TEKSTİL VE MÜHENDİS

(Journal of Textiles and Engineer)

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An Investigation of the Effect of Delivery Speed and Nozzle Air Pressure on Viscose Yarn Properties in Vortex Spinning

Vorteks İplik Eğirme İşleminde Üretim Hızı ve Düze Basıncının Viskon İplik Özelliklerine Etkisinin İncelenmesi

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Online Erişime Açıldığı Tarih (Available online): 27 Mart 2020 (27 March 2020)

Bu makaleye atıf yapmak için (To cite this article):

Volkan YALI, Resul AKDOĞANÖZÜ, Yunus Emre KALAYCI, Fatma GÖKTEPE (2020): An Investigation of the Effect of Delivery Speed and Nozzle Air Pressure on Viscose Yarn Properties in Vortex Spinning**,** Tekstil ve Mühendis, 27: 117, 2-11.

For online version of the article: https://doi.org/10.7216/1300759920202711701

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Araştırma Makalesi / Research Article

AN INVESTIGATION OF THE EFFECT OF DELIVERY SPEED AND NOZZLE AIR PRESSURE ON VISCOSE YARN PROPERTIES IN VORTEX SPINNING

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Gönderilme Tarihi / Received: 29.04.2019
Kabul Tarihi / Accepted: 18.12.2019

ABSTRACT: In this study, 100% viscose yarns were spun at different delivery speed and nozzle air pressure values (within a range of 300-450 m/min and 0.46-0.58 MPa, respectively) by using Murata Vortex spinning system (MVS). Then, the effect of these parameters on physical properties of yarns (such as irregularity, hairiness, tensile strength, breaking elongation, yarn density and diameter) was analysed comparing with the results given in literature for various fiber types. The results show that yarn delivery speed and nozzle air pressure have no effect on yarn irregularity, while they affect hairiness, breaking elongation, diameter and density of yarns. On the other hand, an increase in nozzle air pressure has a slight effect on yarn tenacity while yarn delivery speed seems to have no effect in this work.

Keywords: Viscose Fiber, Vortex Spinning, Delivery Speed, Nozzle Air Pressure, Yarn Properties

VORTEKS İPLİK EĞİRME İŞLEMİNDE ÜRETİM HIZI VE DÜZE BASINCININ VİSKON İPLİK ÖZELLİKLERİNE ETKİSİNİN İNCELENMESİ

ÖZET: Bu çalışma kapsamında, iplik eğirme sırasında farklı üretim hızı ve düze basıncı parametreleri kullanılarak (sırasıyla 300-450 m/dk ve 0.46-0.58 MPa arası değerlerde) Murata Vortex Eğirme sisteminde (MVS) %100 viskon iplikler üretilmiştir. Bu üretim parametrelerinin ipliklerin fiziksel özelliklerinin (düzgünsüzlük, tüylülük, mukavemet, % kopma uzama, iplik çapı ve iplik yoğunluğu) sonuçları üzerindeki etkileri incelenmiş ve literatürde çeşitli lif tipleri kullanılarak elde edilen sonuçlarla karşılaştırılması yapılmıştır. Elde edilen sonuçlar, üretim hızı ve hava basıncı değişiminin iplik düzgünsüzlüğünü etkilemediği ancak ipliklerin tüylülüğü, kopma uzaması, çapı ve yoğunluğu gibi özellikleri üzerinde etkisi olduğunu göstermiştir. Öte yandan, hava basıncındaki artışın iplik mukavemeti üzerinde bir miktar etkisi olurken, iplik sevk hızının önemli etkisi gözlenmemiştir.

Anahtar Kelimeler: Viskon Lifi, Vorteks İplik Eğirme, Çıkış Hızı, Düze Basıncı, İplik Özellikleri

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DOI: *10.7216/1300759920202711701, www.tekstilvemuhendis.org.tr*

1. INTRODUCTION

In vortex spinning process, which has 4 rollers and an apron drawing system, fibers are sucked into a spiral opening at the entrance of a jet by the air flow generated following drafting. During spinning, the front parts of the fibers that enter the yarn forming region are twisted by an air flow forming the central fibers while the back ends of the fibers form a wrapping around the central fibers [1]. With the development of the MVS yarn production system which uses a single air jet, tensile strength of yarns was improved by increasing the number of wrapping fibers and wrapping length on untwisted central fibers as well as diminishing the raw material and blending constraints [2].

As this is a relatively new spinning technology, it is still an interest to understand the spinning factors that affect yarn properties. Some of the first attempts regarding the effect of spinning parameters on yarn properties were reported by Tyagi and Sharma [3, 4, 5] as they stated that tensile energy of polyester-cotton MVS yarns increased by a certain value but then decreased as the nozzle air pressure further increased, while it increased with decreasing yarn delivery speed [3]. Similar findings were also reported by their other study stating that decreasing yarn delivery speed and nozzle air pressure improves yarn regularity. They also reported that yarn hairiness reduces with increasing air jet pressure, however at highest jet pressure and with increased delivery speed, it increases [5].

The effects of nozzle air pressure on vortex yarn properties were also studied by producing viscose yarns at 390 m/min delivery speed and four different nozzle air pressure values (i.e. 0.45 MPa, 0.5 MPa, 0.55 MPa, 0.6 MPa) stating that increase of nozzle air pressure causes an increase in yarn tenacity [6].

In another study, yarn hairiness values decreased as the nozzle air pressure increased and lower hairiness values and smaller yarn diameters were obtained at lower delivery speeds with the production parameters of 4 and 5 kgf/cm^2 nozzle pressures and 350 and 400 m/min delivery speeds for 100% cotton MVS yarns [7]. Interestingly, it was stated that nozzle pressure or delivery speed does not have any significant effect on yarn tensile properties or irregularity values.

100% cotton MVS yarn properties were also investigated at a constant delivery speed of 350 m/min but at different nozzle pressures of 4, 5 and 6 kgf/cm^2 reporting that yarn irregularity, tensile strength, breaking elongation values increased while yarn hairiness decreased as the nozzle air pressure increased [8].

Another interesting work was based on a 2D FSI model combined with fiber–wall contact to simulate a single fiber moving in the airflow inside MVS nozzle. Based on the model, motional characteristics of fiber were analysed and the effect of the yarn delivery speed (300 - 350 - 400 m/min) and nozzle pressure (0,4 - 0,5 - 0,6 MPa) on yarn tenacity was discussed. The results indicate that the fibers undergo a false-twisting process first. Then, its trailing end splays out and whirls within the nozzle chamber for several turns to helically wrap and make the spun yarn. It was also reported that the effect of nozzle pressure on MVS yarn tenacity is not obvious, while increased yarn delivery speed leads to a decrease in yarn tenacity [9].

More recently, viscose MVS yarns were produced at different yarn counts using 1,1 mm, 1,2 mm and 1,3 mm nozzle diameters and different yarn delivery speeds of 325 m/min, 350 m/min and 375 m/min [10]. The nozzle air pressure was constant during the spinning of all types of vortex yarns in this study. The researchers reported that as the yarn delivery speed increases, yarn hairiness increases. However, they have observed different tendencies in different yarn counts regarding irregularity while they did not observe a clear trend in tensile strength and breaking elongation. They stated that yarns produced at the lowest delivery speed and with the smallest spindle diameter have the lowest tenacity values. On the other hand, 20 and 25 tex yarns produced with delivery speed of 350 m/min using 1.2 mm spindle diameter have the highest tenacity, whereas the difference between tenacity of yarns (16.5 tex) produced at delivery speeds of 350 m/min and 375 m/min is not statistically significant. In this study, the lowest elongation values were observed at yarn counts of 16.5 and 25 tex when the highest delivery speed was used, whereas the yarns spun at a delivery speed of 350 m/min have the highest elongation values at different yarn counts.

On the other hand, Ortlek and Ulku studied the effect of nozzle air pressure level and delivery speed on 100% cotton vortex yarn structure producing Ne 20, Ne 30 and Ne 40 yarn counts at 4, 5 and 6 kgf/cm^2 nozzle air pressure values and at 300 m/min, 350 m/min, 400 m/min delivery speeds [11]. They reported that yarn evenness increases with increasing yarn delivery speed at first, but when yarn delivery speed increases further from 350 to 400 m/min, yarn evenness deteriorates because of the reduced efficiency of the airflow at high yarn delivery speeds. The results showed that hairiness increases and tenacity decreases with increasing delivery speed, while hairiness decreases but yarn irregularity and tenacity increases with increasing nozzle air pressure. As a result, it was concluded that the choice of yarn count, delivery speed and nozzle air pressure affects significantly the properties of vortex yarns.

In another study, coloured viscose yarns were produced at delivery speeds of 320 m/min, 350 m/min and 380 m/min while nozzle air pressures were 0.45 MPa, 0.5 MPa and 0.55 MPa and yarn counts were Ne 20, Ne 30, Ne 40 [12]. It was stated that the increase of nozzle air pressure causes a decrease in yarn hairiness and yarn diameter while the increase of delivery speed causes an increase in yarn hairiness but a decrease in elongation at break. It was also stated that an increase in nozzle air pressure causes an increase in yarn tenacity at first but followed by a decrease. The results showed that with an increase in nozzle pressure and a decrease in yarn delivery speed, yarn irregularity value decreases.

The effect of nozzle pressure and yarn count on 100% cotton vortex spun yarn properties were also investigated by another work. Different yarn counts (Ne 20, Ne 30 and Ne 40) were produced under 4 kgf/cm^2, 4.5 kgf/cm^2 and 5 kgf/cm^2 nozzle pressures at a yarn delivery speed of 330 m/min. It was stated that the amount of wrapper fibers increases with the increasing nozzle pressure. On the other hand, a decline in the amount of wrapper fibers was observed in coarser yarns. The results showed that the increase of nozzle pressure causes yarn hairiness decrease and growth in tenacity in general [13].

The effect of yarn count on MVS cotton yarn properties was also investigated by producing yarns at different counts (Ne 20, Ne 30 and Ne 44) with 5 kgf/cm^2 nozzle air pressure at 200 m/min yarn delivery speed. It was stated that yarn hairiness values were similar for different yarn counts while higher irregularity values were obtained when yarns get finer [14].

The properties of 100% polyester vortex yarns by using different fibre finenesses (0.9, 1.1, 1.3 and 1.5 dtex) and different delivery speeds (320, 340, 360, 380 and 400 m/min) were also studied at constant nozzle pressure of 0.5 MPa. The results showed that the hairiness level increases with an increase of delivery speed while the tenacity of polyester vortex yarn is influenced neither by fibre fineness nor by the delivery speed. The results also showed that other yarn properties such as irregularity, thin and thick places achieve much better values when finer polyester fibres were used, while the spinning speed does not have any influence on irregularity of vortex yarn for any fibre fineness [15].

The comparison of vortex yarn properties with other spinning methods is also an interest. For example, properties of cotton-Tencel and cotton-Promodal blended yarns spun in different spinning systems such as ring, vortex and compact yarn spinning were investigated as the vortex yarns were produced at 5,5 bar nozzle air pressure and 400 m/min yarn delivery speed. The results showed that vortex yarns have the lowest hairiness and yarn strength values, while there was no statistically significance difference between the neps values produced by different spinning systems. In general, the best irregularity values were obtained by compact spinning system whereas the vortex yarns seemed to have the highest irregularity values. It was also stated that the increase of regenerated cellulosic fibre percentage causes a decrease of unevenness, roughness, diameter and imperfections generally, while it causes an increase in breaking elongation, breaking force and density and cotton-Tencel blended yarns have better mechanical properties than cotton-Promodal yarns [16].

The effect of different spinning systems such as MVS, air jet, siro and ring spinning were also studied by producing 100% viscose Ne 30 yarns. In this work, vortex yarns were produced at 400 m/min yarn delivery speed and 0.55 MPa nozzle air pressure. The average results as 15 cN/tex for tensile strength, about 14% for breaking elongation and 14% for yarn irregularity and 2,61 for hairiness index (H) values were obtained. The results showed that siro yarns have the highest tenacity values, ring yarns have the highest breaking elongation and hairiness values while MVS yarns have the lowest values for those parameters [17].

Similarly, yarn properties produced by different spinning systems such as vortex, ring and compact spinning were investigated by producing cotton yarns. In this work, vortex yarns were produced at 5 kgf/cm^2 nozzle pressure and 350 m/min delivery speed. The results showed that vortex yarns have the lowest tenacity and hairiness values compare to the other yarns. It was stated that wrapping fibers could be the reason for the lowest tenacity and low amount of hairs and consequently low fabric pilling tendency [18].

Properties of vortex yarns were also compared with ring and OE-rotor yarns. The vortex yarns (Ne 30, Ne 40 and Ne 50) were produced at a constant nozzle pressure while delivery speed of 360 m/min was used for Ne 30, 340 m/min was used for Ne 40 and 320 m/min was used for Ne 50. It was stated that low hairiness of vortex yarns was reflected as lower pilling tendency and smoother fabric appearance compare to other yarn types [19].

The effects of fiber type and blend ratio on MVS yarn properties has been an interest as well. For example, 17 different types of yarn samples were produced on MVS 861 type vortex spinning machine at 350 m/min by using 5,5 kgf/cm^2 air pressure revealing that fiber type has a quite significant effect on yarn properties as yarns with viscose and modal fibers have better structural properties compare to the other fibers used in this work such as cotton, polyester and nylon 6.6 [20].

Also, MVS yarns containing different types of fibers such as viscose, polyester and cotton/polyester were produced in a study comparing yarn properties. In vortex yarn spinning, parameters of both nozzle air pressure values and yarn delivery speeds were given in a wide range such as 4-6 bar and 300-500 m/min, respectively. In this study, higher hairiness and tensile strength values were obtained with coarser yarns for all fiber types. It was also stated that fiber type affects the properties of vortex yarns [21].

As vortex yarns spun by viscose fibers were investigated in this work, the available works in literature regarding vortex yarns by viscose fibers were summarised in detail in this part. Recently, Mouckova *et al*. studied the effect of yarn delivery speeds (within a range of 325-375 m/min) vortex yarns spun by viscose fibers, but with consant nozzle air pressure of 0.5 MPa [10]. There are some other works regarding the effect of both yarn delivery speed and nozzle air pressure on vortex yarns spun by viscose fibers, however it is worth noting that the range of yarn delivery speed and nozzle air pressure were relatively in a limited range (320-380 m/min and 0.45-0.55 MPa, respectively) [12]. Different from these, the effect of both yarn delivery speed and nozzle air pressure was studied in this work but at a wider range (300-450 m/min and 0.46-0.58 MPa, respectively) and also their effect on yarn diameter and density was analysed.

2. MATERIAL AND METHOD

In this study, yarns with a nominal count of Ne 28 were spun by 100% viscose staple fibers (fiber staple length was 38 mm; fiber linear density was 1,2 denier) on a Vortex III 870 (Muratec) spinning machine at room temperature of 29° C and 50% relative humidity. The main production parameters were given in Table 1.

Table 1. Main Production Particulars

Sliver Count (Ne)	0,160
Total / Main Draw Ratio	179 / 30
Break Draft Ratio	2,5
Feed / Take up Ratio	0,98 / 1,0001
Nozzle Type	C1
Winding Angle	14°
Distance Between Front Roller and Spindle	40 mm

During yarn production, seven different types of yarns (as P1 and V1 samples symbolize the same yarn type) were spun at different spinning parameters summarised at Table 2.

Table 2. Yarn Production Parameters

Sample Code	Yarn Delivery Speed (m/min)	Nozzle Air Pressure (MPa)
P1	300	0,46
P2		0,49
P3		0,52
P4		0,58

Sample Code	Yarn Delivery Speed (m/min)	Nozzle Air Pressure (MPa)
V1	300	0,46
V2	350	
V3	400	
V4	450	

For each yarn type, five bobbins were produced using the same five spinning heads on MVS III 870 to eliminate any variation in spinning condition. Yarns were tested for their irregularity, hairiness, density and yarn diameter, by Uster Tester 6 with 400 m/min testing speed at 1000 m testing length. Tensile strength and breaking elongation values were obtained on Premier Tensomaxx 7000 with 5000 mm/min testing speed at 500 mm gauge length and under 0,5 cN/tex pretension. During the analysis, the average of 10 different tests was taken. The yarn surface structures were analysed on FEI Quanta Feg 250 scanning electron microscope by taking 5 samples from each yarn type randomly. Before the tests, yarn samples were conditioned at standard atmospheric conditions. One-way analysis of variance (ANOVA) (Tukey B) test was used to analyse the statistical significance of the results.

3. RESULTS AND DISCUSSION

3.1 The Effect of Nozzle Air Pressure and Yarn Delivery Speed on Yarn Irregularity and IPI Values

The test results regarding the effect of air pressure and delivery speed on yarn irregularity were given in Figure 1. When the effect of nozzle air pressure on yarn irregularity was analysed, it has been observed that there is no clear effect. Similarly, One-way ANOVA test results in Table 3 also confirm this result as reported earlier that nozzle air pressure does not have a significant effect on yarn irregularity [7]. However, different from these findings it was also reported that increasing nozzle pressure affects irregularity of viscose yarns [12] and yarn irregularity increased when nozzle air pressure was increased for polyester-cotton blended yarns [5] and cotton yarns [8, 11]. As it can be seen that there are different trends reported by different workers, therefore further studies might be useful to investigate the effect of these parameters in detail.

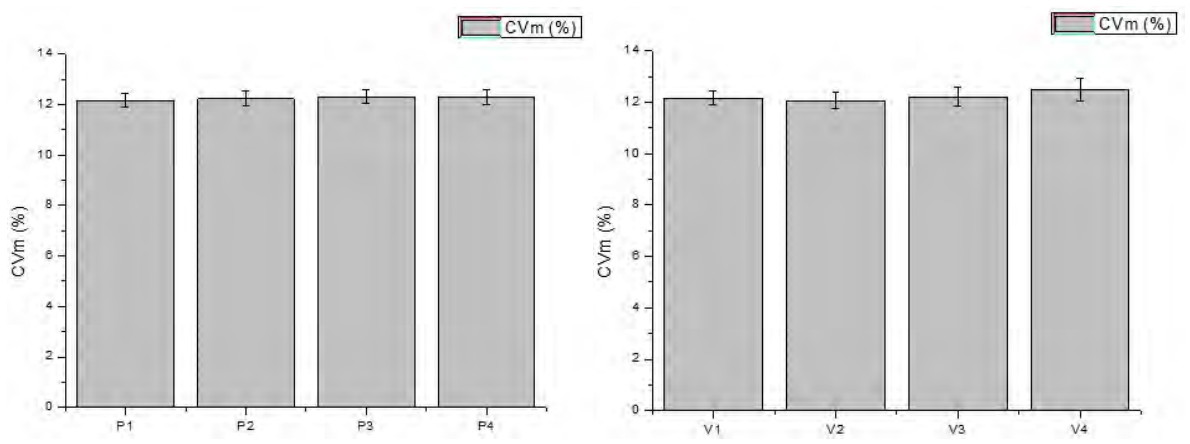

Figure 1. The Effect of Nozzle Air Pressure and Yarn Delivery Speed on Yarn Irregularity Values

Table 3. Tukey B Test for Effect of Nozzle Air Pressure on Yarn Irregularity

Nozzle Air Pressure	N	Subset for alpha = 0.05
		1
0,46 (P1)	10	12,1600
0,49 (P2)	10	12,2160
0,58 (P4)	10	12,2890
0,52 (P3)	10	12,3020

Similarly, there is no clear trend regarding the effect of delivery speed on yarn irregularity when results in Figure 1 were analysed and One-way ANOVA test results in Table 4 also confirm this. It was also reported earlier that yarn delivery speed does not have a significant effect on yarn irregularity [7, 15]. However, the effect of delivery speed might depend on its range as stated that irregularity of the cotton yarn decreases as the yarn delivery speed increases in the range of 300-350 m/min, while it increases in the range of 350-400 m/min [11], therefore it is difficult to indicate a general trend. On the other hand, different from our findings, it was also reported that yarn irregularity increases as delivery speed increases for polyester-cotton blended yarn [5].

The yarns were also analysed in terms of their IPI values such as thick places, thin places and neps, and results can be seen in Figure 2.

Table 4. Tukey B Test for Effect of Yarn Delivery Speed on Yarn Irregularity

Yarn Delivery Speed	N	Subset for alpha = 0.05
		1
350 (V2)	10	12,0620
300 (V1)	10	12,1600
400 (V3)	10	12,1990
450 (V4)	10	12,4940

3.2 The Effect of Nozzle Air Pressure and Yarn Delivery Speed on Yarn Hairiness

The test results regarding yarn hairiness were given in Figure 3 showing that yarn hairiness decreases at higher nozzle air pressure values. One-way ANOVA test results in Table 5 show that only hairiness value of P4 yarn is significantly different from P1 yarn at 5% level. In general, it is known that yarn hairiness decreases as nozzle pressure increases [7, 8, 11, 12, 13].

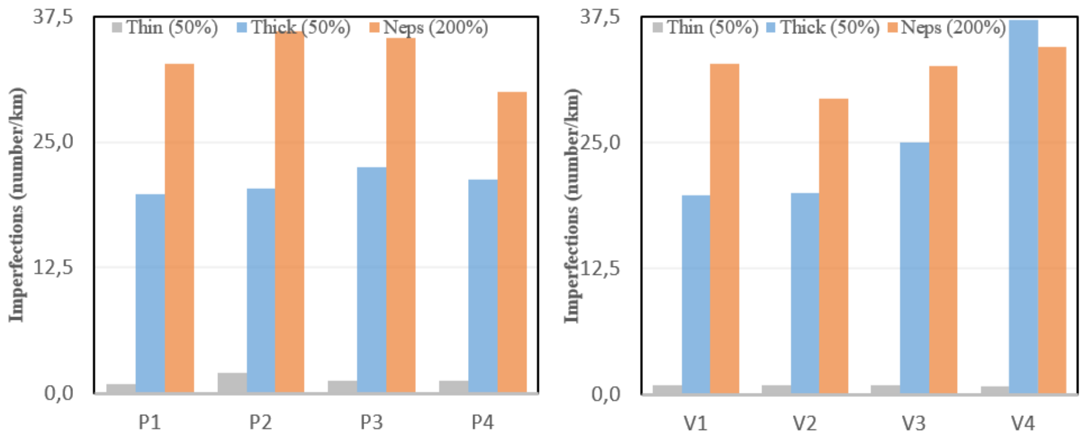

Figure 2. The Effect of Nozzle Air Pressure and Yarn Delivery Speed on IPI Values

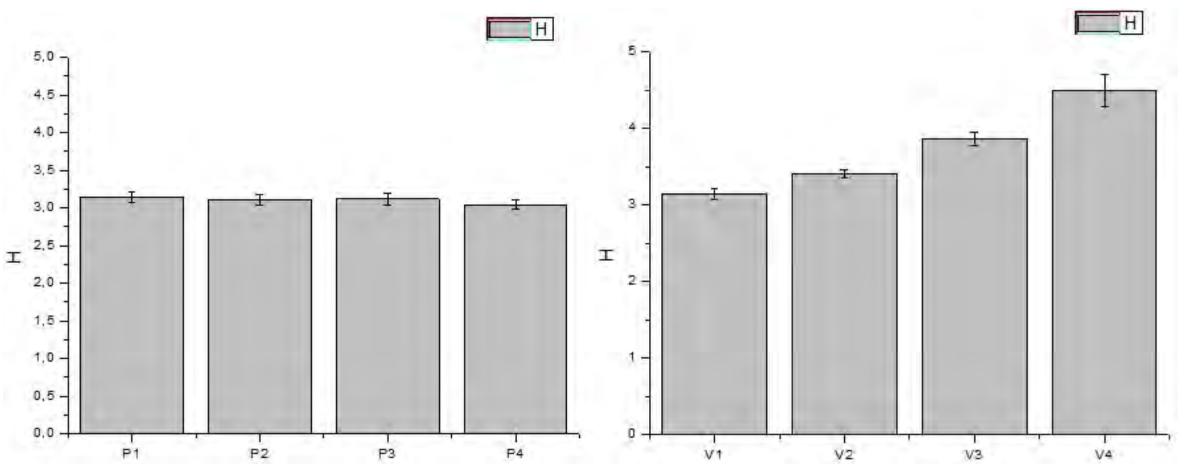

Figure 3. The Effect of Nozzle Air Pressure and Yarn Delivery Speed on Yarn Hairiness Values

Table 5. Tukey B Test for Effect of Nozzle Air Pressure on Yarn Hairiness

Nozzle Air Pressure	N	Subset for alpha = 0.05	
		1	2
0,58 (P4)	10	3,0430	
0,49 (P2)	10	3,1100	3,1100
0,52 (P3)	10	3,1160	3,1160
0,46 (P1)	10		3,1520

On the other hand, the test results show that yarn hairiness increases significantly as yarn delivery speed increases. This can also be clearly seen in the SEM images given in Figure 4. These results are similar to the findings of the previous works [5, 7, 10, 11, 12] as there are fewer fiber wrappings on yarn surface due to reduced time in the spinning zone as the delivery speed increases.

3.3 The Effect of Nozzle Air Pressure and Yarn Delivery Speed on Yarn Tensile Strength and Breaking Elongation

The test results for yarn tenacity given in Figure 5 show that the yarn tensile strength tends to decrease slightly as the nozzle air pressure increases and One-way ANOVA test results in Table 6 show that tenacity of P4 yarn is statistically different from P1 yarn. Different from this finding, there are some other works indicating that there is an increase in tensile strength with an increase in nozzle air pressure [6, 8, 11, 13] while some other studies state that increase in nozzle air pressure has no significant effect on yarn tensile strength [7, 9]. It was also reported that tensile energy increases at first with the increase of nozzle air pressure, but it decreases with further increase in nozzle air pressure [3]. On the other hand, it was indicated that nozzle air pressure does not have a significant effect on tensile strength of Ne 20 yarns but it was significant for Ne 40 yarns commenting that increase in nozzle pressure beyond an optimum level takes out some of the fibres from the fibre strand and form more number of thin places. Because of this reason, nozzle pressure has a negative effect on the medium count vortex yarn and reduces the tenacity level significantly at higher nozzle pressures while the coarser count vortex yarn does not show any significant difference in tenacity with a change in nozzle pressure [22].

When the effect of yarn delivery speed on yarn tensile strength is analysed, the results given in Figure 5 show that yarn delivery speed has no effect on strength of 100% viscose vortex yarns as One-way ANOVA test results in Table 7 also indicate this as well. However, it has been reported that an increase in yarn delivery speed reduces yarn tensile strength of polyester-cotton [3], cotton [11] and viscose yarns [9], but has no effect on Ne 20 polyester/cotton yarns [22] while it was reported that the increase of delivery speed has no significant effect on tensile properties of cotton [7] and polyester yarns [15].

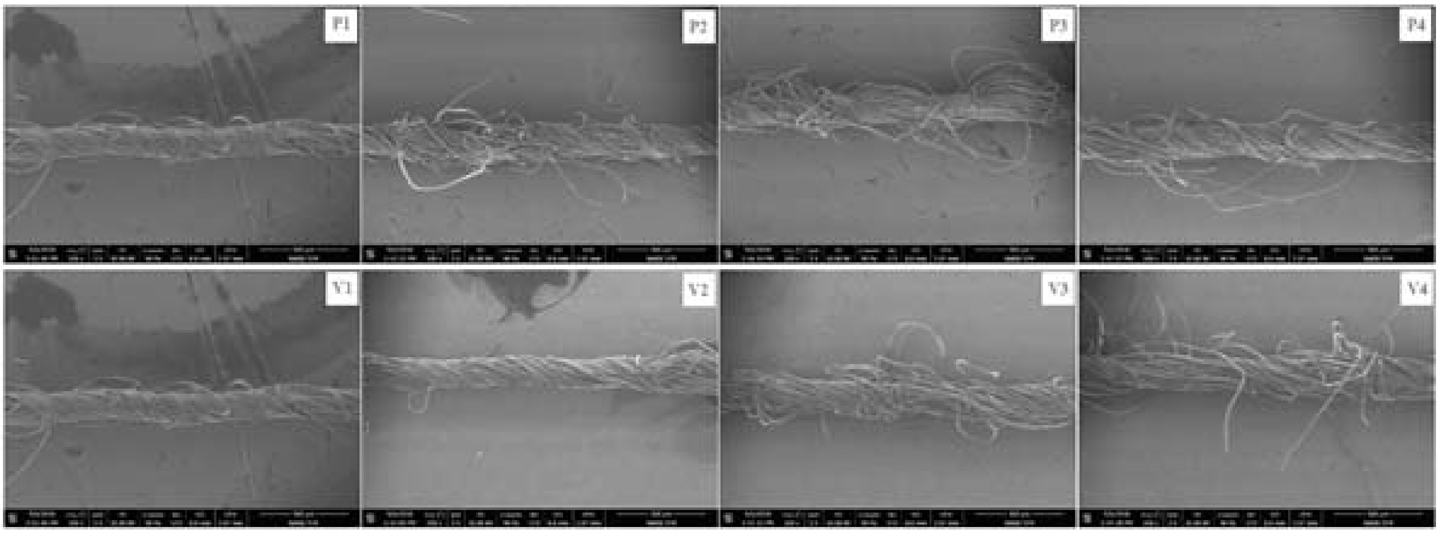

Figure 4. Some Examples of SEM Images of Vortex Yarns Produced

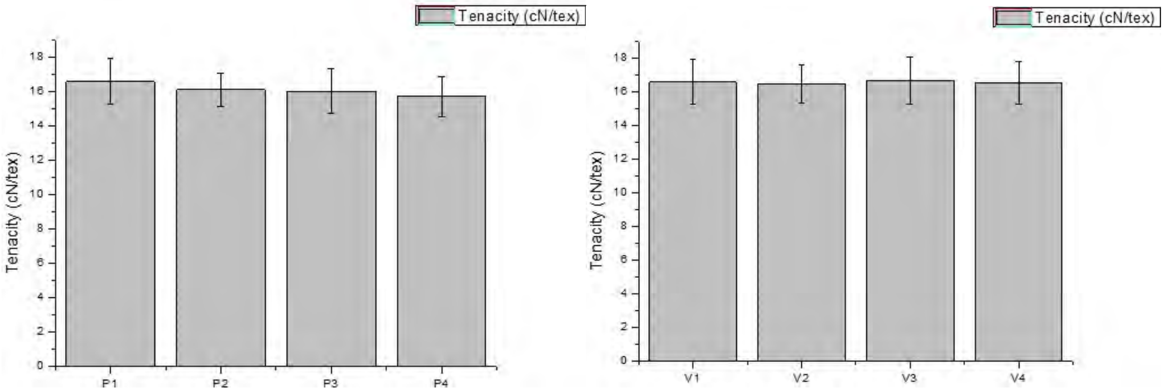

Figure 5. The Effect of Nozzle Air Pressure and Yarn Delivery Speed on Yarn Tensile Strength Values

Table 6. Tukey B Test for Effect of Nozzle Air Pressure on Yarn Tenacity

Nozzle Air Pressure	N	Subset for alpha = 0.05	
		1	2
0,58 (P4)	50	15,7228	
0,52 (P3)	50	16,0252	16,0252
0,49 (P2)	50	16,1060	16,1060
0,46 (P1)	50		16,5794

Table 7. Tukey B Test for Effect of Yarn Delivery Speed on Yarn Tenacity

Yarn Delivery Speed	N	Subset for alpha = 0.05
		1
350 (V2)	50	16,4966
450 (V4)	50	16,5166
300 (V1)	50	16,5794
400 (V3)	50	16,6812

The results in Figure 6 show that an increase in the breaking elongation value is observed between P1 and P2, while after P2, the breaking elongation decreases as air pressure increases. One-way ANOVA test results in Table 8 show that the difference between breaking elongation of P4 and P2 yarns is statistically significant at 5% level. However, there are different findings regarding the effect of nozzle air pressure on breaking elongation as it was stated that yarn breaking elongation increases as nozzle air pressure increases [8] while another study stated that nozzle air pressure has no significant effect onyarn tensile properties such as tenacity and breaking elongation [7].

The test results for the effect of yarn delivery speed on yarn breaking elongation were also given in Figure 6. These results show that yarn breaking elongation values have a tendency to decrease as yarn delivery speed increases differing from an earlier work indicating that increase in delivery speed has no significant effect on breaking elongation [7]. One-way ANOVA test results in Table 9 show that breaking elongation value of V4 yarns is statistically different from the yarns of V1 and V2.

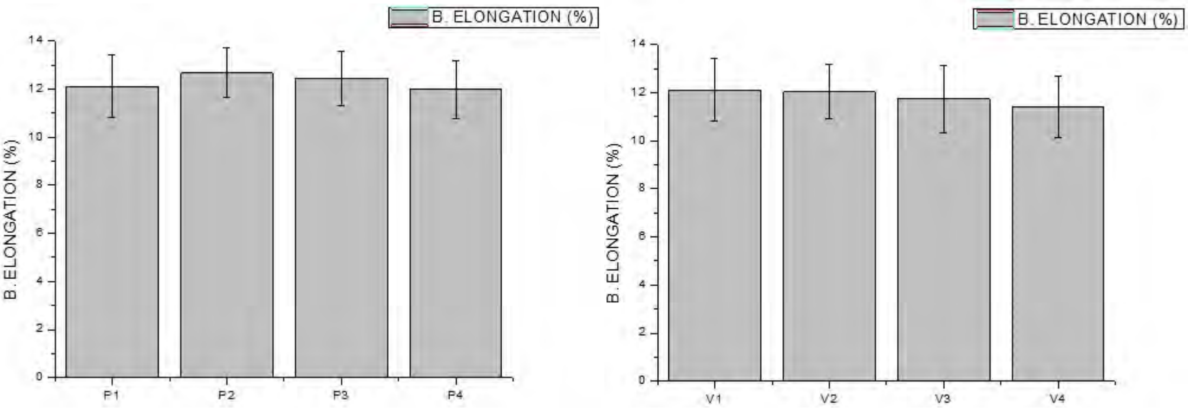

Figure 6. The Effect of Nozzle Air Pressure and Yarn Delivery Speed on Yarn Breaking Elongation Values

Table 8. Tukey B Test for Effect of Nozzle Air Pressure on Yarn Breaking Elongation

Nozzle Air Pressure	N	Subset for alpha = 0.05	
		1	2
0,58 (P4)	50	11,9716	
0,46 (P1)	50	12,1148	12,1148
0,52 (P3)	50	12,4264	12,4264
0,49 (P2)	50		12,6700

Table 9. Tukey B Test for Effect of Yarn Delivery Speed on Yarn Breaking Elongation

Yarn Delivery Speed	N	Subset for alpha = 0.05	
		1	2
450 (V4)	50	11,3900	
400 (V3)	50	11,7344	11,7344
350 (V2)	50		12,0322
300 (V1)	50		12,1148

3.4 The Effect of Nozzle Air Pressure and Yarn Delivery Speed on Yarn Diameter and Yarn Density

The effect of nozzle air pressure and delivery speed on yarn diameter was shown in Figure 7. As can be seen, the nozzle air pressure increase seems to have no effect on yarn diameter, but as the delivery speed increases, yarn diameter increases slightly. The increase in yarn diameter with increasing yarn delivery speed is consistent with the results of a previous study [7], as it was stated that yarn diameter and hairiness values increase due to the less amount of wrapper fibers at higher delivery speeds as might be expected. However, it was reported in another study that increasing nozzle pressure affects 100% viscose yarn diameter but yarn delivery speed does not have a significant effect on yarn diameter [12].

The change in yarn density was also analysed in this work (Figure 8) showing that there is a slight increase in yarn density with an increase in nozzle air pressure, while yarn density decreases as yarn delivery speed increases. One-way ANOVA test results in Table 10 and 11 show that yarn density value of P4 yarn is statistically different from the yarns of P1 and P2. On the other hand, the difference in density of yarns produced with different delivery speeds is statistically significant.

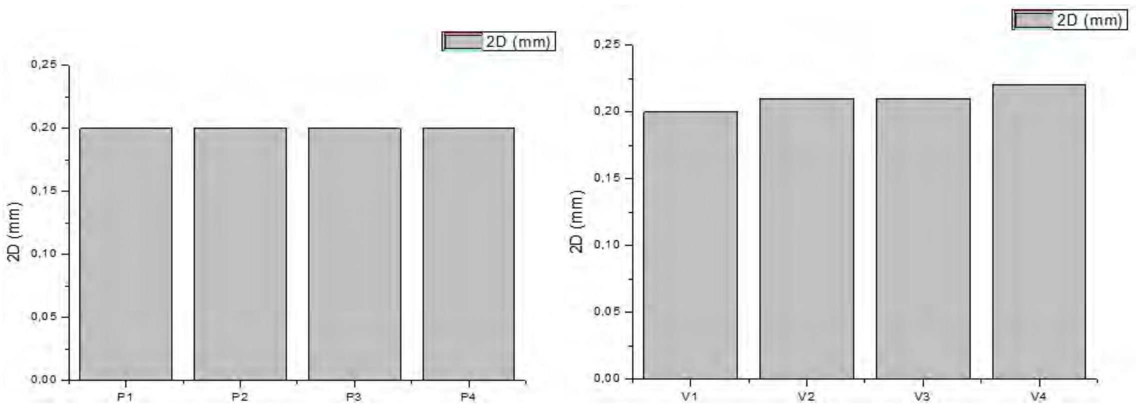

Figure 7. The Effect of Nozzle Air Pressure and Yarn Delivery Speed on Yarn Diameter Values

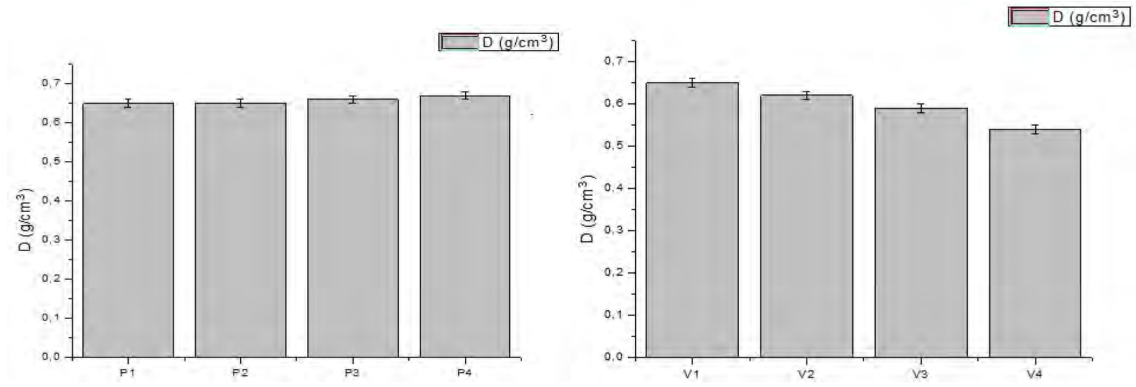

Figure 8. The Effect of Nozzle Air Pressure and Yarn Delivery Speed on Yarn Density Values

Table 10. Tukey B Test for Effect of Nozzle Air Pressure on Yarn Density

Nozzle Air Pressure	N	Subset for alpha = 0.05	
		1	2
0,46 (P1)	10	0,6480	
0,49 (P2)	10	0,6520	
0,52 (P3)	10	0,6570	0,6570
0,58 (P4)	10		0,6660

Table 11. Tukey B Test for Effect of Yarn Delivery Speed on Yarn Density

Yarn Delivery Speed	N	Subset for alpha = 0.05			
		1	2	3	4
450 (V4)	10	0,5440			
400 (V3)	10		0,5880		
350 (V2)	10			0,6170	
300 (V1)	10				0,6480

4. CONCLUSIONS

In this study, 100% viscose MVS yarns were produced at Murata Vortex III 870 machine by using four different yarn delivery speeds and four different nozzle air pressure values within a range of 300-450 m/min and 0.46-0.58 MPa, respectively. Then, yarn physical properties were analysed. For this aim, the yarns were tested for yarn irregularity, imperfection, hairiness, tenacity, breaking elongation, diameter and density properties and yarn surface structure was evaluated in general based on SEM images.

The test results showed that yarn tenacity and hairiness decreased slightly by an increase in nozzle air pressure while spinning. However, the nozzle air pressure did not have a significant effect on yarn irregularity.

As the yarn delivery speed increased, a significant increase in hairiness and decrease in breaking elongation was observed probably due to the effect of less fibre wrapping on yarn surface at higher delivery speeds, while there was no significant change in yarn irregularity and yarn tenacity.

There are many studies in literature about vortex yarn spinning with different fiber types and this work is an attempt to contribute to the results in this field as viscose fibers have been used commonly on MVS system. However further detailed works are needed to analyse the effect of overall spinning parameters during production of viscose vortex yarn properties. Furthermore detailed analysis of fabrics made from these yarns is also needed to understand the effect of production parameters on final product.

Acknowledgements

We would like to thank to Mahmut Kılınç and Barış Ticaret İplik Örgü Boya Baskı A.Ş. for enabling us to use their facilities for yarn production and Garanti İplik San. &Tic. A.Ş. for their help during yarn testing.

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