KSÜ Mühendislik Bilimleri Dergisi, 27(3), 2024
Araştırma Makalesi
KSU J Eng Sci, 27(3), 2024
Research Article

Kahramanmaras Sutcu Imam University
Journal of Engineering Sciences

Geliş Tarihi : 17.08.2023
Kabul Tarihi :04.03.2024
Received Date : 17.08.2023
Accepted Date : 04.03.2024

IMPACT OF VARIOUS TRAVELER WEIGHTS ON THE QUALITY AND PERFORMANCE OF IDENTICAL COUNT YARN PRODUCED FROM DIFFERENT COTTON VARIETIES

FARKLI PAMUK ÇEŞİTLERİNDEN ÜRETİLEN AYNI NUMARALI İPLİKLERİN KALİTE VE PERFORMANSI ÜZERİNDE ÇEŞİTLİ KOPÇA AĞIRLIKLARININ ETKİSİ

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ABSTRACT

In recent years, due to the excessive increase in machine prices, changes in energy policies, the rising cost of fibre, and fluctuations in the prices of spare materials, the goal has been to achieve a high-performance working system without sacrificing quality while reducing production costs. The selection and maintenance of the ring traveler, ring, and bobbin group, which are essential components in the yarn winding process, are crucial in the ring-spinning system for continuous performance. Even small improvements in this area are significant, as they can lead to higher production and increased profits for the enterprise. This study investigates the quality changes and machine performance that may occur by using light and heavy travelers, in addition to the standard traveler, in producing compact ring yarn with a count of Ne 30/1 (20 tex) using 100% domestic cotton. The results indicate a positive effect on yarn quality parameters, especially hairiness, and tenacity, with the best results obtained using ISO 31.5, known as a light traveler. The best result in terms of yarn breaks per 1000 spindles per hour was also achieved with ISO 31.5.

Keywords: Ring spinning, traveler, hairiness, yarn strength

ÖZET

Son yıllarda makine fiyatlarının aşırı artması, enerji politikaları, kullanılacak elyafın fiyat artışı ve yedek malzeme sarfiyatında fiyat dalgalanmalarının yukarı yönde gerçekleşmesinden dolayı, üretimde maliyetin düşürülmesi için kaliteden ödün vermeden performanslı çalışma sistemi hedeflenmektedir. Performanslı çalışmanın devamlı olması için ring iplik eğirme sisteminde kopça, bilezik ve iplik sarım malzemesi olan masura grubunun seçimi ve bakım işlemleri önemlidir. Burada yapılabilecek küçük iyileştirmeler dahi işletmeye üretim ve kar olarak döneceğinden büyük önem arz etmektedir. Bu çalışmada %100 yerli pamuk kullanılarak Ne 30/1 (20 tex) numarada üretilen kompakt ring ipliği üretiminde kullanılan standart kopçanın dışında bir hafif bir de ağır kopça kullanılarak oluşabilecek kalite değişimleri ve makine performansı incelenmiştir. Sonuçta tüm iplik kalite parametrelerinin yapılmış olan bu küçük değişiklikten etkilenmiş olduğu görülmüş olup en iyi sonucun hafif kopça olarak bilinen İSO 31,5'ta elde edildiği tespit edilmiştir. Saatte 1000 iğ başına iplik kopuşu açısından da en iyi sonuç ISO 31.5 ile elde edilmiştir.

Anahtar Kelimeler: Ring iplikçiliği, kopça, tüylülük, iplik mukavemeti

ToCite: ŞAHİN, M., & BABAARSLAN, O., (2024). IMPACT OF VARIOUS TRAVELER WEIGHTS ON THE QUALITY AND PERFORMANCE OF IDENTICAL COUNT YARN PRODUCED FROM DIFFERENT COTTON VARIETIES. *Kahramanmaraş Sütçü İmam Üniversitesi Mühendislik Bilimleri Dergisi*, 27(3), 657-668.

INTRODUCTION

In recent years, the textile sector has been developing rapidly, and the capacity of the spinning sector is increasing. With this large capacity, ring-spinning systems occupy an important place in the sector and require significant attention. Cost is one of the most important issues to be examined in these systems. The most crucial factors affecting the cost of ring-spinning machines are the traveler, ring, and bobbin area, collectively known as the twist trio.

For the traveler, which is a consumable in the twisted triad, using a traveler that is not of optimal weight for the yarn number (Ne) and opting for a heavier traveler can result in improved hairiness values. However, after approximately 75% of the normal usage period of the traveler, production, and quality issues may arise due to surface deterioration. If travelers are used as heavy or light according to the yarn number, hairiness values change accordingly. For yarn counts around Ne 30/1 and finer, hairiness decreases, whereas an increase in hairiness can be observed with higher machine speeds due to increased tension in the yarn run by the ideal traveler. To reduce hairiness, high speeds should be used if a light traveler is employed (Can and Kırtay, 2011).

Using a light traveler and increasing speed optimizes the tension of the yarn on the bobbin, positively affecting production and machine performance. For medium or thicker yarn counts, using light travelers can lead to an increase in ends down during production due to wear on the surface where the traveler contacts the ring, resulting in production loss, decreased machine efficiency, and productivity (Kaya, 2005).

Well-trained technical personnel can mitigate tension and surface wear issues through proper ring centering. Using the ideal weight traveler for Ne 30/1 and thicker yarns results in better quality yarn production and more efficient workflows due to the protection of the traveler coating surface (Erem, 2006).

Travelers used in ring spinning vary according to the type of ring. C-type travelers are used for non-inclined rings (T-flange), while SFB-style travelers are used for inclined rings (orbit rings) (Alaşehirli, 2009). Recently, surface coatings resistant to instantaneous temperature increases (average 300°C) have been applied to prevent wear on the contact surfaces of travelers with rings (Alaşehirli, 2009).

Travelers aim to maximize their change time to enhance ring machine efficiency. This is achieved by producing coating travelers that resist surface temperature-induced wear (Coşkun, 2019; Çetin, 2009). The bracelet, named after the ring spinning diameter, varies according to the yarn count. Small-diameter bracelets are used for fine yarns, and large-diameter bracelets for thick yarns. Proper ring centering, a regular traveler running-in program, and timely traveler changes enable higher traveler speeds and healthier performance. Increasing the contact surface between the traveler and the ring also facilitates higher speeds, necessitating the use of lighter travelers due to increased wear and friction (Uzun, 2007).

The advantages of reducing the ring diameter according to the yarn count to be produced are as follows: a decrease in ring diameter at constant speed leads to reduced energy consumption, and small-diameter collars and short bobbins improve balloon stability due to reduced air resistance. Thus, it is possible to use lightweight travelers at high spindle speeds and small balloon conditions.

However, the smaller diameter of ring spinning can also create some disadvantages. These include an increase in the number of piecings in the yarn package due to the reduced cop volume and a decrease in the efficiency of the ring spinning machine due to frequent doffing.

In ring spinning, the reduction in diameter has led to an increase in production with an increase in spindle speed. The reasons for the increase in production are as follows: improved spindle bearing technology, new arrangements in bracelets and travelers, developments in the materials used for bracelets and travelers, and small-scale bracelet selection.

The most important way to maintain the efficiency of bobbin machines is to ensure compatibility between the ring and the traveler. In bobbin machines, knotting is aimed to be used only during cop changes, thus reducing the number of ends down. High spindle speeds and appropriate quality, obtained according to the limited traveler speed, are only possible with reduced ring diameters (Gemci and Bıçkı, 2003).

To increase machine efficiency, attention should be paid to ensuring that the ring tool changes are made as soon as possible, and the number of ends down per 1000 spindles/hour should be kept at the lowest level. Yarn breaks occur when the ideal spinning triangle is not formed. If the yarn tensions in the spindles are homogeneous and at the perfect level, minimizing thick and thin places faults in the yarns also occurs. When determining the traveler weights, the aim should be to prevent breaks caused by yarn tension and prevent the formation of large balloons. Additionally, to prevent mechanical breaks that occur during doffing in ring machines, the reserve winding (bobbin winding) must be wound smoothly and adequately. In this manner, during tool changing, the yarn from the reserve winding and the actual yarn break are distinguished (Bozkurt, 1993).

Waste of yarn from the reserve during doffing can be clearly understood when yarn residues that have curled at the end of the yarn guides are wrapped. This happens when the yarn only takes a twist after it comes out and eventually breaks due to excessive twists. This problem is primarily related to the initial tension of the thread, which can be eliminated by improving the tension. The problems causing this issue include the speed of yarn output, the machine starting position during ring up and down movement, starting the drafting unit before the spindles, and incorrect traveler selection (Bozkurt, 1993).

Apart from the traveler, the main factors affecting yarn breaks in the machine can be listed as follows: roving evenness, suction, and blowing organs, problems in sleeves and aprons, environmental air currents, values such as maturity, micronaire, and Presley in raw materials, and shooting area cleaning (Usta, 2000).

While analyzing breaks with these six items, the negative situations caused by breaks, which are cost-oriented, can be listed as follows: production stops (reducing efficiency), the number of spindles assigned to the worker, negative effects on efficiency in the coil chamber, problems in weaving and knitting, lower quality, and raw material loss (wick waste).

In general, the yarn frictions caused by yarn breaks can be listed as fiber properties, yarn structural and volumetric properties, and machine-induced process parameters. These include fiber surface roughness, raw material quality values, variation in yarn count, low twist, contamination in the spinning method, hairiness, excessive tension caused by the traveler, moisture, and roughness in the places where the yarn passes (Ayan and Sabır, 2013).

In this study, Ne 30/1 (20 tex) ring compact yarn with three different traveler weights was produced from different kinds of cotton from the Şanlıurfa region: one with the ideal micronaire weight, one lighter than the ideal micronaire weight, and one heavier than the ideal micronaire weight. A T-flange traverse study was conducted to determine the performance related to yarn quality and machine efficiency among the produced yarns.

MATERIAL AND METHOD

Material

The raw materials used in the study were Fiona and Gandia seed-origin cotton from the Şanlıurfa region, and the HVI values of the cotton are provided in Table 1. The fiber samples for obtaining HVI values were taken from 8-10 bales, with an average of 20 g from each bale. Cotton HVI test values were obtained using the Uster HVI M 1000 device. The cotton samples were conditioned in the laboratory for 24 hours at 65±2% relative humidity and 22°C±2 temperature. These humidity and temperature values significantly affect the measurement values of the device. Therefore, laboratory ambient conditions are regularly measured and recorded.

Table 1. HVI Values of Used Cotton

Cotton	Length (mm)	Uniformity index	strength (cN/tex)	Elongation (%)	MIC	SFI	SCI	+b	CG
Urfa Fiona	30.35	84.2	32.4	6.9	4.6	6.4	154	8.4	41-1
Urfa Gandia	31.23	81.1	29.5	5.8	4.9	7.8	129	7.7	51-1

According to Uster statistics, the 1000 spindles/hour end-down evaluation is given in Table 2. The machine's performance can be assessed by examining the number of breaks listed in the table.

Table 2. Evaluation of Yarn Breaks (Bozkurt, 1993).

Breakage of 1000 Spindle/hr-Evaluation	O.E. Rotor	Ring (combed) >Ne40	Ring (combed) <Ne40	Ring (carded)
Very Good	<30	<15	<12	<20
Good	30-70	15-25	12-21	20-30
Mıddle	70-110	25-30	21-28	25-35
Bad	>110	>30	>28	>35

Method

In the experimental study, Ne 30/1 compact combed cotton yarn was produced. The standard traveler weight for Ne 30/1 compact combed yarn is ISO 35.5, which corresponds to 5.0 travelers. However, in this study, ISO 40 (4.0) and ISO 31.5 (6.0) travelers, known as heavy and light travelers respectively, were also used instead of the ideally worked travelers. Traveler weights are expressed in micrograms as the total weight of 1000 travelers determined in production. Factory air conditioning values are set at 30°C temperature and 45% relative humidity.

The type of traveler used is C1 EL UDR type T-flange travelers, and the working time of each traveler is determined as the normal traveler change period, including the time it is attached to the machine and the running-in period (Figure 1).

a) Kops (Kaya, 2005)

b) Ring traveler and yarn (Kaya, 2005)

Figure 1. Compatibility of Spindle, Ring, and Traveler Used in the Study

This period is aimed at an average of 240 hours. The experimental study was conducted on a single 1632 spindle K-45 compact machine, which was determined as a reference. Before starting this study, the twist on the reference machine was set to 720 T/m and the speed to 19,000 rpm, depending on the condition of the traveler.

The following spindle-based studies were applied to all spindles and, therefore, to the entire machine to assess the traveler performance on the reference machine before the experiment. Conditions such as absolute balance control of the ring table, diameter control of the balloon breakers suitable for the ring diameter, control of the traveler blade distance adjustment (3 mm) used to protect the traveler from fiber fly, conformity of the bobbin diameter and length to the ring diameter, control of the ring centering, and control of the yarn guide, pigtail, balloon breaker, and ring in a single center were checked on all machine spindles to ensure ideal air conditioning conditions and prevent fiber fly and air circulation during operation.

The machine data used in the study are given in Table 3 below.

Table 3. Operating Machine Data

Cotton	Gandia and Fiona
Comb Strip Number	5906 Tex (Ne 0,100)
I.Passage Traction Number	5369 Tex (Ne 0,110)
Wadding Weight	78 gram/meter
Combed Ribbon Number	4926 Tex (Ne 0,120)
Combed Waste Rate	18,30 %
Passage II Lane Number	4926 Tex (Ne 0,120)
Roving Ribbon Number	656 tex (Ne 0,90)
Ring Yarn Count	19,68 Tex (Ne 30/1)
Ring Machine Cycle	19000 Rpm
Yarn Twisting	720 Lap/meter
Yarn Clasp Type	C1 EL UDR
Buckle Weights	ISO40, İSO35.5, ISO31.5
Bracelet type	T Flange Orbit
Ring Machine Model	RIETER K45
Number of ring spindles	1632

RESEARCH FINDINGS AND DISCUSSION

In this study, the effect of both heavy and light travelers on yarn quality and machine efficiency was investigated by taking the ideal traveler for Ne 30/1 compact combed yarn as a reference. The device used for yarn quality testing is the USTER® TESTER 5-S400, and the results were obtained by connecting the cops to the device as they arrived in the laboratory environment.

Yarn tests were conducted daily on samples from 10 spindles, which were determined as references on the reference machine, starting from the second day of traveler use and continuing for a total of seven days, including the eighth day. The total number of ends down was recorded for each set daily, aiming to reach a result of 1000 spindles/hour in the total number of breaks. This approach allows for an assessment of the machine's performance.

In the first study, a twist of 720 T/m and a speed of 19,000 rpm was maintained for Ne 30/1 yarn, using an ISO 40 (4.0) traveler for the entire machine. The process began with a 15% reduction in speed and a 6-hour running-in program, with the goal of reaching the machine's normal speed by the end of the 6-hour period to protect the traveler's surface from sudden burns due to yarn tension resulting from the machine speed after fastening.

For the second study, an ISO 35.5 (5.0) C1 EL UDR T-flange traveler was used. After removing the previous ISO 40 travelers, the machine was thoroughly cleaned, and the ISO 35.5 travelers were installed.

The yarn quality values obtained from Fiona and Gandia cotton for the ISO 40 traveler and the 1000 spindle/hour ends down values are given in Table 4 and Table 5.

Table 4. Fiona-Type Yarn Quality Values obtained with ISO 40 Traveler

The working day of the traveler	U%	CVm%	Index	Thin place -%50/km	Thick place +%50/km	Neps +%200/km	Hairiness (H)	1000 spindles/hr ends down values	Rkm
2. Day Av.	8.56	11.76	1.16	0	12.5	27.5	3.15	10	17.1
3. Day Av.	8.64	11.64	1.14	0	15	26	3.2	14	18.2
4. Day Av.	8.95	11.86	1.18	0	18	28	3.18	13	18.6
5. Day Av.	9.25	11.97	1.22	1	18	26	3.42	26	15.76
6. Day Av.	9.42	11.85	1.21	2	24	38	4.26	29	16.2
7. Day Av.	9.89	12.12	1.25	2	25	33	4.16	38	14.35
8. Day Av.	10.12	12.44	1.24	3	28	35.5	4.42	42	15.23
Average	9.26	11.95	1.2	1.14	20.07	30.57	3.68	24.57	16.48

Table 5. Gandia-Type Yarn Quality Values obtained with ISO 40 Traveler

The working day of the traveler	U%	CVm%	Index	Thin place -%50/km	Thick place +%50/km	Neps +%200/km	Hairiness (H)	1000 spindles/hr ends down values	Rkm
2. Day Av.	9.15	11.62	1.18	0	17	34	3.55	25	16.5
3. Day Av.	9.23	11.72	1.19	0	13	39	3.89	19	17.5
4. Day Av.	9.15	11.37	1.12	1	9	45	3.75	17	17.2
5. Day Av.	9.1	11.56	1.21	0	10	16	3.78	20	18.4
6. Day Av.	9.25	11.75	1.21	0	14	19	3.49	25	18.9
7. Day Av.	9.25	11.75	1.25	0	13	25	4.29	37	17.3
8. Day Av.	9.29	11.80	1.27	1	27	32	4.02	39	17.5
Average	9.20	11.65	1.20	0.29	14.71	30.00	3.82	26.00	17.61

In the ISO 40 traveler run, quality deterioration in the Fiona-type cotton became evident from the 6th day, starting with a significant increase in the number of yarn breaks in the machine's operating performance. This traveler run was completed at the end of the 8th day, approximately at the 195th hour. Although the yarn quality values were good on the 2nd, 3rd, 4th, and 5th days of the study, the traveler was removed on the 8th day due to the high surface damage rate caused by the friction of the traveler with the ring and its weight compared to the ISO 35.5 traveler.

In the Ne 30/1 yarn quality values obtained from Gandia-type cotton in the ISO 40 traveler study, ideal quality values were maintained until the end of the 6th day. However, deterioration in yarn and strength values started to occur from the 7th day due to traveler surface abrasion. Additionally, the amount of ends down on the spinning machine started to increase from the 7th day, as seen in Table 5.
The yarn quality values obtained from Fiona and Gandia cotton for the ISO 35.5 traveler and the 1000 spindle/hour ends down values are given in Table 6 and Table 7.

Table 6. Fiona-Type Yarn Quality Values obtained with ISO 35.5 Traveler

The working day of the traveler	U%	CV_m%	Index	Thin place -%50/km	Thick place +%50/km	Neps +%200/km	Hairiness (H)	1000 spindles/hr ends down values	Rkm
2. Day Av.	8.95	11.32	1.18	0	17.5	27.5	3.65	16	18.1
3. Day Av.	9.08	11.44	1.19	0	11.5	23	3.62	15	17.24
4. Day Av.	9.01	11.75	1.13	0	15.5	24	3.44	14	17.9
5. Day Av.	9,12	11.59	1.14	0	14	28.5	3.75	25	17.62
6. Day Av.	9.15	11.85	1.21	1	18	38	3.9	26	17.5
7. Day Av.	9.18	11,75	1.19	0	19	33.5	4.02	29	17.8
8. Day Av.	9.21	11.92	1.21	1	21	35.5	3.98	29	17.4
Average	9.1	11.66	1.18	0.29	16.64	30	3.77	22	17.65

Table 7. Gandia-Type Yarn Quality Values obtained with ISO 35.5 Traveler

The working day of the traveler	U%	CV_m%	Index	Thin place -%50/km	Thick place +%50/km	Neps %200/km	Hairiness (H)	1000 spindles/hr ends down values	Rkm
2. Day Av.	8.78	11.06	1.15	1	12	29.5	3.55	11	16.57
3. Day Av.	8.95	11.19	1.19	0	9	27	3.48	9	15.5
4. Day Av.	9.11	12.41	1.21	1	21	33	3.87	7	19.7
5. Day Av.	9.18	11.58	1.2	0	18	24	3.71	14	18.2
6. Day Av.	9.25	11.35	1.2	1	18	29	3.91	19	17.3
7. Day Av.	9.35	11.84	1.22	0	21.5	30	3.95	16	16.2
8. Day Av.	9.40	11.66	1,2	1	18.5	41	4.2	51	16.8
Average	9.19	11.58	1.20	0.57	16.86	30.50	3.81	18.14	17.18

The ring control of the part in contact with the surface was carried out with 5.0 travelers after approximately 230-240 hours for both cotton types. It was determined that some traveler surfaces burned, some burned dimly, and some showed no problems. Here, burning can be identified by whitening in the area where the traveler comes into contact with the ring. This burning is caused by the temperature at the friction point of the ring-traveler pair rising above 300°C. It is also observed that there is a smooth variation in yarn strength, with a slight decrease in strength towards the traveler change date.

After the ISO 35.5 travelers were removed, the machine underwent a detailed cleaning process. Then, ISO 31.5 (6.0) travelers were attached to the machine, and Ne 30/1 yarn quality values obtained from different cotton types were measured by applying the same lapping program. The yarn master quality values obtained from the ISO 31.5 travelers and the values showing the number of ends down per 1000 spindle/hour are given in Table 8 and Table 9.

Table 8. Fiona-Type Yarn Quality Values obtained with ISO 31.5 Traveler

The working day of the traveler	U%	CVm%	Index	Thin place -%50/km	Thick place +%50/km	Neps +%200/km	Hairiness (H)	1000 spindles/hr ends down values	Rkm
2. Day Av.	8.97	11.31	1.16	0	12.5	40	3.45	14	16.65
3. Day Av.	9.03	11.4	1.17	0	15	22.5	3.38	18	17.9
4. Day Av.	8.83	11.23	1.15	0	15	30	3.61	16	17.54
5. Day Av.	9.17	11.61	1.19	0	32.5	40	3.49	17	18.9
6. Day Av.	8.93	11.27	1.15	2.5	10	17.5	3.69	17	17.48
7. Day Av.	9.47	11.97	1.23	0	15	12.5	3.65	24	17.68
8. Day Av.	9.41	11.93	1.22	0	35	35	3.8	28	16.42
Average	9.12	11.53	1.18	0.36	19.29	28.21	3.58	19.14	17.51

Table 9. Gandia-Type Yarn Quality Values obtained with ISO 31.5 Traveler

The working day of the traveler	U%	CVm%	Index	Thin place -%50/km	Thick place +%50/km	Neps +%200/km	Hairiness (H)	1000 spindles/hr ends down values	Rkm
2. Day Av.	8.95	11.19	1.19	0	13.5	38.0	3.65	16	17.00
3. Day Av.	9.16	11.45	1.15	0	15.0	31.0	3.75	17	16.80
4. Day Av.	9.25	11.56	1.18	0	12.0	29.0	3.71	7	17.45
5. Day Av.	8.90	11.13	1.19	0	11.0	42.0	3.82	22	17.25
6. Day Av.	9.15	11.44	1.20	0	16.5	32.0	3.69	19	18.00
7. Day Av.	9.10	11.38	1.19	0	25.0	29.0	3.71	15	17.35
8. Day Av.	9.25	11.56	1.17	0	38.0	45.0	3.80	20	17.01
Average	9.11	11.39	1.18	0.00	18.71	35.14	3.73	16.57	17.27

The ISO 31.5 traveler differs from the others in that the speed was increased to 19,800 rpm to reduce yarn breaks at the start of the doffing due to its lighter weight and to minimize balloon-induced breakages caused by maximum balloon diameter. The starting position of the traveler on the bobbin was set 5 mm higher on the ring rail.

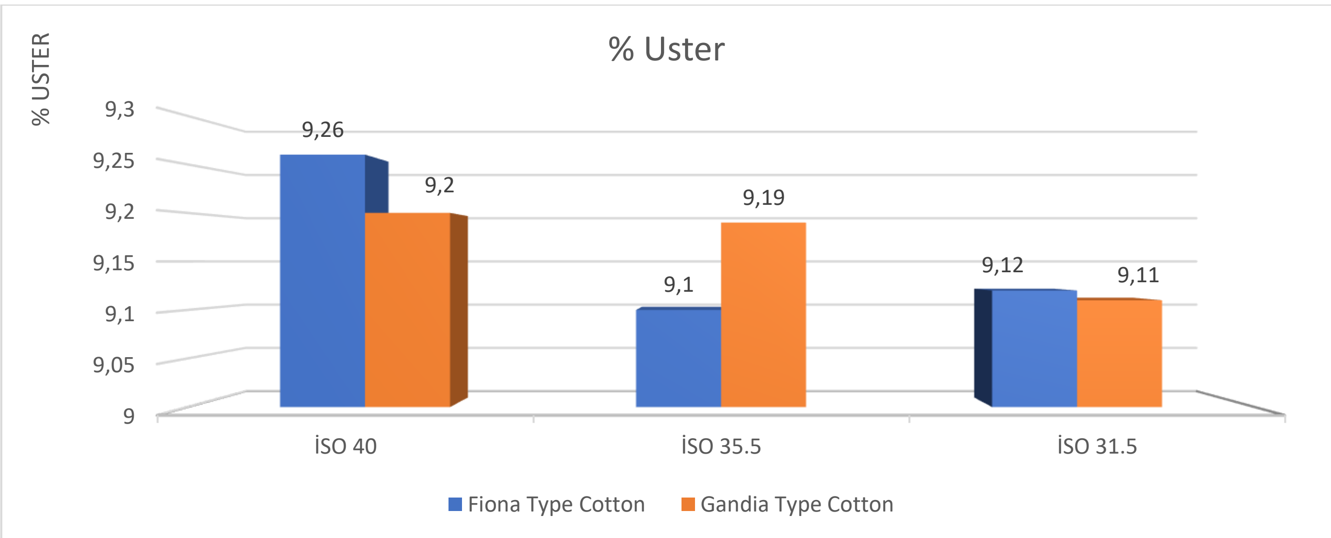

Figure 2. Uster Values of Travelers

The increase in speed was directly attributed to the lighter weight of the ISO 31.5 traveler and its impact on reducing balloon-induced yarn breakages at the traveler-ring contact surface. However, it was observed that better results were achieved in terms of quality and production. Importantly, there were no negative changes in yarn hairiness and Rkm values observed in both types of cotton compared to other travelers.

Figure 2 presents a comparison of Uster values from three different studies conducted on various types of cotton.

In both cotton types, the best result was obtained with ISO 31.5 despite the high speed. It is also observed that similar values are obtained even with the ISO 35.5 traveler.

Figure 3 presents the comparison of CVm% values for three different travelers on two different types of cotton.

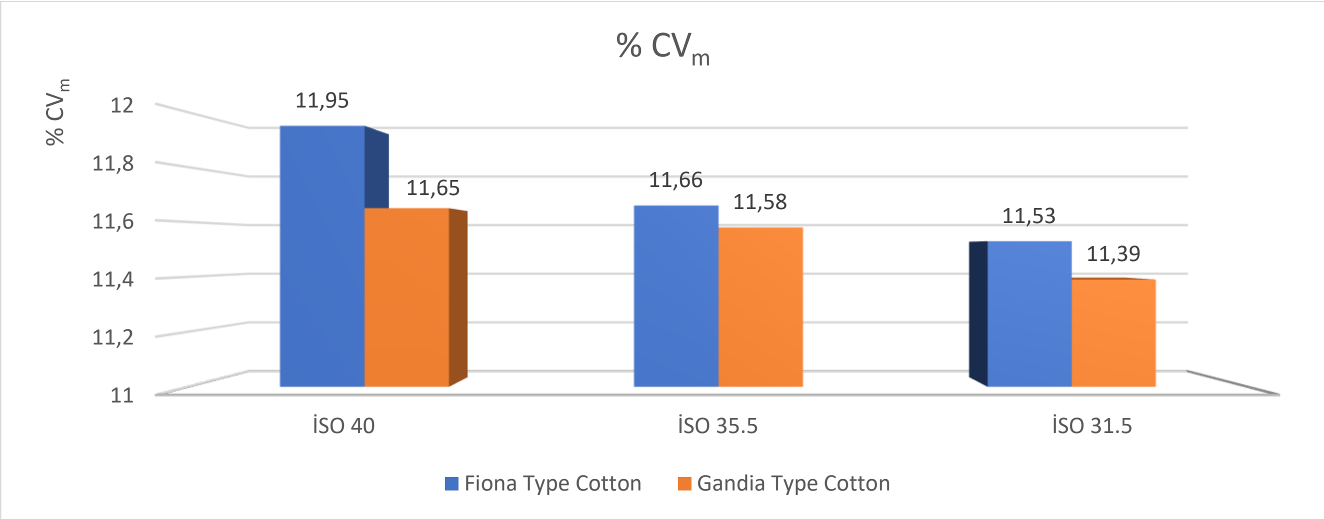

Figure 3. CVm% Values of Travelers

In Figure 3, it was determined that the best results were obtained with the ISO 31.5 traveler despite the high speed in both types of cotton. Additionally, very similar quality values were obtained with the ISO 35.5 traveler.

Figure 4 presents the comparison of index values from three different studies conducted on different types of cotton.

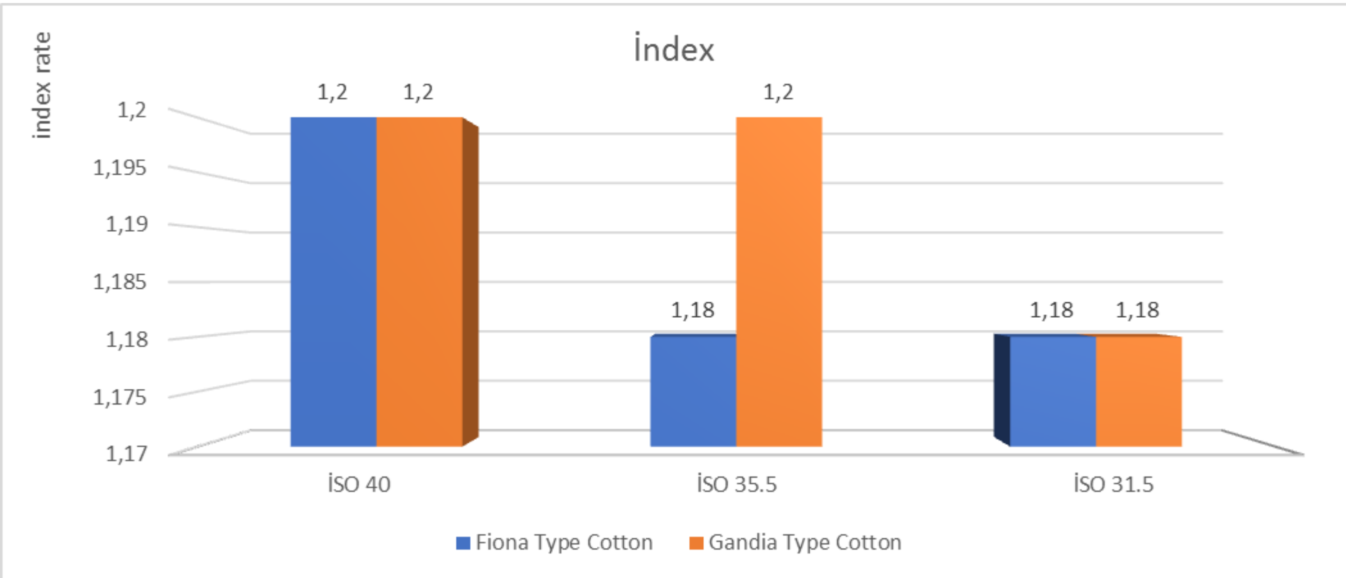

Figure 4. Index Values of Travelers

One of the most important metrics that provides insight into Uster quality values is the index, and according to the results obtained, all index values are very close to each other.

Figure 5 presents the comparison of hairiness values from three different studies conducted on two different types of cotton.

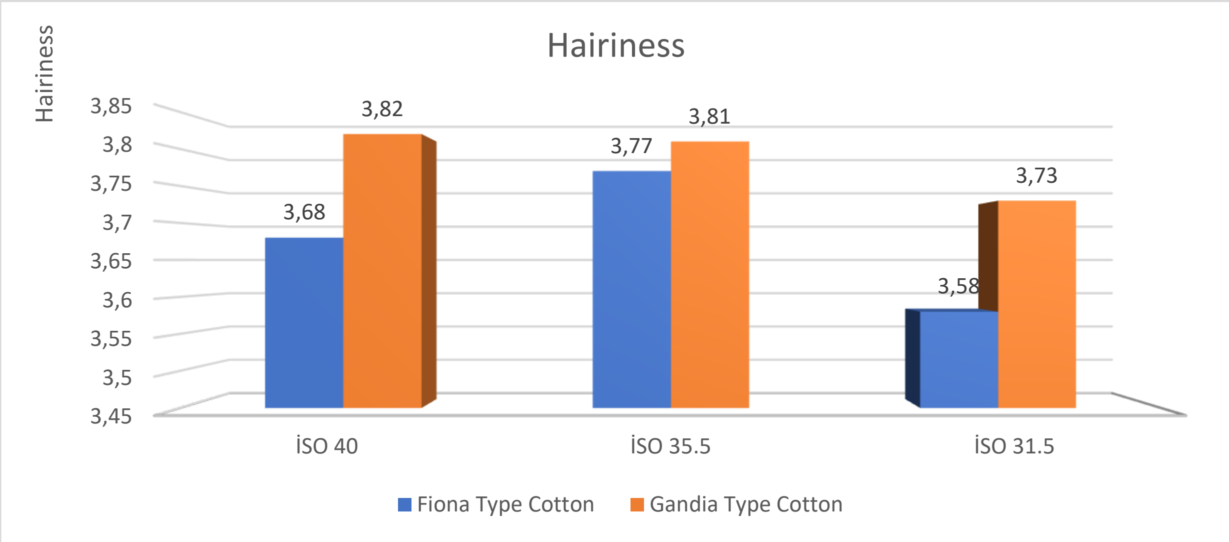

Figure 5. Hairiness (H) Values of Travelers

In general, one of the most crucial factors affected by the traveler in the ring-spinning system is the yarn hairiness value. According to these experimental results, the best result was obtained with the ISO 31.5 traveler, despite the high speed.

The reasons for the increase in yarn hairiness values include airflow at high speeds, increased airflow during the process, various forces exerted by the traveler from variable directions of the yarn winding machine, and fibers escaping from the yarn structure due to increased centrifugal force. Therefore, the light traveler with minimal friction during average working time tends to produce less hairiness (Balcı Kılıç, 2010).

Another critical factor influencing yarn hairiness is the twist level; hairiness tends to be higher in low-twist yarns and lower in high-twist yarns, whether single-ply or multi-ply (Şahin and Babaarslan, 2022).
The superior hairiness and quality values observed with heavy travelers are valid for the initial 4-5 days before friction and tension cause the traveler to burn, as indicated in all tables. However, consistent observations for days 6-9 are not possible, as shown in Figure 5.

Yarn strength is another crucial parameter influenced significantly by hairiness, impacting yarn efficiency in subsequent stages. Figure 6 illustrates the comparison of yarn strength values across different traveler weights obtained from various types of cotton.

In the study, it was concluded that yarn tension reduces hairiness, and yarn count and twist do not significantly affect yarn hairiness, strength, or elongation within the study's conditions. Increasing traveler weight in the ring-spinning system positively impacts defect numbers and hairiness values in combed yarns, as well as hairiness and breakage force values in carded yarns, provided the traveler surface does not burn out.

The shape, weight, and type of the traveler significantly influence hairiness. Generally, hairiness decreases as traveler weight increases. Additionally, yarn tension and twist homogeneity improve with heavier travelers, resulting in smoother fiber placement and reduced hairiness (Örtlek and Babaarslan, 2003).

Moreover, examination of Tables 4-9 reveals no significant changes in nep count or thick place numbers with varying traveler weights. This finding is consistent with Tanır's study (2007), which also emphasized hairiness as a prominent quality indicator, corroborated by Tables 4-9.

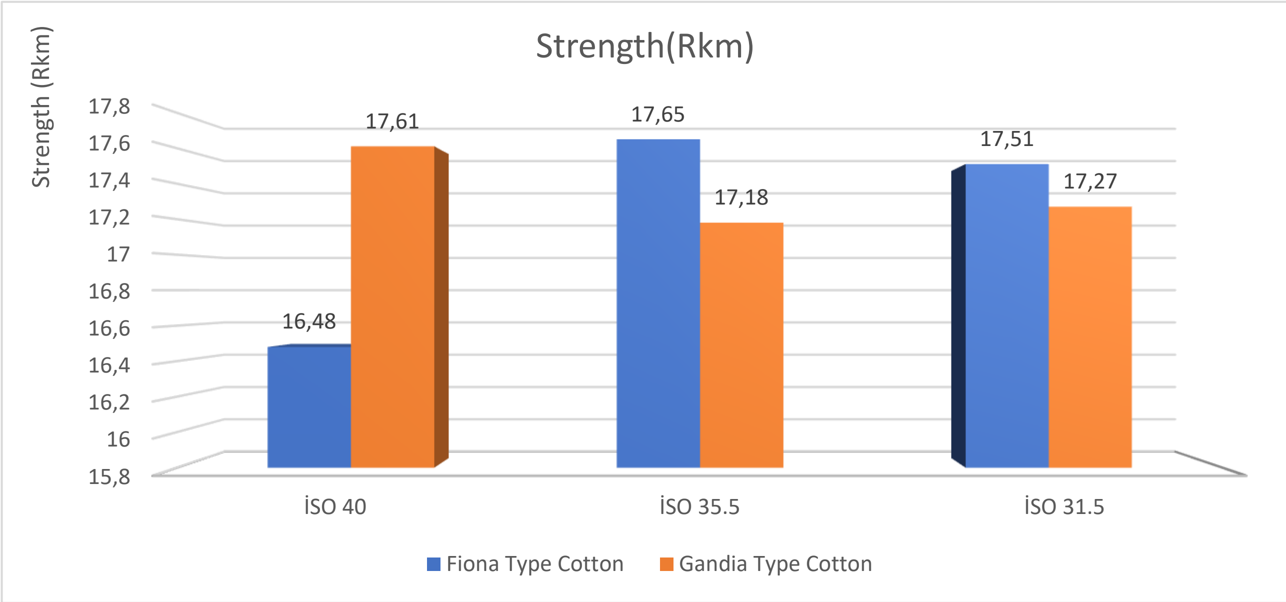

Figure 6. Strength (Rkm) Values of Travelers

A critical aspect for evaluating machine efficiency, a primary focus of this study, is the number of breaks occurring during experimental runs across all days. This metric provides insights into machine productivity and effectiveness. As depicted in Figure 6, the 1000 spindle/hour ends down rate achieved with the ISO 35.5 traveler, considered ideal, outperforms heavy travelers but falls short of light travelers. This discrepancy arises because heavier travelers, while reducing some break causes, experience shorter lifespans due to higher tension, resulting in increased yarn breaks.

According to our experimental findings, the lowest number of breaks occurred with light travelers. This outcome can be attributed to reduced contact between the traveler and ring surface at high speeds, combined with a set position starting 5mm above during tool head changes, effectively lowering the 1000 spindles/hour ends down rate throughout a set. This strategy could potentially optimize production efficiency, especially if complemented by increased machine speed with light travelers, as illustrated in Figure 7.

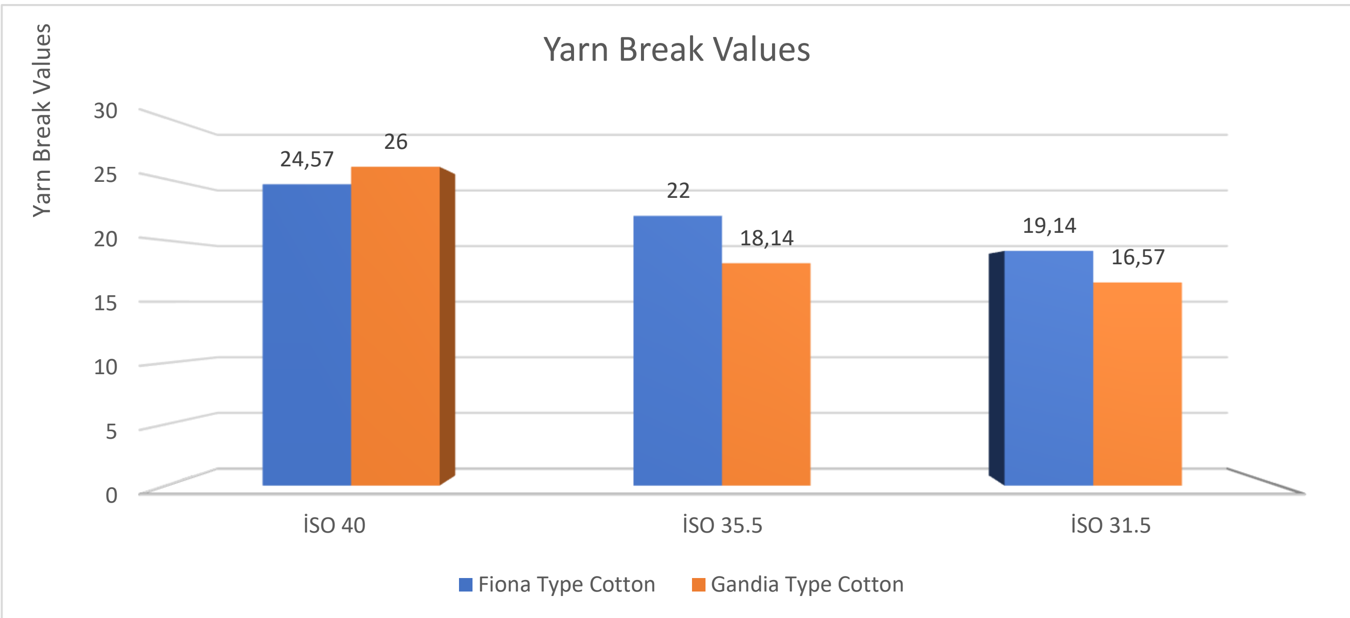

Figure 7. Breakage Values of Travelers at 1000 Spindle/Hour

CONCLUSION

It has been observed that yarn unevenness, which refers to variations in yarn weight per unit length, increases with spindle speed when using the same traveler. This is primarily due to fibers experiencing high tension and inadequate control, resulting in short fibers entering the drafting zone and an increased presence of floating fibers.

Increased unevenness can also result from angular variations in the spinning triangle, exacerbated by higher speeds with either heavier or ideal travelers. As demonstrated in the study, while Uster values are closely comparable for ISO 35.5 and ISO 31.5 travelers, the ISO 31.5 traveler, being lighter, has shown superior results in terms of reduced hairiness and fewer ends down per 1000 spindles/hour, thereby enhancing efficiency and cutting costs.

Issues such as thin and thick places can arise from drafting zone problems in ring spinning machines, potentially affecting yarn quality. Neps, primarily caused during combing, and surface burning due to heavy travelers can further complicate these issues. It's crucial to consider strength values impacted by hairiness, as they correlate with traveler performance.

Consequently, in the machine using the ISO 31.5 traveler, significant ballooning occurs initially due to the traveler's lightweight. This can lead to increased tool head breaks. Higher breakage rates not only increase labor requirements but also raise raw material wastage. Therefore, optimizing ballooning by initiating the tool position 5 mm higher and increasing machine speed by 5-10% can effectively mitigate breakouts and enhance overall operational efficiency compared to other setups.

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