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IMPROVEMENT OF WORKING PARTS OF A FIBRE PURIFIER IN SPINNING PRODUCTION

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ANNOTATION
This article is devoted to the development perspectives of the textile industry in Uzbekistan depend on the competitive ability of its products. The textile industry is one of the most developed spheres in the Republic of Uzbekistan.

Taking into account that the cotton-spinning enterprises of the Republic in recent years have been equipped with modern technological equipment from leading companies in the world, which are fundamentally differ from those that existed before. As a result, the classification and characteristics of waste generated during yarn production have changed significantly. Proceeding from this, the determination of various types of industrial waste in the production of yarn on modern cotton-spinner, the study of their qualitative and quantitative indicators, and the development of effective ways of their further use is an important scientific, technical and economic objective.

Key words: textile industry, cotton fiber, cotton spinning industries, production of fabrics and garments, design of the working bodies, the amount of spinning fibers

Introduction

The industrial enterprises produce yarns, threads, harsh and finished fabrics. Today, the production of knitwear, sewing and household products is rapidly developing in the republic. The importance of the development of this sector of the economy is associated with the following factors:

• Existence and availability of own raw material base (cotton, silk, wool).

• Hence the textile industry is considered as a labor-intensive industry, its development can contribute to solving the problems of employment and increasing the living standards of the population.

• World experience shows that, if there will be given favorable conditions, the development of the textile industry can be explosive. At the same time, due to the deep processing of raw materials, there is a significant increase in added cost, which makes it possible

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to increase incomes of the population, enterprises and the state, as well as to ensure high rates of export growth and a decrease of import goods (finished garments).

The state is running an active policy aimed at developing this sphere of industry. However, there are still a number of serious problems in this industry, associated with the insufficient productivity of cotton fiber and with the low competitiveness of products of the final stages of the production of fabrics and garments. Cotton fiber and yarn are remaining as the main export items, which means the supply of low costed products to foreign markets. [1].

It is known that the rational use of raw resources is important for optimizing the technical and economic indicators of cotton spinning industries, since they compile up to 80% of the total expense in determining the production cost.

PRELIMINARY RESULTS

Taking into account that the cotton-spinning enterprises of the Republic in recent years have been equipped with modern technological equipment from leading companies in the world, which are fundamentally differ from those that existed before. As a result, the classification and characteristics of waste generated during yarn production have changed significantly. Proceeding from this, the determination of various types of industrial waste in the production of yarn on modern cotton-spinner, the study of their qualitative and quantitative indicators, and the development of effective ways of their further use is an important scientific, technical and economic objective.

In order to determine the objective and purpose of scientific work, the authors carried out studies to define the fibrous waste yield, as well as their characteristics when processing yarn from cotton fiber.

Исследования проводились на производстенных условиях в предприятиях «NAM TEKS», «MEGA TEKSTIL» и «ANTEKS», оснащенных самыми современными оборудованиями передовых фирм производителей «Rieter», «Truetzschler» и «Marzoli». В результате исследований определены характеристики и доля волокнистых отходов на разрыхлительно-очестительном агрегате (РОА) и чесальной машине (Таблица-1).

The research was carried out on production conditions in enterprises "NAM TEKS", "MEGA TEKSTIL" and "ANTEKS", which are equipped with the up-to-date equipments of the leading manufacturers such as "Rieter", "Truetzschler" and "Marzoli". Research result shows the characteristics and the proportion of fibrous waste on a loosening-cleaning unit (POA) and a carding machine (Table-1).

Table - 1.
Types and proportion of fibrous waste in the cotton fiber processing

Machine manufacturer enterprises and firms	Fiber Waste Standards	Fiber waste mass, gr	Refined fiber, gr	Loss in yarn, gr	Invisible waste, %
«MEGA TEKSTIL» Rieter	ST 3	100	65,5	33,5	1,0
	ST 7	100	71,8	25,7	2,5
«ANTEKS»	ST 3	100	27	69,5	3,5

Truetzschler	ST 7	100	76	23	1
«NAM TEKS» Marzoli	ST 3	100	53,34	44	2,66
	ST 7	100	62	36,9	1,1

For experiments all enterprises are used the 4^{th} type, 2^{nd} sort cotton fiber of Namangan-34selection grade.

From the table data we can see that when using POA and a "Marzoli" carding machine 100 gr. of fibrous waste remains 53.3% of the fiber, when using a “Truetzschler” machine, 27% of the fiber and when processing cotton fiber on the “Rieter” machines, 53.8% of the fibers can be used for yarn production. Also, during the experiments, it was determined that the composition of the combed hards, respectively, contains 62%, 76% and 65% of spun fibers.

From this it can be concluded that even in the use of the most advanced devices and technology in fiber spinning fibrous waste remains in spun fibers. Today, enterprises use the term “waste-free technology”. And in order to achieve this technology, we have determined the objective: to study the factors influencing the occurrence of fibrous waste and by improving the design of the working bodies, as well as optimizing the operating parameters of the cleaning machines, to reduce the amount of spinning fibers in the waste composition.

MAIN RESULTS

From the conducted analyzes [2] we know that the main factors affecting the degree of loosening and cleaning of raw materials can include the following: the speed of the cleaning drums, the profile of the fire grate, the distances between the working bodies, as well as the profiles and position of the sawtooth of the belts in the cleaning drums.

The main functions of the process control associated with the blow chamber and carding operations in the production of yarn from staple fibers are opening, cleaning and mixing of fibers. The process control aspects associated with these functions are discussed, providing quality and performance issues as well as the controls required in the different areas of the two operations. The control of technological parameters in these operations, which ultimately affect the properties of the yarn, and also discussed in detail in addition to the control excise taxes required for the selection of raw materials [3].

In their research, the authors [4] conducted a number of experiments to identify important factors that affect operating costs and therefore affect factory profits. They investigated and determined the percentage of waste and fractions of stranded fibers in cleaning machines. As a result, it has been determined that the proportion of spun fibers in fibrous waste is 50%. These fibers are of good quality and can be blended between 15 and 25% without subtle changes in rotor spinning.

All experiments to determine the proportion of fibers in the composition of fibrous waste were mainly conducted on laboratory instruments (cotton analyzer AX and Shirley Analyzer MK 2 (Fig. 1))

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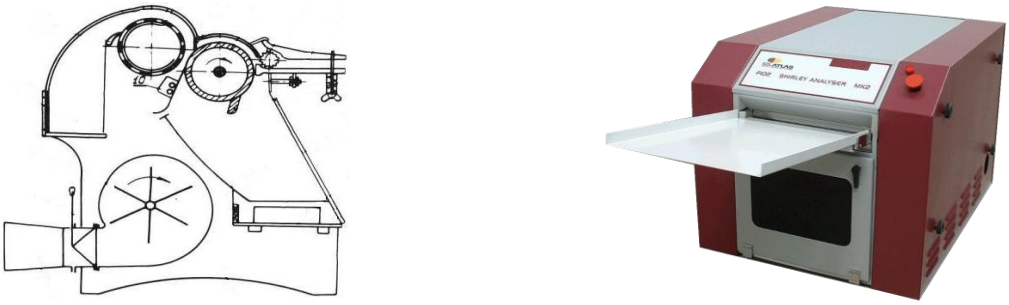
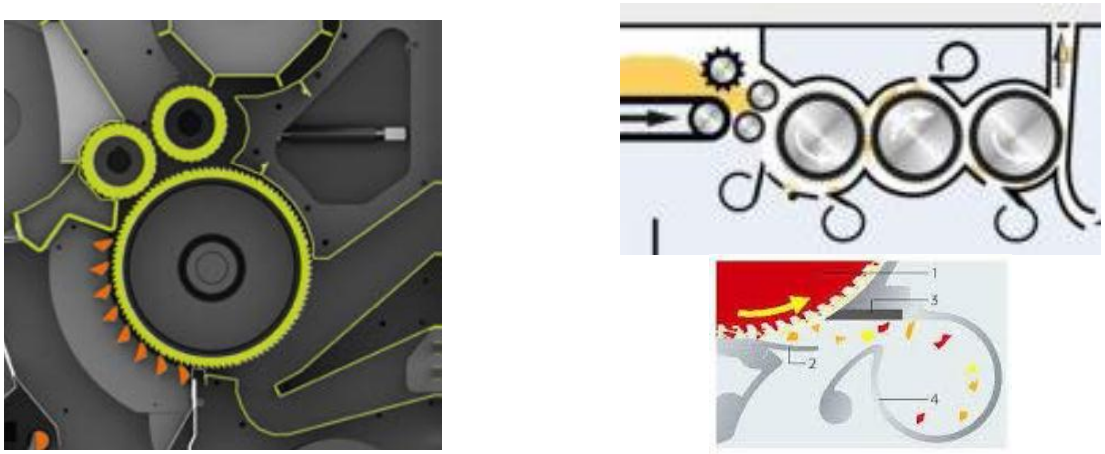


a) b)

Fig. 1 cotton analyzer AX (a) and Shirley Analyzer MK 2 (b)

At present days, enterprises do not use peculiar machines for cleaning fibrous waste generated during the processing of raw materials. They are simply coming out of the standards in the form of a bale, they are stirred in the sorting systems, or they are sent directly to the cleaning machines, including the POA, directly by pneumatic conveyor. But, according to the analysis of the research carried out, it became known that at technological transitions, fibrous waste with fibers is again formed, which can be used to produce yarn.

While analyzing the structure of the cleaning machine working bodies of different companies, it was revealed that, basically, the cleaning bodies consist of cleaning drums with serrated bands, rings and discs, as well as cleaning knives and grates of different profiles (Fig. 2).



a) b)

Fig. 2. Cleaning drum with grates (a) and cleaning drum with knives (b)

The machines, in a high degree corresponding to the character of the prospects for achieving, with the further development of high indicators in the cleaning ability, are direct-flow sawing fiber-cleaning machines.

The solution to the problem of finding new reserves for improving the designs of fiber cleaning machines presupposes the need for deep theoretical and experimental studies of the complex processes occurring in them [5].

In order to determine the possibilities of improving the working elements and technology of cotton fiber cleaning machines, the authors studied a number of scientific works. In the work of R.V. Korabelnikov and others [6] were presented the results of theoretical and experimental

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studies of fiber cleaners in relation to cotton technology. There were presented the elaborations in the theory of fibrous materials. Models of interaction of working bodies with fiber have been developed. And also, the main disadvantages of direct-flow fiber cleaners are revealed and the ways of their improvement are outlined.

Analysis of the structures of fine litter cleaners shows that although they have some differences in construction, they are generally of the same type and have identical units, such as cleaning mesh surfaces. Researchers, in order to increase the cleaning effect, have developed and recommended various designs of mesh surfaces and devices used in fine litter cleaners.

In work [7], mesh surfaces of the fine litter cleaner are proposed, where part of the bridges of each row of holes are made spherical protruding, in a checkerboard pattern.

All the above works are developed and partially applied in machines for cleaning fibers from fine litter in cotton refining plants.

Based on the analysis of the conducted work, the authors carried out an experimental study on the use of mesh surfaces on cleaning machines in the spinning shop.

For this, the authors made working sketches and mesh surfaces for use in a purification plant (Fig. 3). In the cleaning installation, instead of cleaning knives and grate bars, mesh surfaces are applied in three versions, with different holes: 6mm, 9mm and 12mm. The hole sizes are appropriately chosen based on the size of the short fibers, since the short fibers are less than 12 mm. If the holes are less than 6 mm, then the proportion of short fibers in the composition of the purified fibers increases, and, with an increase in the diameter of the hole more than 12 mm, the proportion of spun fibers in the composition of the fibrous waste increases.

a) b)

Fig. 3. Manufactured working sketches (a) and mesh surfaces (b)

In theory, the advantage of the mesh surface compared to grates and cleaning knives installed in cleaning machines is the reduction of spun fibers in the litter composition. For clarification, on the basis of the AX cotton analyzer, a fibrous waste purifier was installed. Since, today, a separate cleaning machine for cleaning fibrous waste is not used in production, experiments were carried out to clean cotton fibers that are processed in the enterprise.

The fiber of the 4th type, selection grade Namangan-34, 1-2-sort is used for the production of yarn at the “Namangan Tukimachi” enterprise. Also, up to 5% skims and fibrous waste are mixed into the sorting. The physicomechanical properties of the fibers from the bale, the rates, after the detacher, after the mixing machine and after the cleaning of the fibers in 3 variants were determined (table 1.). Physicomechanical properties were determined at the

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laboratory of the Sifat under the scientific center in Namangan city using an HVI-900 SA device [8].

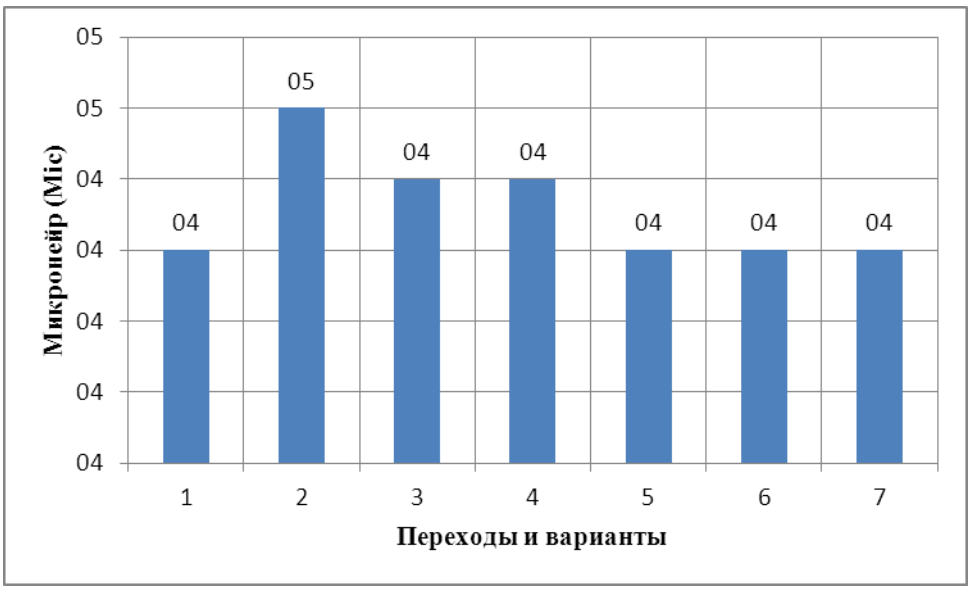
Table 1.
Physical and mechanical properties of fiber

№	Patterns	Mic (micronaire)	Str (relative strength g / tex)	Len (fiber length, inch)	Unf (uniformity index %)	SFI (number of short fibers, %)	Elg (elongation %)	T (unevenness body index	Cnt (The number of heterogeneous bodies, pieces)	Area (trea of heterogeneous bodies)	CG (class indicator	Rd (degree of whiteness)	+b (yellowness index)
1	plant	4,3	34,1	1,20	84,8	5,9	8,9	7	28	0,7	51-1	70,5	7,2
2	rate	4,5	34,3	1,18	84,9	5,2	9,1	5	13	0,5	41-3	74,1	8,2
3	detacher	4,4	33,5	1,16	85,0	5,9	8,5	5	12	0,5	41-1	75,9	7,0
4	blender	4,4	33,8	1,15	84,2	5,8	8,7	5	14	0,5	41-1	74,6	8,4
5	purifier 1-Option (6mm)	4,3	35,7	1,19	84,5	6,0	8,0	5	8	0,5	31-2	76,3	8,0
6	purifier 2-option (9mm)	4,3	33,3	1,16	83,1	8,3	8,3	5	6	0,5	41-2	73,4	7,5
7	purifier 3-option (12mm)	4,3	33,3	1,16	83,5	8,1	7,7	5	8	0,5	31-2	76,3	8,3

Above, on the construction of the cleaning machine, the authors propose a mesh surface in three versions instead of a fire grate, and the table shows the efficiency of the mesh surfaces (Table-1 No. 5,6,7).

As can be seen from the above table, although the content of microneer (Mic), relative strength (Str), fiber length (Len) and evenness or uniformity index (Unf) in the product is almost unchanged, it can be observed that the amount of short fiber (SFI) in the proposed option compared with other options decreased by 22-28%.

Chart of micronaire indication (Mic) of fiber by transition



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Here: 1 - samples (specimens) obtained from cotton ginning factories;
2 - samples obtained from the spinning industry rates;
3 - samples taken after loosening machines;
4 - samples taken after blending machines;
5 - samples taken from cleaning machines of the first option;
6 - samples taken from cleaning machines of the second option;
7 - samples taken from cleaning machines of the third option.

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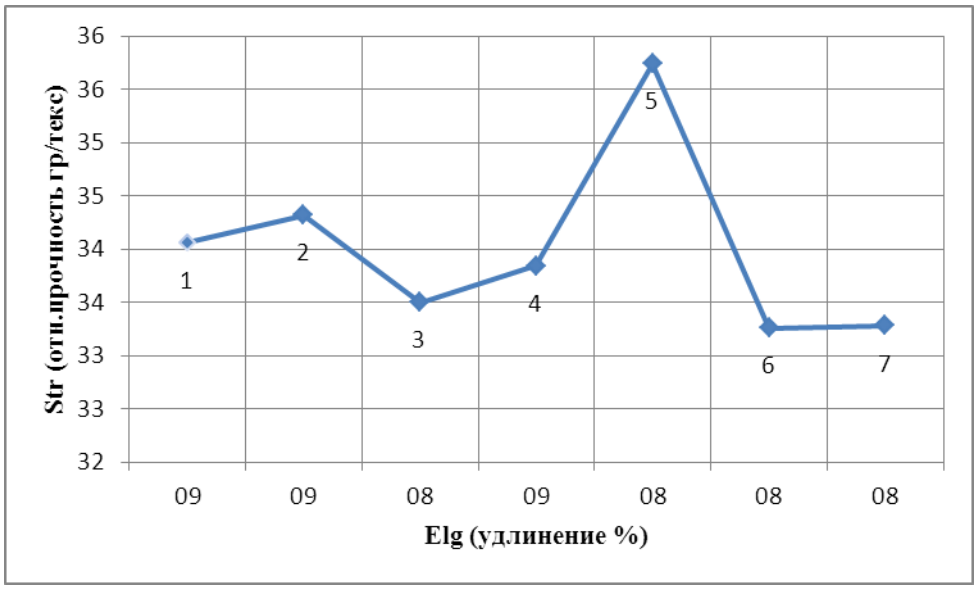
As can be seen from the above graph, the micronaire value of a sample taken from a cotton plant of 4.3 in the rate it changed to 4.5 micronaires. It's connected to the fact that various fibrous mixtures and skims are added to the rate. In other variants and transitions, the micronaire index is almost not different from that of a cotton refinery plants. As a result of cleaning the fibers from foreign impurities, short fibers and other defects after the rate and mixing process, the micronaire index of the fiber is almost the same as the micronaire index of the feedstock, this indicates that the degree of fiber maturity is within the specified norm.

Относительная разрывная нагрузка волокна и удлинение при разрыве оцениваются по прочности являющимся одним из основных показателей определяющих качество готовой продукции, то есть пряжи. На следующем графике показана взаимосвязь между относительной прочностью волокна и удлинением при разрыве.

The relative fiber breaking load and the elongation at break are estimated by strength, which is one of the main indicators that determine the quality of the finished product - yarn. The following chart shows the relationship between relative strength of fiber and elongation at break.

Chart of the relationship between the relative strength of the fiber (Str) and elongation at break (Elg)



the indications in the picture are the same as in the figure - 1

From the above graph it can be seen that the relative strength of the fiber obtained from the cleaning machines of the first option compared with the second and third options increased

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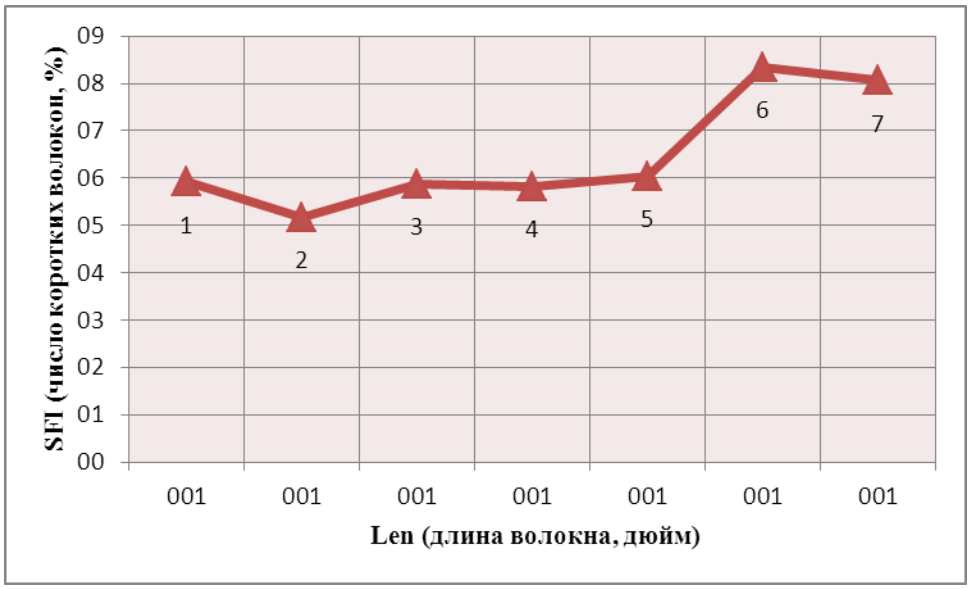
by 6%, that is, from 33.5 g / tex increased to 35.5 g / tex. Because the proportion of the content of short fibers in the product after the cleaning process in the proposed version has decreased, which directly affects the quality of the yarn produced from this raw material. It is known that the lower the proportion of short fibers in the raw material, the stronger and better the yarn is.

From the proportion influence analysis of short fibers contained in the raw material on the average fiber length, it became known that the larger the proportion of short fibers, the lower the average fiber length. The following graph shows the relationship between the average fiber length and the number of short fibers.

Chart of fiber length (Len) versus short fiber amount (SFI)



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As you can see from the graph above, the number of short fibers after the second and third variants of the cleaning machines increased if compared to the recommended variant. From this, it can be seen that the average fiber length in the product obtained in these variants is less than the average fiber length in the proposed variant. It follows that the lower the proportion of short fibers in the product, the longer the average fiber length and the higher the likelihood of producing higher quality yarns.

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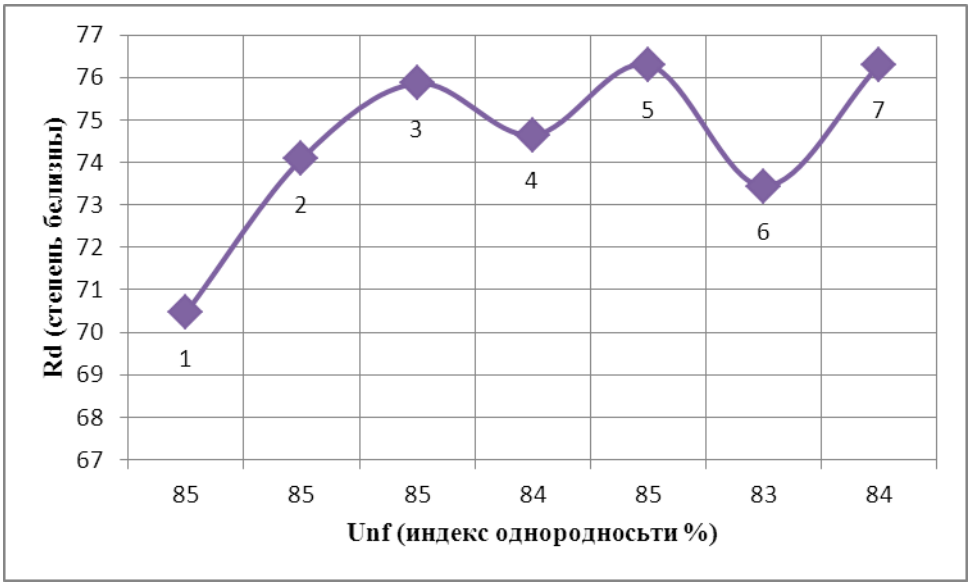
Chart of the relationship between the uniformity index (Unf) with the degree of light reflection (Rd) of fiber



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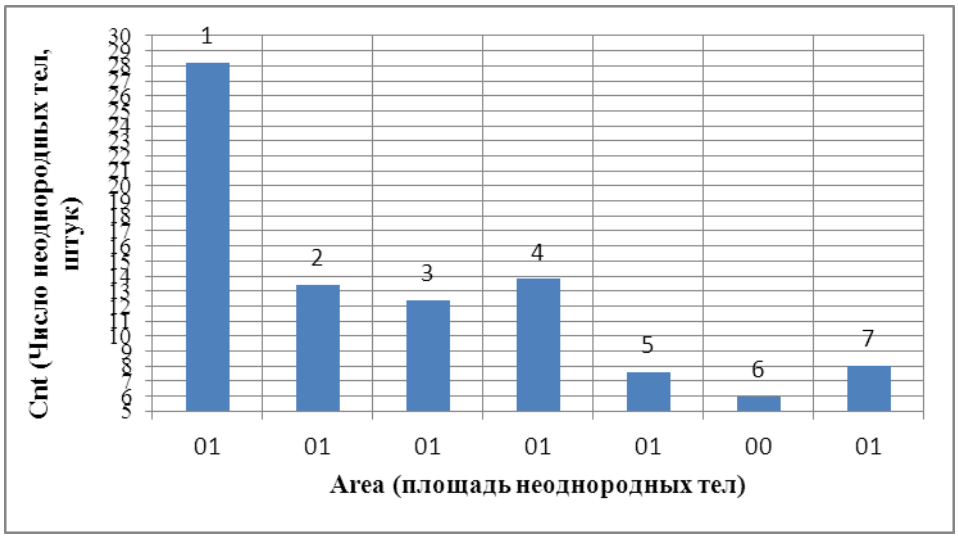
To determine the amount of trash impurities in the raw materials per unit area, HVI system laboratory equipment was used. The results are shown in the bar diagram below.

Bar diagram representing the number of foreign bodies (Cnt) per unit area (Area)



the indications in the picture are the same as in the figure - 1

CONCLUSIONS

As can be seen from the bar diagram, trash and foreign body amount in the products in the proposed version has sharply decreased. In other words, the amount of trash and foreign bodies in the sorting composition decreased by more than 40%.

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