SSRG International Journal of Polymer and Textile Engineering
ISSN: 2394 – 2592 /doi:10.14445/23942592/IJPTE-V7I3P101
Volume 7 Issue 3, 1-11 Sep-Dec 2020

Viscose Spun Yarn and Knitted Fabrics Properties Produced by Using Different Spinning Technologies

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Abstract

In this study, using Ne 28/1 (21 tex) 100% viscose fiber, ring, compact, rotor, and vortex spinning systems are used to examine the yarns and some selected properties of knitted fabrics from these yarns. Yarns produced using different spinning technologies were knitted into a fabric with a plain structure produced in two different yarn stitch densities (ring and compact are the same, rotor and vortex are the same). Then, the pilling abrasion (with ICI box and Martindale) of knitted fabrics produced using yarns from different spinning technologies and burst strength performance is examined. As a result, the yarn produced with the compact system in terms of yarn gave the best results of general properties. Fabrics were examined in two groups. It was observed that the fabrics knitted with compact yarns had better pilling properties than the fabrics knitted with ring yarns. However, the pilling performance of knitted fabric made from yarns produced by vortex technology is better than knitted fabric from OE rotor yarns.

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Keywords — *Spinning Systems, Ring, Compact, OE Rotor, Vortex, Yarn Properties, Knitted Fabric, Pilling, Bursting Strength.*

I. INTRODUCTION

The spinning industry remained handicraft from the early ages until the beginning of the industrial revolution in Europe in the early last century, despite its development in the method of manual work and the tools used for the process of manual spinning [1].

All variations in yarn properties can be due to differences in their composition, which is the result of different processes of production. In textile short fiber spinning, four types of yarn production processes, i.e., ring, compact spinning, rotor, and vortex spinning, are commonly accepted today [2].

The yarn manufacturing process, structure, properties, and performance have a direct relationship. Yarn production technology defines the term of the yarn forming process in this sequence of relationships in which ring spinning, rotor spinning, vortex spinning, friction spinning, etc. have different effects on the yarns produced [3].

The ring-spun yarns have high strength, low imperfection, and ring yarn knitted fabric has a smooth feel [4,5]. Also, the compact spinning system gives an improvement in tensile properties, reduces hairiness as well as improved the regularity of a yarn. On the other hand, compact yarns are considered to be stronger as well as less hairy for raising fiber connecting and have good yarn elongation, workability, and yarn unevenness compared to traditional ring yarns [6,7,8].

Open-end spinning is a part of the technology, which is competent and capable of producing yarn without the usage of the spindle. However, the fibers in the core of the yarn are twisted during open-end rotor yarn forming, and some surface fibers are wrapped around the core, this is which distinguishes this type of yarn [9]. The structure and characteristics of vortex spinning yarns varied from other processes, considering the processing speed of vortex yarns that are 15 to 30 times higher than the ring-spun yarns, the yarn delivery speed of vortex spinning can be basically as high as 500 m / min [10,11].

Knitting is a fabric forming process involving interloping of the yarn through needles in a sequence of linked loops. Knitted fabrics are known for producing exceptional characteristics for comfort. Not only do they enable flexibility and ease of movement, but they also have good handle properties and promote the fast transfer of body water vapor. These characteristics make knitted fabrics the common choice for sports clothing, casual clothes, and underwear [12].

Viscose rayon has several advantageous qualities. During its processing, it has some limitations. Medium dry strength, resistance to pill, and resistance to abrasion along with low wet strength, affect its processability. While the rayon fiber construction is smooth, inelastic filaments such as glass rods make it slippery in nature, difficult to manage until sized or strongly twisted during production. Beyond this, entangling with a shuttle eye or needle is extremely coherent. Everything together adds to the difficulties with its manufacturing [13,14].

II. MATERIALS & METHODS

Yarns

100% viscose fibers (fineness 1.2 denier with 38 mm length) were spun to produce yarns from four different systems: ring, compact, rotor, and vortex spun yarns with count Ne 28/1 (21 tex). Yarn samples were conditioned prior to testing under standard conditions of 20±2 °C and 65±4 % relative humidity according to ISO 139 before the tests (ISO 139:2005).

1. Yarn linear density test (Ne)

• Test standard; TS 244 EN ISO 2060, 13.04.1999 Textiles-Yarn from packages-Determination of linear density (mass per unit length) by the skein method.
• Device Used; Yarn Wrap Reel Machine (Uster Zweigle Yarn Reel & Auto Sorter 4).
• 100 yards (91.44 meters) x 10 bobbins were measured.

2. Twist test (Turns/inch)

• Test standard; TS 247 EN ISO 2061: 1999 "Textiles - Determination of twist in yarns - Direct counting method."
• Device Used; Yarn twisting Device (Uster Zweigle Twist Tester 5).
• 500 mm x 10 Bobin was measured per coil.

3. Yarn unevenness test

• Test standard; TS 628 July 1970 Yarn Unevenness Determination Methods.
• Device Used; Unevenness Device (Uster Tester 4).
• 400 m x 10 Bobin were measured.

4. Yarn strength test

• Test Standard; TS 245 April 1988 Breaking Strength of Single Yarn and Determination of Breaking Elongation.
• Device Used; Strength Device (Uster Tensorapid 4).
• 50 cm x 10 Measurement x 10 Bobin was measured.

We observed the different yarn properties in the study, such as U%, CV%, Imperfection Index (thick/km, thin/km, neps/km), hairiness, and strength (CSP) of the ring, compact, rotor, and vortex spun yarns. Parameters for the production of sample yarns are given in Table I.

Knitted Fabrics

In this study, it is aimed to investigate the influence of spinning technology on the properties of knitted fabrics performance, namely, fabric pilling performance and fabric bursting resistance.

Four different fabric samples were knitted with the same structure 1/1 plain. All fabric types were knitted with 100% viscose yarn with a count of Ne 28/1 (21 tex) was used as a pattern yarn. All fabrics samples were conditioned according to TS EN ISO 139; all the tests were performed in the standard atmosphere of 20±2 °C and 65±4 % relative humidity.

In order to investigate the effects of spinning technology on the fabric pilling resistance (Nu-Martindale Figure 1, ICI pilling box Figure 2) and the burst strength (Figure 3), fabric samples were tested according to the standards of EN ISO 12945-1, EN ISO 12945-2 and EN ISO 13938-2 respectively. These tests were performed on dry, relaxed fabrics. Structural features of knitted fabric samples, namely, fabric weight, fabric thickness, and numbers of wales and courses, were determined according to TS EN 12127, TS 7128 EN ISO 5084, and TS EN 14971 standards, respectively. The structural features of knitted fabric samples are given in Table II.

To understand the statistical significance of spinning technology on knitted burst strength fabric efficiency, ANOVA was performed in one-way. Tukey HSD multiple comparison tests were applied to determine which classes belong to the substantial differences obtained. To this purpose, the experimental data were interpreted using the statistical software program SPSS 22.0. All test results were evaluated at a confidence interval of 95%.

Fig 1: Nu-Martindale abrasion and pilling tester

Fig 2: The ICI pilling box tester

Fig 3: The bursting strength tester

TABLE I
Production parameters of sample yarns

	Ring (Rieter 35)	**Compact (Rieter k-46)**	**OE Rotor (Rieter R40)**	**Vortex (MVS Ⅲ870)**
Raw materials	CV100%	CV100%	CV100%	CV100%
Origin	Taiwan	Taiwan	Taiwan	Taiwan
Number of passages	2	2	2	3
Card sliver count, Ne	0.110	0.110	0.110	0.140
Roving count, Ne	0.90	0.90	-	-
Yarn Count, Ne	28/1	28/1	28/1	28/1
Delivery speed, m/min	19.62	24.27	158.5	450
Ring diameter, mm	38	38	-	-
Spindle speed, rev/min	15500	17800	-	-
Yarn twist turns/m	790	790	705	-
Rotor speed, rev/min	-	-	111760	-
The rotor diameter of mm	-	-	40	-
Spindle air pressure, MPa	-	-	-	0.49
Spindle holder	-	-	-	Orient M1
Spindle, mm	-	-	-	1.08

TABLE II
Structural features of sample knitted fabrics

	Ring	**Compact**	**Rotor**	**Vortex**
Dry weight, g/m2	1.219	1.261	1.383	1.339
Thickness, mm	0.42	0.42	0.47	0.47
Wales, number/10 cm	140	140	170	170
Courses, number/10 cm	120	120	120	120

III. RESULTS & DISCUSSION

A. Yarns

The tenacity parameters of the sample yarns were tested with the USTER TENSORAPID test device. The physical and mechanical properties result of the used yarns is presented in Table III. All test results were evaluated using one-way ANOVA to detect the significant difference between the means of the properties of yarns spun on the four spinning systems.

Comparison Of Mass Variation

Observing the results of yarn irregularity is shown in Figure 4. Generally, the test results show that the compact yarn had the best irregularity, whereas rotor yarn had the worst irregularity results. However, ring-spun yarn shows higher evenness than vortex spun yarn. Also, it can be seen in Figure 4. It is clear that ring yarn shows the total average 9.12% improvement in the U%, whereas the rotor yarn shows the total average of 10.89%. Then, the yarn irregularity deteriorates as the number of fibers in the yarn cross-section decreases. On the other hand, the average difference between the four spinning systems is found to be statistically significant.

ANOVA results for the mass variation property of samples are given in Table 4. The effect of yarn spinning technology on mass variations is considered statistically significant (p=0.000<0.05) at a 95% confidence interval. According to Tukey HSD, multiple comparison test results yarns produced from the ring, compact, rotor, and vortex have statistically similar CVm% values among each other.

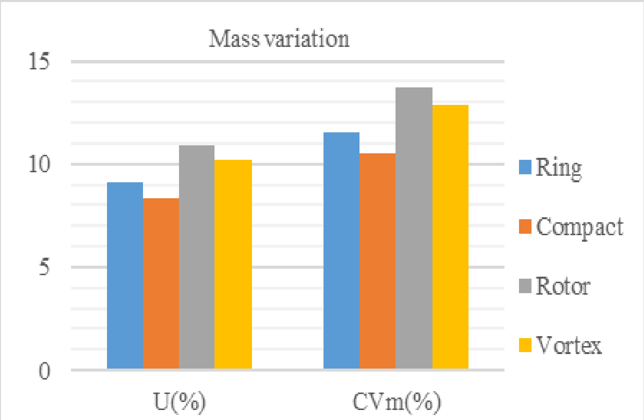

Fig 4: Comparison of mass variation among ring, compact, rotor, and vortex yarn.

TABLE III
The values of yarn physical and tensile properties are measured.

Properties		Ring Spun Yarn	Compact Spun Yarn	Rotor Spun Yarn	Vortex Spun Yarn
Mass variation	U %	9.12	8.35	10.89	10.2
	CVm %	11.57	10.53	13.7	12.88
Imperfection	Thin (-50%/Km)	0.8	0	15.5	5.5
	Thick (+50%/Km)	8	3.5	23.5	26
	Neps (+200%/Km)	12.3	7.3	12.5	10
	Neps (+280 %/Km)	5.8	1.8	0.3	1.5
Hairiness	H	4.39	4.15	4.02	3.79
	Sh	0.95	0.90	1.05	0.88
Strength N		3.71	4.14	2.87	3.21
Elongation %		10.93	11.95	9.44	9.72
Tenacity CN/tex		17.59	19.62	13.59	15.2
Breaking strength s		0.66	0.72	0.57	0.58

Comparison Of Imperfection

The effect of spinning system types on the spun yarn imperfection index is shown in Figure 5. According to Figure 5 it is clear that compact yarn appears to have given the best values for the thin place, whereas rotor yarn gave the worst values around 15. On the other hand, the numbers of thin places in vortex yarn reached around 5, while it was slightly under 1 for ring-spun yarn. However, these thin places probably appear in the form of yarns caused by an irregular (uncontrolled) process, which happened in draft zones of the draft machine.

Figure 5 shows the number of thick places in the four spinning systems yarns. It is clearly evident that thick places values (Figure 5) similar to the thin places value results. Overall, thick places values have increased for all spinning systems. The largest numbers of thick places were found on vortex yarn, reaching 26, whereas it was the least in compact yarn at just under 4. On the other hand, the number of thick places in the rotor was higher than that of ring yarn (about 23.5 and 8 respectively). Also, there had been an increase in the number of thick places in each of the ring and compact yarn. However, no statistically significant difference was found between rotor and vortex yarn test results.

Also, Figure 5 provides information on the number of neps in the yarns. According to Figures 5, it is obvious that both ring and rotor yarns have approximately the same and largest values of neps(+200%)/km nearly 13. On the other hand, the number of neps (+200%)/km was in compact yarn with around 7, which is lower than vortex yarn with 10. Due to the processing of fibers (cleaning, carding, and drawing) tends to produce neps through a stress buildup/sudden release mechanism, which induces buckling along the fiber length.

Looking more closely at Figure 5, there was a decrease in the number of neps (+280%)/km for all the yarns. General, the number of neps (+280%)/km decreased in-ring yarn, reaching closely 6, while rotor yarn recorded the lowest values with slightly below 1, also compact and vortex yarns decreased too, showing around 2 for neps (+280%)/km.

ANOVA results for the number of thin places property of samples are given in Table IV. The effect of yarn spinning technology on the number of thin places is considered to be statistically significant ($p=0.000<0.05$) at a 95% confidence interval. According to Tukey HSD multiple comparison test results, yarns produced from rotor and vortex have a statistically different number of thin places values among each other, besides ring and compact samples have a statistically similar number of thin places results.

ANOVA results for the number of thick places property of samples are given in Table IV. The effect of yarn spinning technology on the number of thick places is found to be statistically significant ($p=0.000<0.05$) at a 95% confidence interval. According to Tukey HSD, multiple comparison test results yarns produced from the ring, compact, rotor, and vortex have a statistically similar number of thick places results. ANOVA results for numbers neps (+200%/km) property of samples are given in Table IV. The effect of yarn spinning technology on numbers neps is found to be insignificant ($p=0.305>0.05$) at a 95% confidence interval.

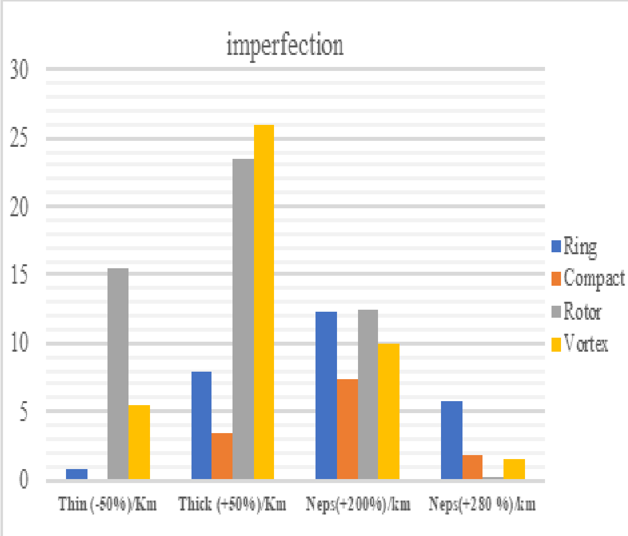

Fig 5: Comparison of IPI among ring, compact, rotor, and vortex yarn

Comparison Of Hairiness

The Uster hairiness (H) result is given in Figure 6. It is clearly evident from Figure 6, that vortex yarn shows the least hairiness with just under 4, whereas compact spun yarn is less hairy than ring-spun yarn. Also, as shown in Figure 6, the vortex yarn has lower hairiness than other system yarns, which is due to a uniform layer of wrapper fibers in the yarn sheath that decreases hairiness along yarn lengths. However, the increased hairiness of ring-spun yarn is attributable to the unregulated passage of edge fibers in roller drafting and friction occurring in the balloon control ring.

ANOVA results for the hairiness property of samples are given in Table IV. The effect of yarn spinning technology on hairiness is found to be statistically significant ($p=0.000<0.05$) at a 95% confidence interval. According to Tukey HSD, multiple comparison test results yarns produced from ring and vortex have statistically different hairiness values among each other. Besides, rotor and compact samples have statistically similar hairiness results, which is clear in Figure 7.

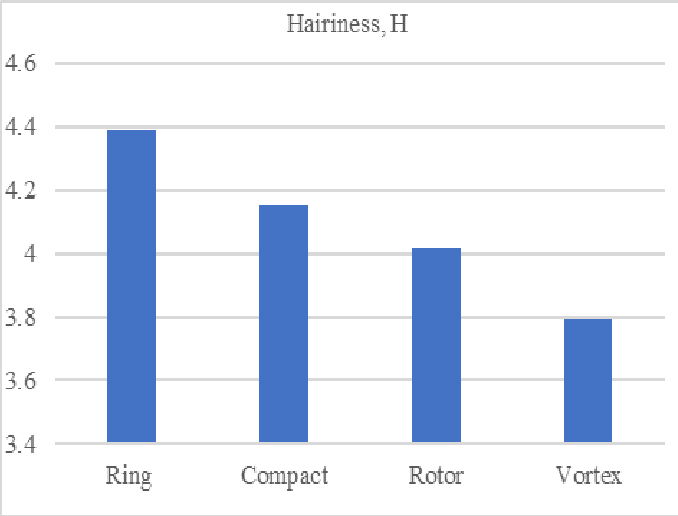

Fig 6: Comparison of hairiness among ring, compact, rotor, and vortex yarn

TABLE IV
ANOVA results of the yarn properties

ANOVA Results							
		Sum of squares	**df**	**Mean square**	**F**	**Sig.**	**Tukey HSD**
Mass variation (CVm %)	Between groups	58.687	3	19.563	134.901	0.000	(ring, compact, rotor, vortex)*
	Within groups	5.220	36	0.145	-	-	
	Total	63.907	39	-	-	-	
Imperfection Thin (-50%/km)	Between groups	1527.969	3	509.323	44.926	0.000	(ring, compact)
	Within groups	408.125	36	11.337	-	-	
	Total	1936.094	39	-	-	-	
Imperfection Thick (+50%/Km)	Between groups	3742.500	3	1247.500	23.120	0.000	(ring, compact, rotor, vortex)*
	Within groups	1942.500	36	53.958	-	-	
	Total	5685	39	-	-	-	
Imperfection Neps(+200%/km)	Between groups	178.750	3	59.583	1.253	0.305	-
	Within groups	1711.250	36	47.535	-	-	
	Total	1890.000	39	-	-	-	
Hairiness (H)	Between groups	1.885	3	0.628	40.913	0.000	(compact, rotor)*
	Within groups	0.553	36	0.15	-	-	
	Total	2.438	39	-	-	-	

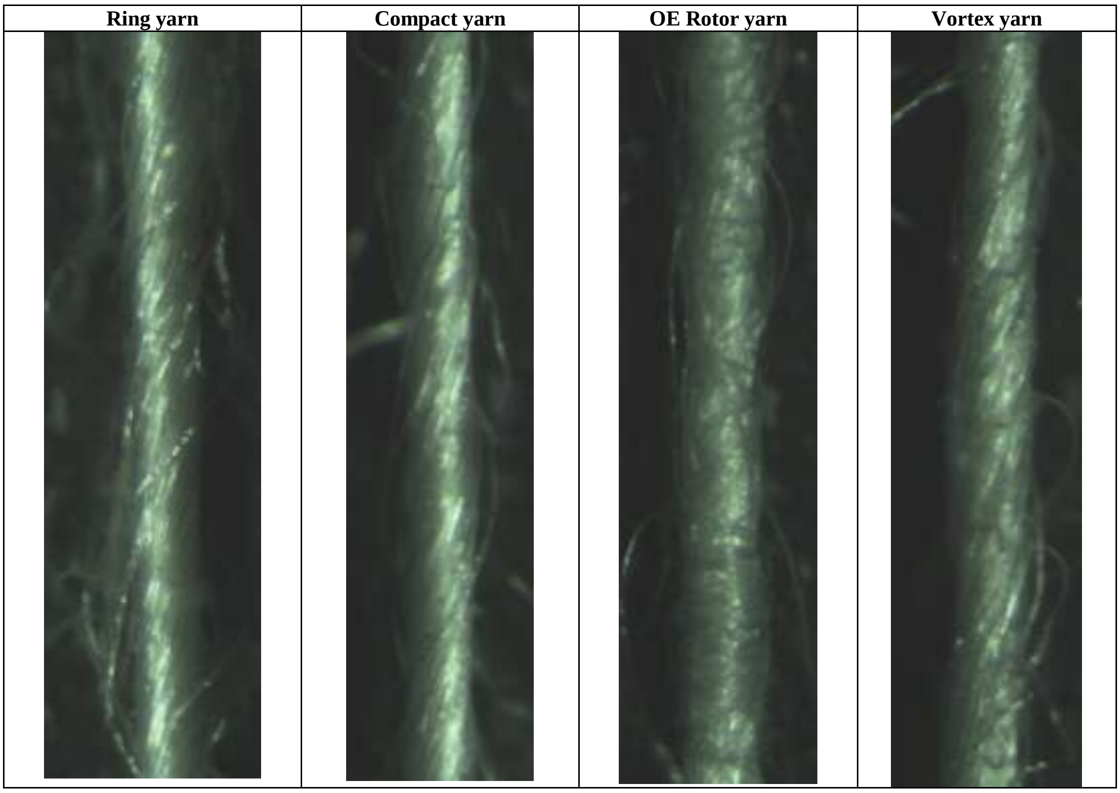

Fig 7: Shots of yarn surfaces spun with different spinning processes (65x)

Comparison Of Strength

The strength test results are shown in Figure 8. According to the Figure 8, it is clear that the strength of compact spun yarn (4.14 N) is higher than the rotor (2.87 N) and ring (3.71 N) spun yarn, whereas the strength of the vortex (3.21) lies between the ring and rotor yarn, so we can say that compact yarn has the best strength compared with the other four systems. However, it is also apparent that the number of twists of ring-spun yarns is greater than the number of twists of rotor spun yarns due to the various methods used for twist delivery to the yarn.

All parameters (number of twist, uster uniformity, and number of irregularities) influence the yarn tensile properties shown in Figure 8. This means that parameters have an effect on the tensile property of the yarns, either over or decrease. Overall, in the case of rotor and vortex yarn, the increase in tenacity due to the greater number of fibers in the yarn cross-section and the higher number of fibers contributes to the yarn and load-bearing composition.

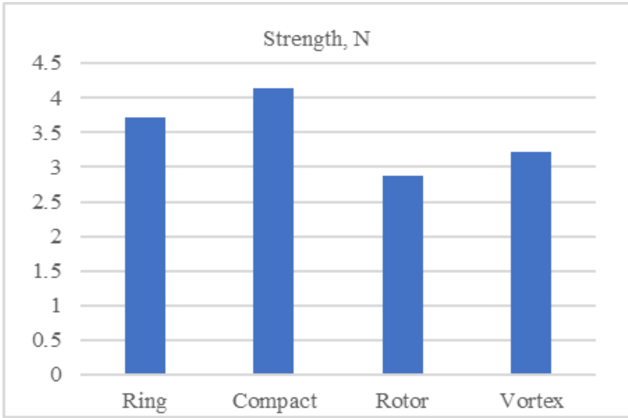

Fig 8: Comparison of Strength among ring, compact, rotor, and vortex yarn

Comparison Of Elongation

Figure 9 provides information on the elongation of the four systems yarns. From Figure 9, it is clearly evident that compact in case of breakage elongation (%), spun yarn is better than ring-spun yarn, whereas elongation at break of vortex spun yarn lies between ring and rotor spun yarn. It is apparent that the trend in yarn elongation is nearly identical to its related trend in tenacity. However, the rotor yarn has the lowest breaking elongation compared to other systems yarns due to the irregular wrapping effect in rotor yarns, which raises premature failure incidence.

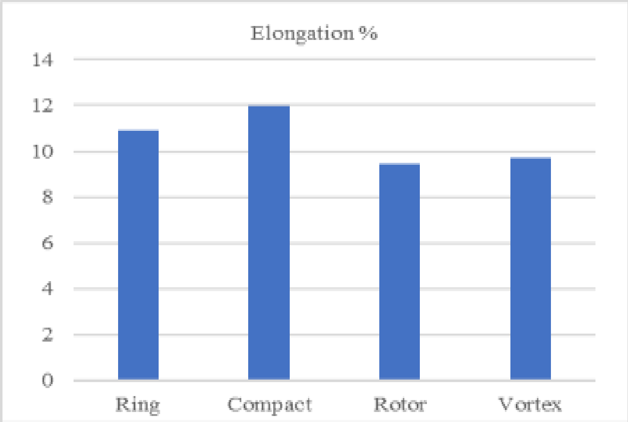

Fig 9: Comparison of elongation among ring, compact, rotor, and vortex yarn

B. Knitted Fabrics
a) Pilling

The pilling tendency of the test samples and their resistance to abrasion is evaluated with the Martindale and the ICI pilling box abrasion tester, respectively.

1) Nu-Martindale Abrasion and Pilling Tester

Martindale Tester was used to find out the pill form of the fabrics. Fabrics were mounted to the Nu-Martindale tester according to EN ISO 12945-2 standard and the face of the same fabric for a specific number of movements. For all the samples, standard 500, 1000, 2000, 5000, and 7000 revolutions were given, and the fabrics were graded for grades there. The fabrics then compared to the standard pilling photographs for calculating pilling grades, and values were given in Table V. According to standard pilling rating standards are 1- Severe formation of pills, 2- Obvious pilling, 3-Moderate pilling, 4-weak pilling, 5-No, or very weak pilling.

Table V below gives information about the results of fabric resistance to the pilling by the Nu-Martindale device. In Table V, it is clear by comparing the compact and the ring fabrics (which have the same stitch density), that the best pilling resistance of fabrics was a compact system. However, ring-spun yarn knitted fabrics have shown higher pilling than the fabrics produced with compact yarns at the same number of revolutions (2000). Ring also reported 4, 3-4, and 3 grades for the number of revolutions 1000, 2000 and 5000 respectively, whereas compact reported 4, 4, and 3-4 grades for the number of revolutions 1000, 2000, and 5000 respectively, due to the ring-spun yarns are hairier than compact spun yarns (see Table Ⅲ), which can require quick exposure to abrading forces from the raised fiber ends. Also, no change in the grades of both ring and compact after the 5000 revolutions.

TABLE V
Pilling resistance of Nu-Martindale

Revolutions	Ring	Compact	Rotor	Vortex
500	4-5	4-5	4-5	5
1000	4	4	4	4-5
2000	3-4	4	4	4
5000	3	3-4	3-4	3-4
7000	3	3-4	3	3-4

On the other hand, the results show in Table V, that as expected, the fabrics made from vortex yarns have better pilling resistance performance compared with the one which is knitted from open-end yarns (which have the same stitch density). The grades of the vortex are around 5 and 3-4, while it is around 4-5 and 3 for the rotor. However, the fabrics which are knitted from open-end yarns have a tendency to pill to a much higher degree than the vortex fabric. This is attributed to the low hairiness value of the vortex yarn compared to the rotor yarn (see Table Ⅲ). In other words, the more hairy the surface of the yarn, the more pill formation on the surface of the fabric is.

2) ICI Pilling Box

Fabrics were mounted to the ICI pilling box by using James Heal Orbitor® test device, according to EN ISO 12945-2 standard. For measuring pilling grades, the same pilling standard photographs of Nu-Martindale testers were used with the same number of revolutions. Pilling values of the fabrics are classified from worse to best as 1-3, 2-3, 3-4, and 4-5.

Table Ⅵ below illustrates the pilling test results of the samples given by using the ICI pilling box device. The results in Table Ⅵ (see Figure 10) show as expected for the same stitch density knitted fabrics (ring and compact) that the pilling resistance of compact fabric was higher compared to ring fabric as like as Nu-Martindale test, due to compact yarns have less hairiness than ring yarns. It can be said that yarn hairiness is effective in fabric pilling performances. Also, the obtained results in Table Ⅵ showed that the pilling resistance of vortex fabric is better than the rotor fabric.

Moreover, for the same number of test revolutions (e.g., 7,000) and the same fabric, the degree of damage in ICI pilling box fabrics was more than the Nu-Martindale test. This may be because of the different experimental conditions between the two tests. Furthermore, the samples of the ICI pilling box test were exposed to greater stress than the Nu-Martindale test, which helps for greater and faster weariness with less resistance to pilling.

In this case, the vortex and rotor fabrics have a good pilling performance compared to the compact and ring fabrics. This is most probably due not only to hairiness but also to stitches density of these fabrics. Test results for the pilling tendency are explained visually in the photographs below (Figure 10).

TABLE VI
Pilling resistance of ICI pilling box

Revolutions	Ring	Compact	Rotor	Vortex
500	4-5	5	5	5
1000	4-5	4-5	4-5	4-5
2000	3-4	4	3-4	4
5000	2-3	3	3	3-4
7000	2	2-3	3	3-4

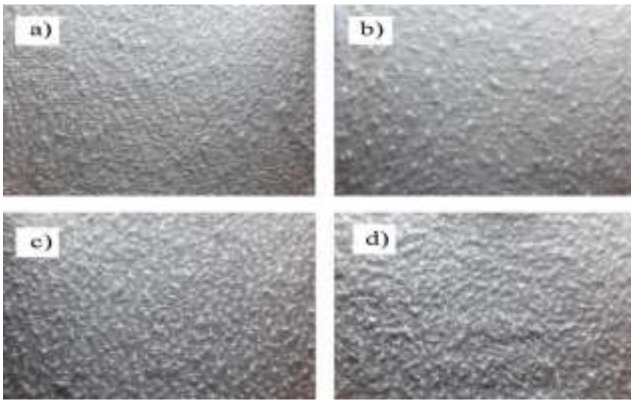

Fig 10: Photos of fabrics after pilling; a) vortex, b) rotor, c) compact, d) ring.

When the values of the images in Figures 10 are evaluated, it is found that the pilling tendencies of fabrics knitted from vortex yarns are lower than those of fabrics knitted from rotor yarns. This situation may be the result of lower hairiness of vortex yarns compared to the rotor yarns, which are given in Table Ⅲ. Besides, it can be seen that compact knitted fabrics have a better appearance than ring knitted fabrics.

C. Bursting Strength

The bursting strength of the fabrics was measured in accordance with the EN ISO 13938-2 standard with James Heal Truburst® bursting strength measurement device. In the case of knitted fabric with the same stitch densities (ring and compact).

According to Figure 11, the bursting strength of the sample knitted fabrics changes between approximately 300 to 365 kPa. (all the results in Figure 11 are the average obtained from the tested samples) and all detailed results of the samples are available in the section ADDS.

The results of the measurements of bursting strength (see Figure 11) show that with high imperfection and lower tenacity, the ring knitted fabric shows low bursting strength than the compact knitted fabric.

The results also show that as expected, rotor fabrics have weaker bursting strength performance compared with vortex fabrics due to the higher tenacity of the vortex yarn compared with the rotor yarn. In this process, as the tenacity values of the yarn increases, the bursting strength increases too.

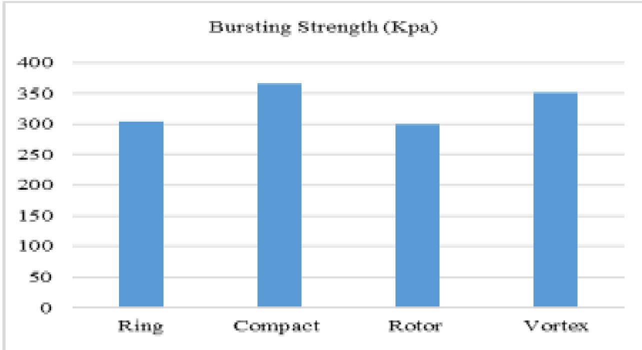

Fig 11: Bursting strength values (kPa) of the fabrics

ANOVA results are given in Table Ⅶ for the bursting strength properties of the samples. The effect on bursting strength of knitted fabric spinning technology is found to be statistically significant (p=0.011<0.05) at a confidence interval of 95 %. Knitted fabrics produced from the ring, compact, rotor, and vortex knitted fabrics have statistically similar bursting strength results, according to Tukey HSD multiple comparison tests.

IV. CONCLUSIONS

Yarns

Spun yarns were produced from 100%viscose fibers at Ne 28/1 (21 Tex) count with four different spinning technologies, namely ring, compact, rotor, and vortex. Regarding the results of the performance test and ANOVA, spinning technology has a major effect on the properties of mass variation, imperfection, hairiness, strength, and elongation. It is seen from the experimental research results that ring and compact spinning systems have a better evenness, strength, and elongation properties and fewer imperfection properties to the yarns. However, yarns spun using the rotor technique has more irregularity than other systems yarns. The imperfection of compact spun yarn is very much lower than rotor spun yarn, but rotor spun yarn contains fewer neps (+280%)/km. IPI of ring yarn lies between compact

TABLE VII
ANOVA results of the bursting strength

ANOVA for bursting strength							
		Sum of squares	**df**	**Mean square**	**F**	**Sig.**	**Tukey HSD**
Bursting strength	Between groups	118080.850	3	3936.283	5.152	0.011	(ring, compact, rotor, vortex)*
	Within groups	12225.320	16	764.082	-	-	
	Total	24034.170	19	-	-	-	

*This mean difference is not significant at the 0.05 level.

And rotor yarn. The vortex spun yarn has the largest number of thick places compared with the others spun yarns. As for the spinning systems, the variation in neps is very small, but the variation is very noticeable for the thick and thin places.

According to Tukey HSD multiple comparison tests, there are two groups of yarns that exhibit similar to the number of thin places results, the first group consists of ring and compact with fewer thin places, and the second group consists of rotor and vortex with more number of thin places. In a 95% confidence interval, the difference between these groups is found to be statistically significant. The yarn sample produced from ring-spun yarns is hairier than that of vortex yarns, with less thin and thick places, but with more neps of 1000 m of yarn. The compact yarn showed better yarn evenness due to the lower U%. The hairiness of compact yarn is also lower than other systems yarn.

Compared to the rotor yarn, the strength of the yarn is significantly lower relative to the other systems produced, and this is attributed to the variation in the structure of the yarns produced by the different spinning techniques. Consequently, compact yarn can be adjudged to have better quality characteristics than the other yarn spinning technology.

Knitted Fabrics

In this thesis, we intended to investigate the effect of plain knitted fabrics made from 100% viscose ring, compact, rotor, and vortex spun yarns with Ne 28/1 (21 tex) count on the pilling performance and bursting strength properties. The results of investigation for pilling performance show that fabrics knitted with compact yarns were found to have better pilling properties than fabrics knitted with ring yarns. However, the pilling performance of knitted fabric made from vortex spun yarns have a higher value compared with rotor knitted fabric. The hairiness of the yarn is the most important property that affects the performance of the knitted fabrics towards the pilling. In this case, an increase in yarn hairiness property reduces knitted fabric abrasion resistance and pilling performance.

On the other side, fabrics knitted with compact yarns had higher bursting strength than knitted fabrics produced with ring yarns. Furthermore, the rotor knitted fabrics have less bursting strength compared with vortex knitted fabrics. Mainly, the difference between the bursting strength results of the knitted fabrics produced depends on the tenacity of yarns.

It can be concluded that to be able to produce knit fabrics whose bursting strength and pilling performance are a high vortex, and compact yarns should be used.

ACKNOWLEDGEMENT

The author thanks the Adana Mensocat factory for allowing to produce the yarns and test them, and also thanks to Türk Tekstil Vakfı Mesleki ve Teknik Anadolu Lisesi for allowing to access to the knitting lab.

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