vapour permeability at different fabric structure.

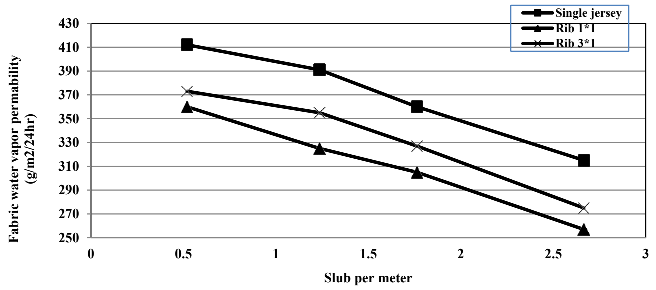

Figure 12: The relation between yarn slub/meter and fabric water vapour permeability at different fabric structure.

Source of Variation	SS	df	MS	F	P-value	F crit
Between Fabrics	9143.75	3	3047.917	541.8519	2.71E-16	3.238872
Within Fabrics	90	16	5.625			

Table 18: ANOVA single factor data analysis for water vapor permeability "single jersey with different blend ratio".

Source of Variation	SS	df	MS	F	P-value	F crit
Between Fabrics	7323.333	2	3661.667	627.7143	7.2E-13	3.885294
Within Fabrics	70	12	5.833333			

Table 19: ANOVA single factor data analysis for water vapor permeability "with different fabric structure – slub/meter 0.52".

Source of Variation	SS	df	MS	F	P-value	F crit
Between Fabrics	26645	3	8881.667	1973.704	9.28E-21	3.238872
Within Fabrics	72	16	4.5			

Table 20: ANOVA single factor data analysis for water vapor permeability "single jersey with different slub/meter".

A material that is permeable to air is likely to be permeable to water. As cleared in Figure 11, the more polyester fibers percentages in the fiber mix, the water vapour permeability is reduced. WVP of fabrics knitted with lower polyester blend ratio, are higher than others produced with higher polyester blends. Generally, the thermal resistance of polyester fibers is better than cotton fibers where, the cotton fibers have higher absorbing and wicking merits. So, fabrics knitted with lower polyester fibers blend ratio are appropriate for summer season. High humidity transfer of cotton fiber makes it as a microclimate. Therefore, the water vapour permeability improves with the low polyester proportion inside the yarn blend.

Additionally, Figure 12 shows that the high slub/meter value lessens the internal spaces inside the fabric and decreases of fabric air pockets which therefore cuts the water vapor permeability rate. Also, the ANOVA analysis confirmed that there is a significant difference for the all water vapor permeability property results where, as example Tables 18-20 shows the F- Critical is smaller than F-value.

Conclusion

The friction and bursting performance of the fabrics are improved through increasing the yarn slub/meter while, it decreases fabric pilling performance by making the fabric surface to gather extra pills on it, decrease its stiffness. Moreover, the more slub/meter the less fabric flexibility, air flow rate and water vapour transmission. The single jersey structure has the highest pilling performance, air permeability rate and water vapour permeability than the rib 1 × 1 and rib 3 × 1 structures. On the other hand, this structure has the least fabric stiffness, friction resistance and bursting strength.

A fabric produced from a blend having higher percentage of polyester fiber has a higher friction resistance, pilling grade, bursting strength and fabric stiffness. While the air permeability and water vapour permeability increase with the decrease in polyester content in the blend, which related to the thermal resistance of polyester fibers and the wicking and absorbing properties of cotton fibers.

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References

1. Chimeh M, Amani M, Latifi M, Mohaddes R (2005) Characterizing bulkiness and hairiness of air-jet textured yarn using imaging techniques. J Text Instit 96: 251-255.
2. Kothari K, Chattopadhyay R, Agrawal P (1996) Studies on Filament Migration in Air-jet Textured Yarns and the Relationship between Migration Parameters and Properties. J TextInstit 87: 335-348.
3. Wray R (1969) 9-The properties of air-textured continuous filament yarns. J TextInstit 60: 102-126.
4. Bruno A (2004) Fancy yarns-opportunities in the spinning process. Internat Text Bulletin-Filature et tissage: 40-42.
5. Ilhan I (2010) Developing an Electronically Controlled Slub Attachment for Ring Spinning Frame and Investigating on the Slub Yarn Properties. Thesis of Decorate degree in Çukurova University.
6. Grabowska K (2001) Characteristics of Slub Fancy Yarn. Fib Text Eastern Europe 9: 28-30.
7. Kumpikaite E, Ragaisiene A, Barburski M (2010) Comparable Analysis of the End-use Properties of Woven fabrics with Fancy Yarns Part I: Abrasion Resistance and Air Permeability. Fib Text Eastern Europe 18: 56-59.
8. Liu J, Xie Z, Gao W, Jiang H (2010) Automatic Determination of Slub Yarn Geometrical Parameters Based on an Amended Similarity-based Clustering Method. Text Res J 80: 1075-1082.
9. Gong R, Wright R (2002) Fancy yarn-their manufacturing and application. Wood head Publication Limited, North America 31: 48-50.
10. Lawrence A (2003) Fancy yarn production - Fundamentals of Spun Yarn Technology. CRC Press Ltd., U.S.A 481-499.
11. Ilhan I, Babaarslan O, Vuruskan D (2012) Effect of Descriptive Parameters of Slub Yarn on Strength and Elongation Properties. Fib Text East Eur 20: 33-38.
12. Su XZ, Gao WD, Liu XJ, Xie CP, Zhu Y (2014) Numerical analysis of the slub yarn breaking strength using finite element method. Indian J Fib Tex Res 39:437-440.
13. Lu YZ, Gao WD, Xie CP (2006) Twist Distribution of Ring Spun Slub Yarn and Its Influence on The Yarn Strength. J Text Res.
14. Liu J, Li Z, Lu Y, Jiang H (2010) Visualisation and Determination of the Geometrical Parameters of Slub Yarn. Fib Text East Eur 18:31-35.
15. Gao R, Gong RH (2004) 3D modelling of fancy yarn. Quality Textiles for Quality Life 4: 1290-1293.
16. El-Khalek RA (2015) Computer-based system for evaluation and recognition of fancy yarns properties, quality and their applications. Thesis of Doctorate degree in Mansoura University.
17. Sevda A, Banu O (2016) The effect of slub yarn descriptive parameters and yarn linear density on upholstery fabric abrasion resistance. J Text Inst 107: 1232-1239.
18. Mole K, and Knox K (1989) The Properties and Uses of Specific Hollow Spindle Yarns. J Text Instit 80: 31.
19. Xu BJ, Yu CW (2004) Cad and simulation for fabric appearance effect woven by slub yarn. Quality Textiles for Quality Life 4: 1380-1383.
20. Kowalski K, Ledwon J (1999) Computer modelling of patterns on fabrics made from fancy yarns on weft knitting machines and of slub repeats of the yarns. Fibres & Textiles in Eastern Europe 7: 42-44.
21. Vidan S, Eren O, Ayse O (2013) Roughness and Frictional Properties of Cotton and Polyester Woven Fabrics. Indian J Fiber & Textile Res 38: 349-356.
22. Lu Y, Gao W, Wang H (2007) A model for the twist distribution in the slub□yarn. Inter J Clothing Science and Tech 19: 36-42.
23. Sivakumar V, Pillay R (1981) Study of Pilling in Polyester/Cotton Blended Fabrics. Indian J Fiber & Textile Research 6: 22-27.
24. Bhargava S, Yaday K (1983) Effect of Blend Composition and Fabric Sett on Some Characteristics of Polyester-Viscose Fabrics. Indian J Textile Res 8: 115-120.
25. Bedek G, Salaün F, Martinkovska Z, Devaux E, Dupont D (2011) Evaluation of thermal and moisture management properties on knitted fabrics and comparison with a physiological model in warm conditions. Applied Ergonomics 42: 792-800.
26. Kar F, Fan J, Yu W, Wan X (2007) Effects of Thermal and Moisture Transport Properties of T-shirts on Wearer's Comfort Sensations. Fibers and Polymers 8: 537-542.
27. Stevens K, Fuller M (2015) Thermoregulation and clothing comfort, Textile-led Design for the Active Ageing Population. 117.