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Issue Article

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RESEARCH ON THE EFFECT OF THE NEW TRUNCATED CONE-SHAPED ROVING GUIDE PLACED ON THE BREAK DRAFT ZONE ON YARN QUALITY PARAMETERS IN A RING-SPINNING MACHINE

***Abstract**: In this article, a new truncated cone-shaped roving guide was installed in the break draft zone of the ring spinning machine, yarns were spun for the sample, and their quality parameters were compared based on the standards. In the research, the same cotton and roving of the same linear density were used in the same technological and kinematic indicators. The yarns obtained for the sample were compared with the yarns obtained on a conventional ring-spinning machine. According to the results of the comparison, it was found that the yarn samples obtained by the new method had higher quality indicators.*

***Key words**: ring spinning machine, truncated cone-shaped roving guide, tension, yarn quality, drafting system, rollers.*

***Language**: English*

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Introduction

Modernization and fast technology only in the field of ring spinning, when the yarn is formed, the process of winding into a tube remains the same until now. In addition, the ring-spinning machine is still dominant over other spinning machines. Manufacturers of modern ring spinning frames have improved the construction of various working elements with optimal spinning geometry, the tube length is 180 mm, the ring diameter is 36 mm, and the number of spindle rotations is up to 25,000 min-1. The functions of the ring-spinning machines are already automated. The high degree of connection between technological processes of spinning and winding, even winding and twisting, was achieved with the help of computer automation and control elements. In addition to traditional functions, speed, delivery speed, productivity, twisting, traction, machine efficiency, computer-aided systems, control of spinning conditions (shape of yarns in the tube, structure of the ring path, automatic removal and adjustment of full skein yarns) makes and allows to optimize, it will be possible to clean and lubricate the main parts of the empty machine [1, 2, 3]. Improving the construction of various working elements of the ring spinning machine, the structure of the optimized spinning process, and the continuous shape of the fibres allows to increase in the productivity of the machine, the quality of the yarn is improved, and at the same time, the flexibility of the process improves the profitability. All these were done to optimize and improve the ring-spinning frame but did not allow us to reduce the spinning triangle that could be detected. One of the most difficult and weakest problems in the traditional ring-spinning machine is the large twist triangle. This leads to more wastage of fibre and fewer opportunities to use the strength of fibres in yarns. The appearance of the spun thread is mainly evaluated by the degree of hairiness.

Researches in the field of ring spinning show that today, the drafting system of the ring spinning machine consists of three cylinders and three rollers, and leaving or partially dividing the roving greatly affects the quality of the obtained yarn. Research on ring spinning machines has shown that if the spun yarn is obtained with a truncated cone-shaped incoming fibre flow guide (densifier) placed after the drafting zone receiving the previous fibre flow (roving), the quality of the resulting yarn is improved.

The purpose of the research presented in this article is to analyze and compare yarns using two different systems from ring spinning machines and compact spinning machines offered by the ring spinning machine manufacturers of Switzerland Rieter, one of the world's leading famous firms. From the ring spinning factories of the Republic of Uzbekistan, "Namangan To'qimachi" LLC produces fine and coarse yarns consisting of cotton fibre and a mixture of cotton and chemical fibres.

The main part

Today, every enterprise aims to produce spun yarn with high-quality indicators and low prices. Therefore, the conventional spun yarn and placing an additional roving guide between the second and third drafting pairs need to optimize the equipment of the spinning machines and the distance between the drafting pairs in order to improve the quality parameters of the yarns obtained by the method. Therefore, taking into account production costs, conventionally obtained yarns can be made competitive with compact spun yarns without changing the spinning machine to a compact spinning machine by changing drafting pairs or adding additional devices. In the research, roving with a linear density of 600 tex produced at the spinning factory of "Namangan To'qimachi" LLC was used. The tests were carried out on a ring-spinning machine manufactured by Rieter. The tests were conducted together with the leading technical staff of the spinning mill and specialists of the spinning mill. During the research, in order to compare the results, between the second and third drafting pairs of the single drafting system of the ring spinning machine, a device that moves in parallel to the guide and reversibly moves and thickens the fibres is placed, and the remaining drafting pairs in the enterprise used in the traditional way. One for each test, in order to check the quality indicators of the spun yarns, to ensure sufficient yarn quantity for the tests in which the factory spun yarn and an additional truncated cone-shaped compactor, was placed between the second and third drafting pairs of threads were taken in the tube. The obtained yarns were checked for quality indicators in several USTER production equipment (Table 1).

Table 1. Quality parameters of the spun yarn with linear density T=27

№	Quality parameters of the spun yarn	Quality parameters of yarn produced at the enterprise	Quality parameters of the yarn from which the flow of fibres is compressed
1	Coefficient of variation by yarn number, U %	10.8	10.43
2	The coefficient of variation of the yarn on unevenness, CV m	13.7	13.2
3	Thin places, -40 % /km	108	98
4	Knots in the yarn, Neps 200% /km	180	165
5	The hairiness of the yarn, H	7.1	6.9

In the process of ring spinning, the twist that is transmitted to the thread appears along a curved line between the traveller and the front rollers. The transmission of the twists is opposite to the movement of the threads in this area. The traveller then passes the twists to the drawn fibres as close as possible to the compression point after the release rollers. However, the twists never reach the compression point because the fibres are directed towards the yarn axis after leaving the previous draft pairs. The path of the inner and outer fibres forming the spun thread forms a spinning triangle in a ring spinning.

The length of the rotating twisted triangle depends on the geometry of its rotation and the intensity of the twist [4,5,6]. The dimensions and shape of the spinning triangle significantly affect the structure, surface characteristics, and physical-mechanical properties of the yarn being spun. All the fibres placed on the outer edges of the twisted triangle can remain unspun into the yarn structure. Such fibres have a great effect on increasing the hairiness of the thread.

As a result of the gradual transmission of the twists and travellers of the spinning thread, a twisted triangle is formed. It creates a certain tension in the set of fibres that make up the thread.

In the cross-section of the spun yarn, the non-symmetrically distributed fibres are located at the edge of the twisted triangle of textile products, and the smallest ones are located inside the twisted triangle. During this asymmetric distribution, it causes the fibre to break according to the condition of the spinning triangle, the fibres do not cause the yarn to be cut slowly, and the outer axial yarn takes over the load, thus they also cause the yarn to break [8,9,10].

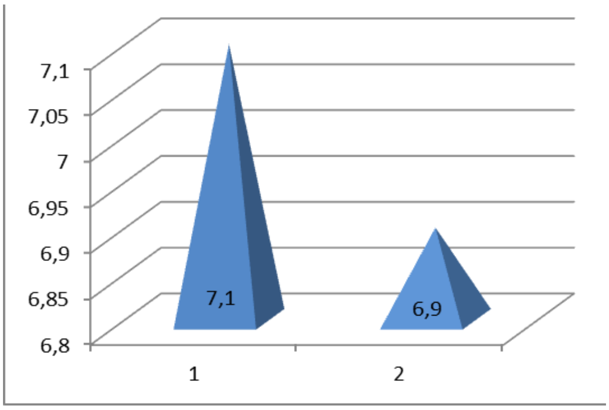
As a result, the strength of the thread decreases and the strength of the fibres is used less. Minimizing or eliminating the spinning triangle allows almost all fibres to be incorporated into the yarn structure with the maximum possible length and fibre precompression, regardless of the position of the spinning triangle. A uniform pre-tension of many fibres provides a synchronous breaking strength of many fibres, which helps to increase the strength of the spun yarn and maximize the use of the fibres in the yarn.

Featuring a completely new range of all compact spun yarns from short staple fibres (cotton-type man-made fibres, cotton, and their blends) or long staple fibres (man-made fibres, wool, wool-type fibres, and their blends). When comparing their quality and appearance to the yarns obtained from the traditional ring spinning machine, compact yarns are significantly stronger, meet the standard requirements for elasticity, have less hairiness, and are characterized by abrasion resistance. A lower number of twists per meter can be used to achieve the yarn strength obtained from a conventional ring-spinning machine, resulting in increased ring-spinning machine productivity.

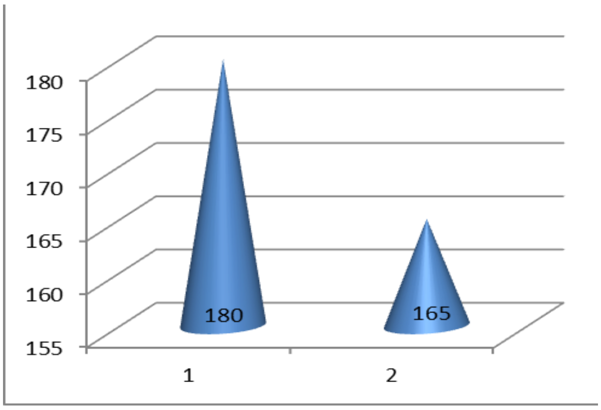
Better use of fibre strength in spun yarns results in reduced hairiness of the spun yarn. The length of the second pile is 3mm when the fibres are used for further processing. Compared to conventional yarns, it should be noted that the length of one end of the fibres left out of the spun yarn is reduced by 50%. In some cases, it is not required to determine the degree of hairiness of the fibres in the yarn. Fibres with a main length of 1-2 mm and fibres with a length of more than 3 mm are rarely seen in the textile industry.

The level of hairiness of the spun yarns is as low as possible and the external appearance is better and clearer if the cross-section is flat, it allows for the production of high-quality textile products. For example, in jacquard woven and printed fabrics, there is a strong demand for the smooth surface, high beauty, and high durability of the gauze product. It is necessary to use compact threads, the prices of which are slightly higher than those of traditional threads. Despite the high level of competition in the entire textile industry, some countries still produce spun yarns with high hairiness, low durability, and poor appearance. Manufacturers of high-quality spun yarns have been testing various traditional spinning machines.

In the study, the statistical significance of the spun yarns obtained experimentally and traditionally produced at the enterprise was checked with the help of standard methods and laboratory equipment. Data were analyzed and compared. An additional compacting device was placed between the produced cylinders, and the physical and mechanical properties of the spun threads obtained by the traditional method were tested. Unevenness, tensile strength, elongation at break and several indicators were checked according to the actual number. Uster tester 5 was used to check the hairiness of 100 meters of thread in the Uster device (Fig. 1).



Hairiness level indicators of spun yarns, H
1. Traditional thread
2. Yarn obtained by the additional compacting device



Knots of spun threads, Nep 200% /km
1. Traditional thread
2. Yarn obtained by the additional compacting device

Figure 1. Indicators of yarns were obtained by the traditional method, with an additional compacting device placed.

These two types of spun yarns are 100% cotton yarns. An additional compacting device was placed between the cylinders, and the quality indicators of the yarn with a linear density of 27 tex obtained by traditional methods were checked.

The degree of hairiness of the spun yarn obtained by placing a device moving parallel to the truncated cone-shaped guide in the space of the cylinders has been significantly improved compared to the yarn obtained by the traditional method. The hairiness of the yarn obtained by the traditional method was 7.1, The degree of hairiness of the thread obtained through the additional thickening device was 6.9.

In the conducted studies, when we checked the defects on the surface of the thread, the average number of knots of the yarn spun at the enterprise was 180 units/km, and we can see that the number of defects in the sample yarn obtained by installing the compactor device was 165 units/km. It can be seen that, when comparing the T=27 tex number of yarns obtained in the spinning machine, compared to the yarn produced in the enterprise, it was improved by 8.3%.

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