Engineering, 2022, 14, 536-543
https://www.scirp.org/journal/eng
ISSN Online: 1947-394X
ISSN Print: 1947-3931

Influence of the Mode of Discrete Drum Speed and the Number of Inputs on the Technological Parameters of the Yarn Produced

Yuldashev Jamshid

Namangan Institute of Engineering and Technology, Namangan, Uzbekistan
Email: jam23041981@gmail.com

How to cite this paper: Jamshid, Y. (2022) Influence of the Mode of Discrete Drum Speed and the Number of Inputs on the Technological Parameters of the Yarn Produced. *Engineering*, **14**, 536-543.
https://doi.org/10.4236/eng.2022.1412040

Received: October 15, 2022
Accepted: December 23, 2022
Published: December 26, 2022

Abstract

This article is devoted to the research work aimed at improving the quality of yarns obtained by pneumomechanical spinning. The yarn quality indicators obtained at different speed modes of the pneumomechanical spinning machine discrete drum were studied and analyzed. The effect of the number of incisions of the sawtooth coatings on the discrete drum on the quality indicators of the yarn produced was also studied. The results of the experiments were analyzed by graphical and histogram methods, and alternative options were suggested.

Keywords

Fiber, Yarn, Discrete Drum, Quality, Text, Toughness, Speed

1. Introduction

Improving the quality of consumer goods is becoming a constant and urgent task, the solution of which serves to further improve the living standards of the population.

The production of high quality competitive products based on the use of high, cost-effective technologies is also the most important task of the textile industry. The quality of textile products largely depends on the smoothness, cleanliness and durability of the yarn. This goal can be achieved through the introduction and use of modern equipment operating on the basis of more advanced technological principles [1] [2] [3] [4] [5].

To increase the number of teeth on the surface of the discrete drum, granite pitch reduction, multi-input headset wrapping methods can be used, but this in turn increases fiber formation as a result of increased exposure (shock) to the fibers in the headset, making it difficult to separate fibers from headset teeth. Therefore, in order to increase the sampling efficiency of the supplied yarn, it is important to study the effect of the alternative sampling drum speed mode and the number of inputs on the technological parameters of the yarn produced.

2. Related Works

The effect of the number and speed of the discretion drum on the yarn quality indicators was evaluated and studied in the production of 37 tex yarns.

In order to produce yarn for experimental studies type 4, I-grade, good grade cotton fiber was selected. Physical and mechanical properties of raw cotton are given in Table 1.

Figure 1 showed processing of raw materials was carried out in a shortened technological chain of equipment installed in the following order: 1) supply mixer;

Table 1. Physical and mechanical properties of raw material.

№	Naming of indicators	Indicators
1	Selection sort	C-4727
2	Linear density, m tex.	159
3	Staple length, mm	33.1
4	Variation coefficient of staple length, %	23.8
5	Relative toughness, sN	4.7
6	Tensile strength, sN/tex	29.55
7	Class	Good
8	Degradation rate, %	2.5
9	Short fiber content,%	8.2
10	Maturity	1.8

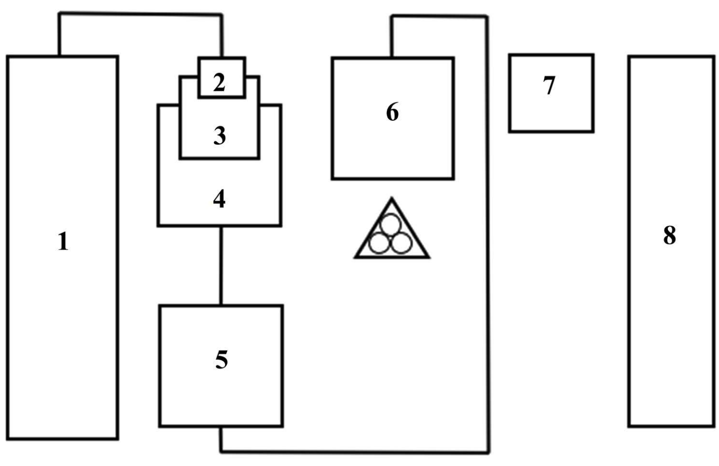

Figure 1. Technological chain of equipment. Here, 1—BO-C supply mixer, 2—LVSA-condenser, 3—VE-963-fiber breaker, 4—SVT-3 Cleanomat cleaning machine, 5—DX-aerodynamic cleaning machine, 6—DK-903-carding machine, 7—HSR-1000-spinning machine, 8—D-330-pneumomechanical (rotor) spinning machine.

2) condenser; 3 - 4) aerodynamic cleaner machine; 5) mechanical cleaner machine; 6) carding machine, 7) tape machine 8) pneumomechanical (rotor) spinning machine [6] [7] [8].

The rate of change of the experimental factors is shown in **Table 2**. All variant semi-finished products and yarn were produced in series on the same technological equipment, on the same spinning chambers, based on the same spinning plan given in **Table 3** [9].

The research plan consists of 9 experiments.

Alternative parameters:

$У_1$—hairiness, cm,

$У_2$—tensile strength of yarn, cN/tex,

$У_3$—number of technological neps (pNeps/km),

$У_4$—modulus of elasticity.

Yarn quality was evaluated using the following modern laboratory equipment:

- the quality of the fiber obtained from the spinning chamber was studied in Using HVI and USTER-AFIS Version 4.22 device;
- indicators of physical and mechanical properties of the yarn were determined on the STATIMAT-C tester and on the automatic tester AVTOTWISTCOUNTER
- physical and mechanical properties of the yarn were determined on the STATIMAT-C device, and the automatic twist detection device AVTOTWISTCOUNTER;

Table 2. Levels of change of factors.

Фактор	Values		
	−1	0	1
X_1—frequency of rotation of the sampling drum, rpm	6000	6500	7000
X_2—the method of wrapping the headset on a discrete drum	One entry	Two entry	Three entry

Table 3. Spinning plan for linear density 37 tex yarn production by pneumomechanical (rotor) spinning method.

№	Name and brand of machines	Linear density of the output product, kTeks, tex	Number of Joins,D	Elongation rate,E	Number of twists		The speed of the output working parts		Profitability ratio, %	Theoretical productivity of a single output working part, kg/h
					α_T	K twist/m	V m/min	n min^{-1}		
1	Carding machine DK-903	4.5	-	-	-	-	100	65.6	0.98	65
2	Draw frame HSR-1000	5.0	8	7.2	-	-	500	-	0.75	150
3	Rotor spinning machine BD-330	37.0	1	135	35.9	590	118	70000	0.96	0.264

- the degree of fluffiness of the yarn was determined on PREMIER equipment (India) and Nikon microscope (Japan);
- knots on the surface of the thread and the unevenness of the cross section of the thread were studied using the PREMIER device.

When analyzing the physical and mechanical properties of cotton fiber obtained from the spinning chamber, the main physical and mechanical parameters of the fiber bundles obtained in all 9 variants were determined using the device HVI i USTER-AFIS. The results obtained are shown in **Table 3**. According to the table, the increase in the number of discrete drum inputs indicates an increase in short fibers in all 9 variant samples, the results of which were also confirmed by the data obtained on HVI and USTERAFIS. This information can also be seen from the graphs in **Figure 2** [10] [11].

The content of short fibers in cotton fiber used for experimental work is −8.2%. When using a single-input sampling drum, the amount of short fibers in the cotton fiber increases by 4.9% - 25.6% - 51.2% (with increasing speed of the sampling drum). In the two-input packaging method, the growth is 2.4% - 7.3% - 12.1%, and in the three-input packaging method it is 2.4% - 4.9% - 9.8% (according to USTERAFIS).

According to HVI data, the short fiber index was found to be the lowest of the double-input discrete drum and 9.73% at 6000 min^{-1}, 10.3% at 6500 min^{-1}, and 11.3% at 7000 min^{-1}.

The cotton fiber length distribution at a speed of 6500 rpm on a discrete drum rotation that the filament index of the yarn obtained using a discrete drum wrapped in a double-sided headset is an alternative. Studies have shown that an increase in the upper average length (average length of the longest fibers, which accounts for 50% of the total mass) to 1070 inches (27.2 mm) when using a single-input discretion drum, a high average length of 1051 inches (26.69 mm), a three-input discrete drum when applied, the base was found to be −1.046 inches (26.56 mm).

When studying and analyzing the defects in the raw material, 48% - 64% of the total number of defects are neps (knots), 32% - 50% are small wastes with a size of less than 500 microns, 0.4% - 1.5% are seeds cortical fibers and coarse wastes of no more than 1% in size larger than 500 µm.

There was an increase in the amount of separation of the waste in the semi-finished product (ribbon), which is provided by the acceleration of the force between the teeth of the discrete drum set and the fiber. [12] [13] [14]

For visual assessment of the fluff of the yarn using a microscope, samples of yarn with a linear density of 37 tex were studied under a Nikon microscope. Using a Nikon digital camera, wire micrographs were made that could be transmitted to a computer. The microscope results are shown in **Figure 3**.

Examining the graphs in **Figure 3**, we can draw the following conclusions:

- with one and three inputs of the headset in the sampling drum, the stiffness of the yarn increases as its rotational frequency increases;

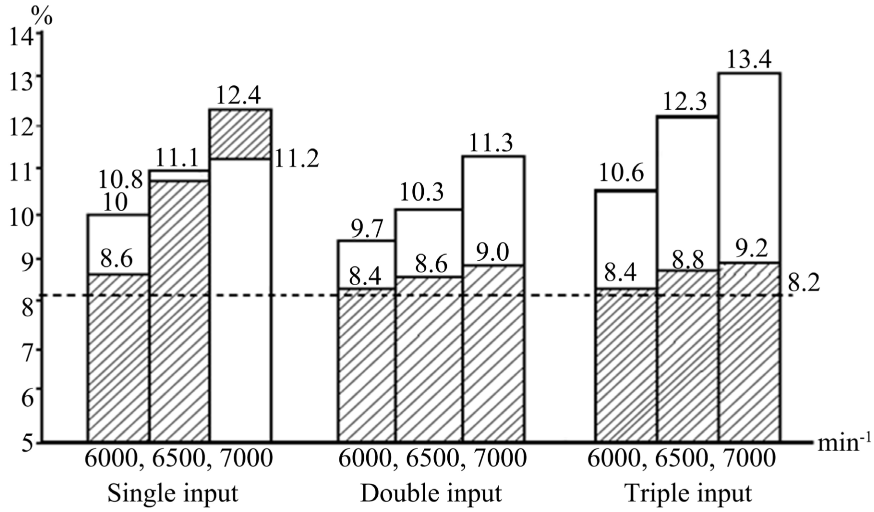

Figure 2. The amount of short fibers in cotton fiber. Here is, 1—6000 min^{-1}; 2—6500 min^{-1}; 3—7000 min^{-1}, [hatched box] amount of short fiber, %, according to USTERAFIS data, [empty box] short fiber index, % according to HVI data, content of short fibers in cotton fiber—8.2%.

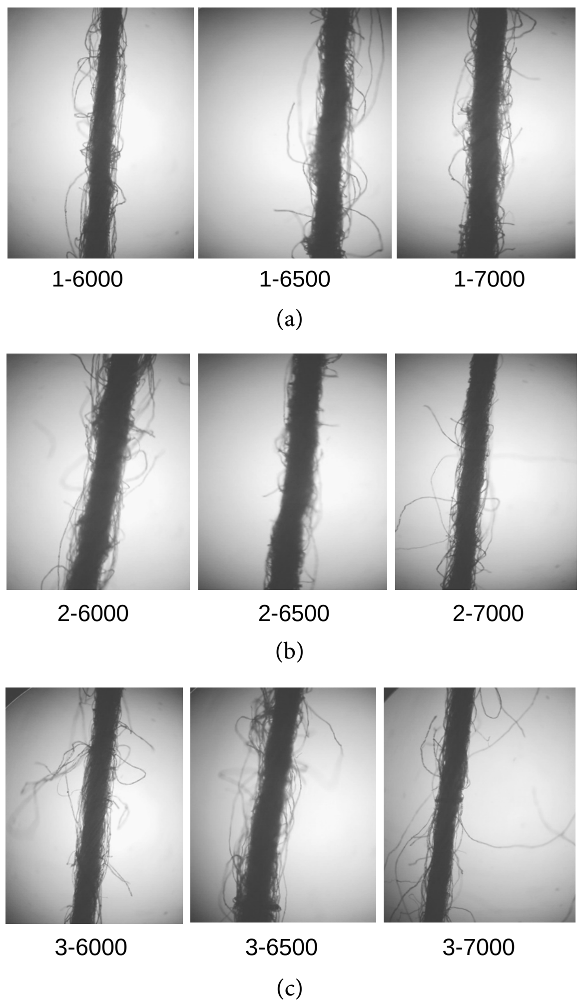

Figure 3. Electron microscopic images of the studied samples. Here, for (a) single-sided sampling drum (b) for double-sided sampling drum; (c) for triple-sided sampling drum.

- when the rotational speed of the sampling drum varies from 6000 to 7000 min^{-1}, the stiffness of the yarn with double-sided winding is almost unchanged;

At 6500 rpm for any winding, the stiffness of the yarn will be low relative to frequencies from 6000 to 7000 rpm.

3. Materials and Methods

The results of the conducted experiments show thatrotational speed of one-, two- and three-input discrete drums in the unloaded state remained unchanged, *i.e.* 3600 min^{-1}. During the operation of one-, two- and three-input discrete drums (with a tape), a decrease in the frequency of their operation was observed. The rotational speed of a single-input discrete drum decreased by an average of $24 \div 32$ min^{-1}, the rotational speed of a two-input discrete drum decreased by an average of $53 \div 79$ min^{-1}, and the rotational speed of a three-input discrete drum decreased by an average of 67,220 min^{-1}.

4. Calculation and Results

Figure 4 shows a graphical relationship between the mean values of the discretion drum velocity drop in the operating mode with the variation of the sampling drum speeds. Analysis of the graphs shows that the decrease in the average rotational frequency of a single-input sampling drum is insignificant (5 - 6 min^{-1}). This means that an increase in the speed of a single-input sampling drum does not actually lead to an increase in performance, the number of fibers that the drum teeth pick up from the supplied coil increases slightly. In the two-input design of the discreting drum, with an increase in the frequency of

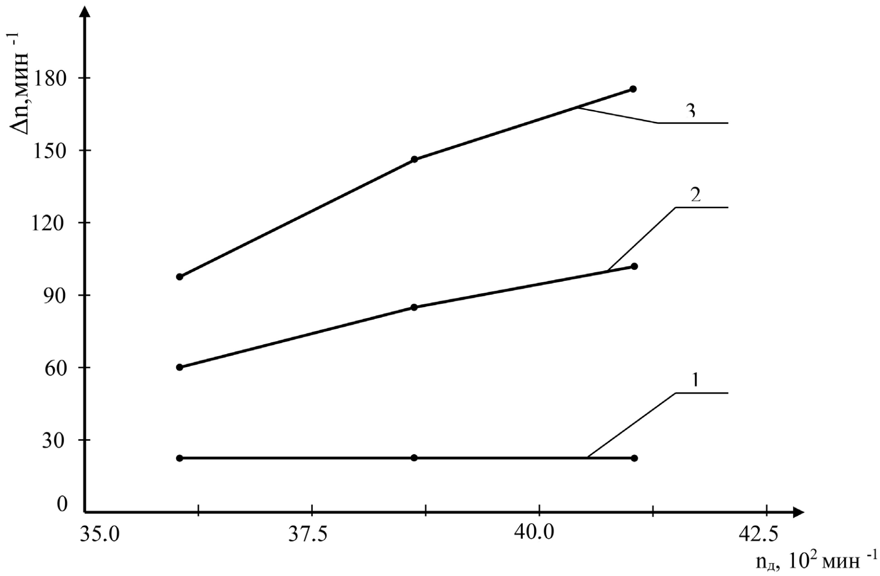

Figure 4. Graph of the dependence of the change in the average values of the discrete drum speed in the operating mode on the increase in the rotational speed. Here, 1 is single-input discrete drum; 2—Double-input discrete drum; 3—Triple-input discrete drum.

rotations from 3.6 × 102 min^{-1} to 41 × 102 min^{-1}, its average rotational frequency decreased to 62 - 125 min^{-1}. This process can be explained by an increase in the rate of fiber extraction from the pile, which is provided by an increase in the number of discrete drum inputs.

It was found that the frequency of three-input discretion drum rotations decreased from Δn 179 min^{-1}. Although an increase in the degree of fiber retention with the headset teeth was observed when a three-input discrete drum was used, a decrease in the quality of the yarn produced was found with a decrease in the parallelism of the fibers and a decrease in the degree of accuracy.

5. Conclusion of the Work

The laws of variation of the speed of the sampling drum for unloaded and operating modes in one, two and three-input modes of the sampling drum were obtained experimentally. It was found that in the two-input version of the sampling drum, the headset teeth have a fiber retention rate of 1.3 ÷ 1.6 times more than in the two-input version.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

[1] Jamshid, Y. Akbarjon, U. and Olimjon, S. (2020) Dynamics of Interaction of a Single Fiber with a Headset of a Sampling Drum. *Engineering*, **12**, 347-355. https://doi.org/10.4236/eng.2020.126027

[2] (2018) Исследования по измерению деформации пряжи при помощи оптических приборов. Universum: технические науки: электрон. научн. журн. Бобожанов Х.Т. [и др.]. № 12, 58-62. https://7universum.com/ru/tech/archive/item/6716

[3] Yuldashev, J.Q., Dilrabo, R., *et al.* (2019) Analysis of Modern Sportswear Materials International. *Journal of Advanced Research in Science, Engineering and Technology*, **6**, 8535-8540.

[4] Ugli, Y.A.A., Tokhirovich, B.H. and Qambaraliyevich, Y.J. (2021) Analysis of Changes in the Physical and Mechanical Properties of Twisted Yarns as a Result of Finishing. *ACADEMICIA*: *An International Multidisciplinary Research Journal*, **11**, 117-122. https://doi.org/10.5958/2249-7137.2021.00600.5

[5] (2018) Анализ деформационных свойств высокоэластичных трикотажных полотен для проектирования спортивных одежды. Universum: Технические науки: электрон. научн. журн. Максудов Н.Б. [и др.]. № 9, 12-16. http://7universum.com/ru/tech/archive/item/6370

[6] Qambaralievich, Y.J. (2022) Research to Improve the Working Parts of a Pneumo-Mechanical Spinning Machine. *E Conference Zone*, 17-18. http://www.econferencezone.org/index.php/ecz/article/view/906

[7] (2018) Расчет силы трения волокон о переднюю гран зуба дискретизирующего барабана прядильной машины. Universum: Технические науки: электрон. научн. журн. Жуманиязов К.Ж. [и др.]. № 11, 4-8. http://7universum.com/ru/tech/archive/item/6605

[8] Khamrakulova, Z. (2022) Improving Product Quality by Improving the Working Body of the Spinning Machine. *E Conference Zone*, 21-24. http://econferencezone.org/index.php/ecz/article/view/1127

[9] Olimjonov, D., Yuldashev, J. and Juraeva, M. (2022) Prospects for Textile Fabrics. *Conferencea*, 237-243. https://www.conferencea.org/index.php/conferences/article/view/898

[10] Yuldashev, J.Q. and Bobojanov, H.T. (2020) Study of the Influence of the Parameters of the Sampling Zone on the Condition of the Capture of Fibers by the Drum Teeth. *The American Journal of Engineering and Technology*, **2**, 75-78.

[11] Bobajonov, H.T., *et al* (2017) The Arrangement of the Fibers in the Yarn and Effect on Its Strength. *IOP Conference Series*: *Materials Science and Engineering*, **254**, Article ID: 082005. https://doi.org/10.1088/1757-899X/254/8/082005

[12] Islam, M., Rokonuzzaman, M., Saha, J. and Razzaque, A. (2017) Effect of Machine Setting Parameters on Ring Slub Carded Yarn Quality and Spinning Performance. *Journal of Textile Science and Technology*, **3**, 45-55. https://doi.org/10.4236/jtst.2017.34004

[13] Abdumuxammadovich, S.J. and Soliyevich, B.A. (2022). Application of Double Network Gel Structure Production Technology in Electrolyte Hydrogels. *Innovative Technologica*: *Methodical Research Journal*, **3**, 105-109.

[14] Shodmanov, J.A. and Boymirzaev, A. (2021) Electrophysical Properties of Supercapacitor on the Basis of New Gel Polymer Electrolyte. *Scientific Bulletin. Physical and Mathematical Research*, **3**, 35-41.