ANALYSIS OF PRODUCT RELEASE FROM UNPRESSED FIBERS IN SPINNING TECHNOLOGY

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Annotation. *The article deals with the characteristics of raw materials, sketches and expired products in the justification of technological parameters of spinning from non-spun fiber in cotton-textile clusters. The paper describes the introduction of rational spinning options in production, direct transfer of fiber to the spinning process without spinning were compared on the basis of Uster Statictics 2018. Also, in the article described that at the ginnery "Boston Cluster" LLC from the seed cotton of the selection "Sultan" was selected fiber DP-130 gin, and a sample of unbleached fiber was prepared. Experimental work was carried out in two options under the conditions of production in the spinning mill of "Boston Mega Tekstil" LLC. In the experimental version, semi-expired products and yarn were made from 4 types of unpressed cotton fibers of the "Sultan" selection in the combined technology (ginning fibers no bale opening directly mixed). In the enterprise version, semi-expired products and yarn were made from 4 types of pressed cotton fiber of the "Sultan" selection in the current technology. The performance of cotton fiber was evaluated in the laboratory of the joint venture "Wakefield Inspection Services (Tashkent) Ltd" under the Tashkent Institute of Textile and Light Industry on the system Uster® HVI 1000. Furthermore, in the paper, experimental tests were carried out in the spinning system of the spinning mill on the basis of the plan of spinning Ne 32/1 in a ring method and in accordance with the standard norms established in the conditions of the enterprise. Sketches and expired products prepared in the experimental version, comparative study of the properties of the sketches and expired products prepared in the enterprise version were compared. In addition, in this work, the high-density, non-discrete cotton fiber mixture was processed in a spinning system to analyze the impact of technological processes on product efficiency and product quality.*

Keywords. *Unpressed cotton fiber, fiber properties, sliver, roving, yarn, Uster HVI 1000 system, Uster Statictic 2018 indicators.*

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Introduction. In order to generalize production, introduce resource-saving techniques and technologies, as well as to create a compact mechanism for regulating the relationship between cotton and textile clusters and farms, the Association "Cotton-textile clusters of Uzbekistan" was established [1].

Regard to the location of these established cotton-textile clusters, the State Commission has made scientific proposals and conclusions on the existence of a number of current problems

in the production of quality yarn, effective use of raw materials in spinning processes in clusters as a result of fiber cultivation of the proposed cotton selection.

Cotton-textile clusters as a result of scientific research on the possibility of creating and implementing in production the harmonized technology of primary processing and spinning of cotton.

Theoretical part. The technologies used in the cotton-textile clusters of Uzbekistan lag behind today's requirements. Cotton is processed seasonally and continues to be stored in open (bunts) area. In the world practice, storage of harvested cotton in mini bunts (model) has been introduced since 1970 [3].

In the United States, cotton picked by machine and packed in rolls is being transferred directly to processing without being stored in bunts. Reducing the costs of fiber pressing, transportation and storage of cotton fiber is now a priority in the production of expired products, 100% of cotton fiber is processed in the country [4].

The presence of crude products in the sequence of spinning processes and the presence of tangled fibers and neps in the yarn was mainly determined by scientific research as a negative consequence of the technology of primary processing of cotton [5,6].

There is also a traditional method of spinning, which causes a high degree of damage to the fibers in the production of cotton yarn. Repeated mechanical shocks in these technologies can severely damage the fibers, leading to a decrease in the quality of the spun yarn [7,8].

Studies have shown that in the technological processes of primary processing and spinning of cotton, the physical and mechanical properties of fiber and raw materials are damaged as a result of various impacts [9].

In order to study the properties of the raw yarn and yarn products from the unpressed fiber by the method of ring spinning, research was conducted. The results of the study revealed that the fibers are not strongly compacted due to non-abrasion, the adhesion of the fibers is low, the number of fiber injuries is reduced due to the lack of repetitive shocks, the cleaning process is effective. That is, when analyzing the performance of the combed fiber made of unpressed fiber compared to the current combed fiber made of unpressed fiber, the short fiber index (SFI) decreased by 6.78% (improved); total Nep Cnt number (Total Nep Cnt) decreased by 59% (improved); the number of nodes (SCNep Count) was observed to decrease (improve) by 84% [10].

Experimental section. In order to study the quality of sketches and expired products in the production process, samples of sketches and yarns were prepared and practical experiments were carried out in the combined technology of unbleached cotton fibers (ginning fibers no bale opening directly mixed).

In the preparation of the sample, a sample of raw cotton from the "Sultan" selection was prepared at the ginnery "Boston Cluster" LLC, DP-130 gin, and unpainted fiber. Experimental work was carried out in two options under the conditions of production in the spinning mill of "Boston Mega Tekstil" LLC:

Experimental version, raw products and spun yarn were made from 4 types of non-pressed cotton fibers of the "Sultan" selection in a combined technology (ginning fibers no bale opening directly mixed);

Enterprise version, raw products and yarn were made from 4 types of cotton fiber of the "Sultan" selection in the current technology.

Experimental work was carried out in the spinning mill of "Boston Mega Tekstil" LLC on the basis of the plan of spinning yarn Ne 32/1 in the spin carding system, on the basis of standard norms established at the enterprise, and analyzed changes in the properties of sketches and yarn products.

The performance of cotton fiber used for both options is evaluated in the laboratory of the joint venture Wakefield Inspection Services (Tashkent) Ltd under Tashkent Institute of Textile and Light Industry using the system Uster® HVI 1000 [11]. The results obtained are summarized in Table 1 and shown in Figure 1 in the histogram view.

Table 1

Indicators of cotton fiber

№	Options	Mic (Micronaire)	UI - Uniformity index [%]	Str - Strength [g / tex]	Elg - Elongation [%]	Rd - Reflectance	+ b - Yellowness	Tr Cnt - Trash count	Tr Ar - Trash area [%]	SFC (n) - Short fiber content by number [%]	SCI - Spinning Consistency Index	Len Dm	Type
1	Experience option	4,79	82,9	31,5	6,1	80,1	8,5	39	0,32	8,0	131,3	1,082	4
2	Enterprise option	4,70	82,6	30,6	6,6	76,6	9,3	40	0,40	8,2	130,8	1,097	4
Difference, in %		-1,8	+0,4	+2,8	-7,5	+4,3	+8,6	+2,5	+20	+2,4	+0,4	-1,3	

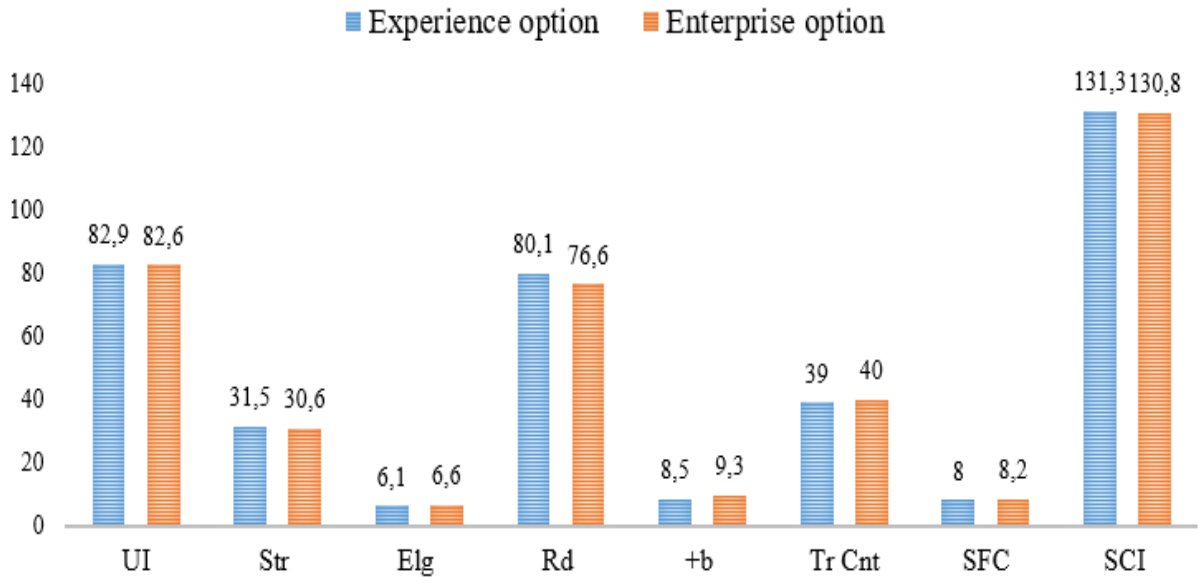

Figure 1. Histogram of cotton fiber indicators

Characteristics of cotton fibers used for the experimental option in relation to the enterprise option: fiber tensile strength (Str) by 2.8% (good), Reflection coefficient (Rd) by 4.3% (good), short fiber index (SFC) 2, At 4% (improved), it can be observed that the spinning stability index (SCI) has improved by 0.4%. Since the cotton fiber used for the experimental option was not milled, it was observed that the enterprise option performed better than the cotton fiber properties due to the low impact effects of the fibers.

Scientifically based on the fact that the biological process continues at the expense of impurities and seeds, fiber and seed properties deteriorate, fiber yield decreases and has a negative impact on subsequent processes [12].

In quality indicators such as micronaire (Mic), spinning stability index (SCI), fiber toughness (SFI) are based on studies to increase the fiber maturation index (Mat) from seeds as a result of long-term storage of cotton in gins [13].

A study conducted by Uster Technologest recommended that the minimum value of the spinning stability index (SCI) in the production of quality yarn should not be less than 128 [14,15].

In the production of yarn, the maturity index of cotton fiber (Mat) is 0.87, which proves that long-term storage of cotton in bales leads to a deterioration in the quality of fiber, rough and expired products in subsequent processes [16]. Therefore, it is advisable to prevent long-term storage of cotton in gins and to organize short-term processing and storage in the form of fiber.

Experimental work on both options of the prepared raw materials was carried out in "Boston Mega Tekstil" LLC on the basis of the plan of the spin carding system Ne 32/1 yarn in accordance with the established standards (humidity 65 ± 2, temperature 22 ± 3 C^0). The parameters of the technological machines for the production of Ne 32/1 strip were selected on the basis of the spinning plan and recommendations (Table 2).

Table 2

Ne 32/1 yarn spinning plan at “Boston Mega Tekstil” LLC

№	The name of the machine and brand	Linear density (Ne)	Number of additions	Stretching, E	Number of issuing bodies	Strength, *K* twist/m	Extractor speed		Applied productivity, kg / h
							n (min^{-1})	th (m / min)	
1	B.O.Cleaning machines (Truetshler)	-	-	-	-	-	-	-	1000
2	Carding machine TC-15	0,100	1	-	-	-	-	240	80,0
3	Drawing frames TD9 (I –transition)	0, 110	5	4,5-11,6	1	-	-	650	180,0
4	Drawing frames TD8 (II –transition)	0, 110	6	4,0-11,6	1	-	-	600	195,0
5	Roving machine , JWF 1436 B (Japan)	0,760	1	5,290	208	48	1000	-	200
6	Ring spinning machine, JWF 1566 (Japan)	Ne 32/1	1	43,50	1200	980	16500	-	24

The quality of semi-expired products and yarn obtained in both options was determined on the equipment of the production laboratory of the enterprise and compared and analyzed.

The properties of the rough products prepared on both options of Ne 32/1 yarn were monitored on the Uster Tester 6, and the results obtained were summarized in Table 3 and presented in the form of a histogram in Figure 2.

Table 3

Unevenness of semi-expired products

Semi-expired products name	SHE IS, %	CV m,%	CVm 0.5 m,%	CVm 1 m,%	CVm 3 m,%	CVm 10 m,%
Enterprise option						
Carding sliver	2.90	3.69	1.66	1.15	0.47	-
1st transition of draw frame sliver	2.49	3.16	1.21	0.81	0.56	-
2nd transition of draw frame sliver	2.19	2.73	0.94	0.48	0.32	-
Roving	4.30	5.40	-	1.76	1.34	0.99
Experience option						
Carding sliver	2.39	3.02	1.65	1.29	1.03	-
1st transition of draw frame sliver	2.29	2.90	1.34	1.09	0.73	-
2nd transition of draw frame sliver	2.08	2.63	0.62	0.46	0.26	-
Roving	4.26	5.37	-	1.46	1.05	0.72

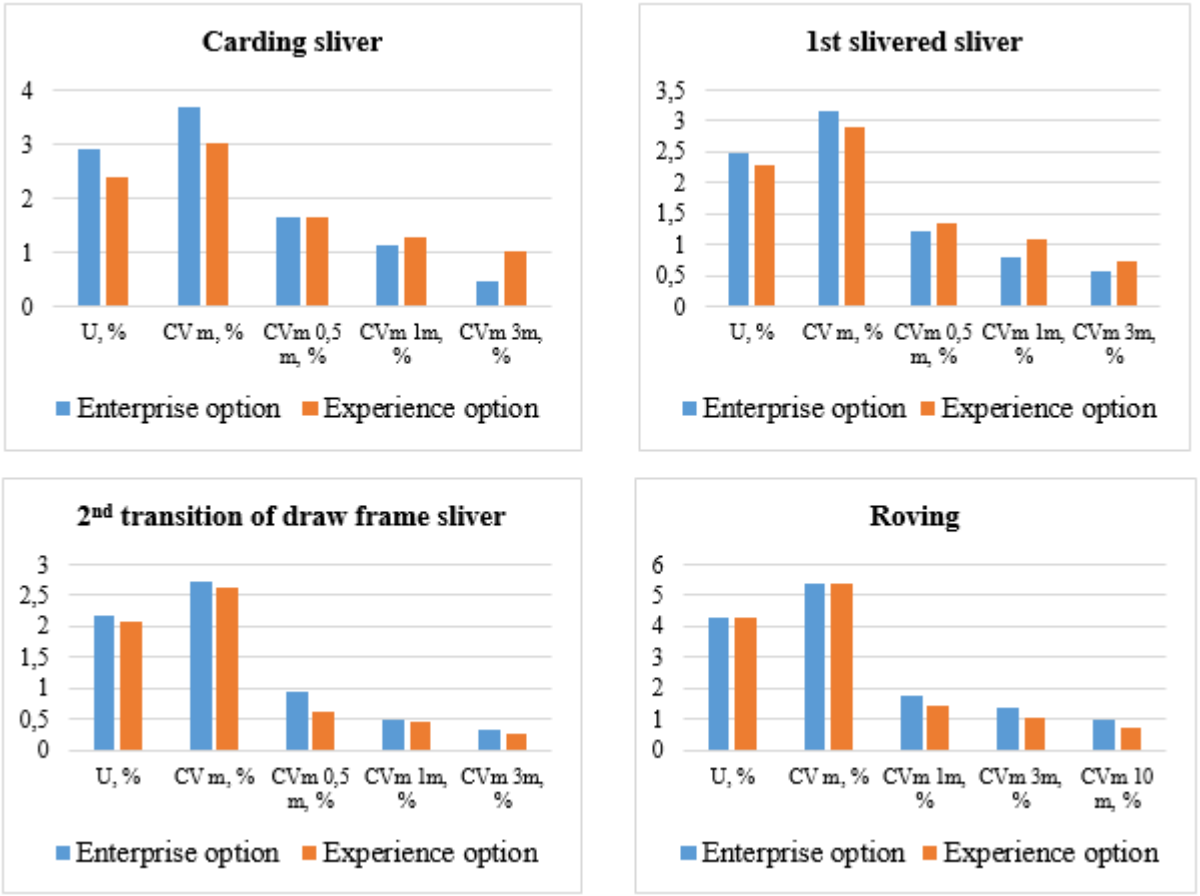

Figure 2. Uneven histogram of semi-expired products

Both options were studied comparatively on the basis of histogram, it was prepared in the experimental option: by 18,15 % in the scattered pile; I- transition to 8,22 % in the coated pile; II - by 3,66 % in the cross-sectional area; improved by 0,55 % compared to the enterprise option.

It was found that the value of the quantities in terms of the output of raw products did not differ significantly between the two options and met the recommended standards in the manufacture of yarn [17].

Physico-mechanical properties of Ne 32/1 yarn prepared on both options were determined. The results were presented in Table 4 and in the form of a histogram in Figure 3.

Table 4

Physical and mechanical properties of the yarn

Options	Linear density, Ne	Um%	CVm%	CVm%, 1 m	CVm%, 3m	Thin / km -50%	Thick / km + 50%	Neps / km + 200%	The number of turns is bur / m	Tenacity, [Rkm]	H- Hairiness
Enterprise	32	12,13	15,46	5,14	4,04	4	206	344	9 45	14,85	6,89
Experience	32	11,72	15,01	5,04	3,94	2	179	286	9 41	16,64	6,50

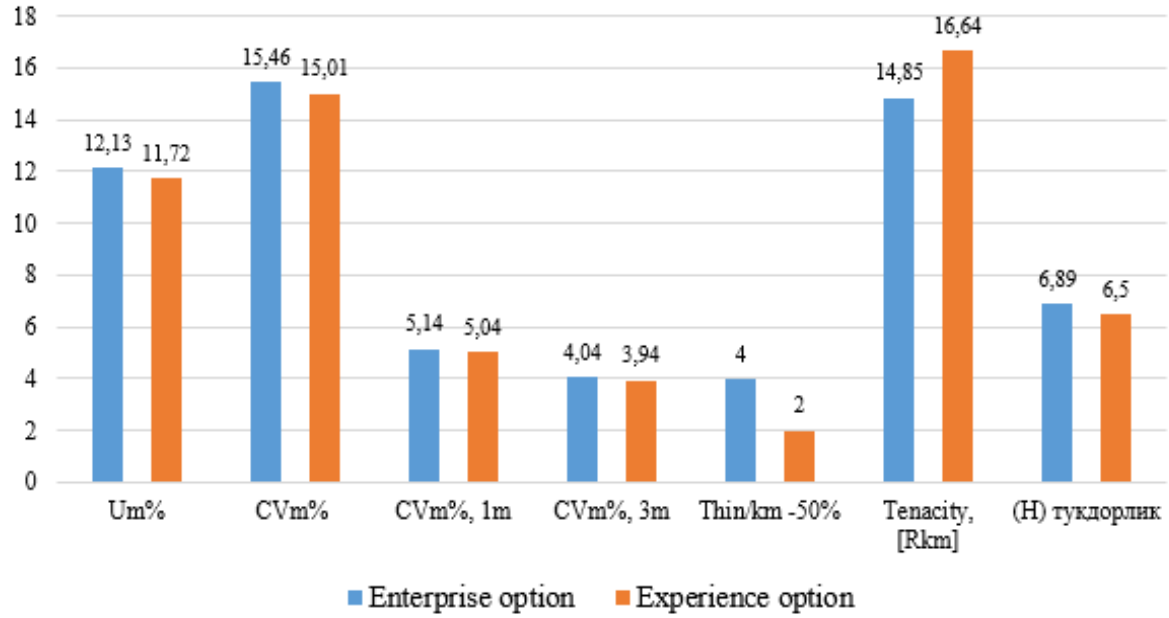

Figure 3. Histogram of physical and mechanical parameters of the thread.

According to the experimental option, the amount of returns, waste, sketches and yarn output at each technological transition was determined in an approved manner [18]. Output of raw products prepared in the experimental option an increase of 1.13% compared to the enterprise option. Yarn yield was 86.89% in the control option and 88.03 % in the recommendation option, i.e. yarn yield increased by 1.14% (Table 5).

Table 5

Waste, sketch products and yarn output

№	Product and waste	In the enterprise option,%	In the experiment option,%
1.	Carding sliver output	89,17	90.30
2.	1st transition of draw frame sliver output	88.72	89.85
3.	2nd transition of draw frame sliver output	88.27	89.40
4.	Roving output	87.54	88.67
5.	Yarn output	86.89	88.03
	Total waste, %	**13.11**	**11.97**

Outcome analysis. It was found that the performance of the yarn obtained in the experimental option on the roughness was better compared with the yarns of the enterprise option. The mechanical properties of the yarns were also determined in the dynamometer "Uster Tensorapid 5", the experimental option yarn was found to be 10.88% more durable than the enterprise option yarn in terms of tensile strength (Rkm). It was also found that the fluff content level (H) of the yarn in the recommended option yarn was 5.66% better than that of the control option yarn.

Uster Statictics yarns made in both options Quality indicators were analyzed on the basis of 2018 indicators. It was found that the quality of the yarn produced in the experimental option was better than that of the enterprise option yarn (Table 6).

Table 6

Ne 32/1 yarn Uster Statictics Analysis based on 2018 indicators

Indicator, units of measurement	Enterprise option		Experiment options	
	Value	Uster Statictic s 2018 quality classes	Value	Uster Statictic s 2018 quality classes
CVm,%	15.46	75 %	15.01	25 %
CVm%, 1 m	5.14	75 %	5.04	75 %
CVm%, 3m	4.04	50 %	3.94	50 %
Thin / km -50%	4	25 %	2	5 %
Thick / km + 50%	206	50 %	179	50 %
Neps / km + 200%	344	75 %	286	25 %
Tenacity, [Rkm]	14 , 85	95 %	16.64	50 %
H- Hairiness	6.89	95 %	6.50	95 %

It was found that the unevenness values in the experimental option of the combed pellet were better than in the enterprise option of the combed pellet. One of the main factors in the improvement of these indicators is the transfer of cotton fiber to the mixing-cleaning-scraping process without spinning and grinding after ginning in the experimental option. Strong non-compacted cotton fibers retain their natural properties due to the lack of impact effects, and the less the fibers are subjected to impact, the less the oily layer on their surface is damaged, resulting in increased softness and workability [19]. It can be concluded that the cleaning process was carried out efficiently due to the low adhesion strength of the cotton fiber used in the experimental option, due to the low content of active impurities.

Conclusion. In the future, as a result of the introduction of the possibility of "creation of a new integrated technology of primary processing and spinning of cotton in cotton-textile clusters" will be achieved by streamlining the technological lines as a result of direct transfer of fiber to the spinning process. This is a major advantage of the technology created side, because the fibers are not strongly compacted, in the cleaning-mixing and combing processes, a better quality sketch product is prepared than the traditional method, the output of the expired product is increased and appropriate cost-effectiveness in production is achieved.

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