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To cite this article: H Yu Ulugmuradov *et al* 2020 *IOP Conf. Ser.: Earth Environ. Sci.* **614** 012127

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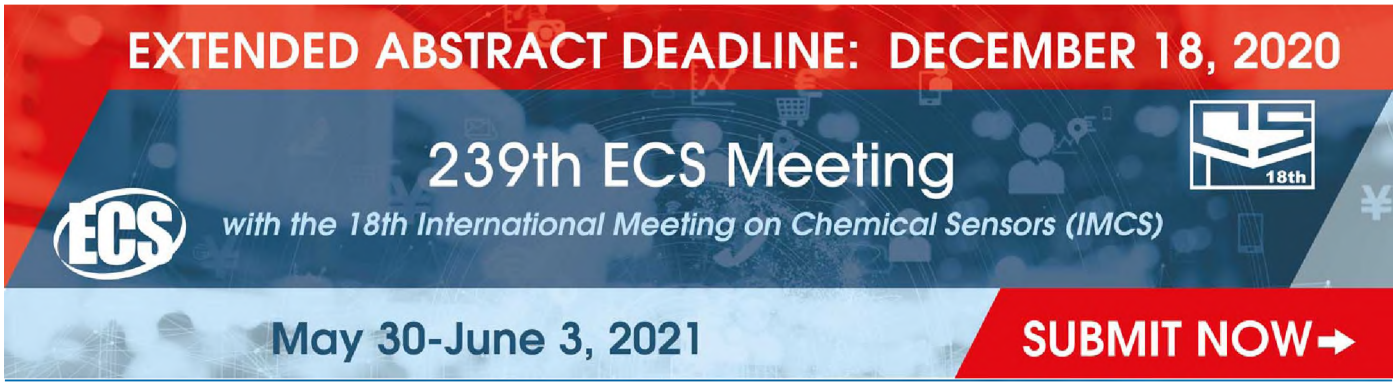

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Study on improving the efficiency of cleaning the pile drum

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Abstract. This article provides an analysis of current news about the development of the cotton industry in the country. It is also based on theoretical research and analysis of cleaning processes used in foreign countries, as well as ways to improve the efficiency of cleaning the pile drum, which is the main working body of equipment for cleaning cotton from small impurities. It is based on the need for theoretical calculations of its cleaning surface to increase the cleaning efficiency of fine-grained cleaning equipment. The results of theoretical research on the calculation of useful surfaces of mesh surfaces based on the calculation of the surface of the pile and the mesh located at the bottom, which are currently used in the republic and abroad. The need to develop new structures and their calculations were made to increase the use of mesh surfaces up to 100%.

1. Introduction

In our country, special attention is paid to the production of high-quality fiber, which ensures competitiveness in the world market on the basis of improving the equipment and technology of ginning and textile cluster enterprises, processing of harvested raw materials while maintaining quality. At the meeting of the President on April 23, 2020 on ensuring the stability of the textile industry, mitigation of the impact of the pandemic on the development of the industry, he said: It is possible to fully process cotton and increase exports to $ 15 billion. To do this, increase the production of finished products by 4-5 times in the next 5 years, reduce the cost of competitors, expand the range of products to enter and occupy foreign markets the quality needs to be dramatically improved.

Resolution of the Cabinet of Ministers of the Republic of Uzbekistan dated June 22, 2020 "On measures to organize the activities of cooperation in the cultivation and processing of raw cotton" Resolution No. 398 was adopted [1]. The resolution states that cooperatives for the cultivation and processing of raw cotton have been established on the basis of mergers of farms. Their main tasks are to receive, store and process raw cotton by ginners, to organize the introduction of advanced foreign experience and resource-saving innovative technologies in order to increase the efficiency of agricultural land use and productivity, etc. tasks are loaded. Deep processing of cotton raw materials grown in our country is the most important task facing scientists and members of cooperation to provide the domestic and foreign markets with quality products.

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The efficiency of ginning machines installed in the technological process of today's ginneries is low. In addition, repeated exposure to cotton piles can damage the seed and lead to various defects in the fiber content [2]. Therefore, if the theoretical and practical study of the process of cleaning cotton from fine impurities is one of the important issues, we will analyze the scientific research conducted for this purpose.

2. Method

In this study, the process of cleaning cotton from fine impurities is one of the most important processes in the initial processing of cotton, which has a major impact on the later stages, i.e. ginning and fiber cleaning. If the fine impurities are not cleaned sufficiently, it will pass from the passive impurity to the active impurity, and it will be difficult to separate these impurities in the fiber cleaner. All cleaners that separate fine contaminants from cotton work in the same way, i.e. the cotton is sifted through pile drums and moved through mesh surfaces. This process is repeated several times and the cotton is cleaned of fine impurities. The cleaning efficiency depends on the number of turns of the pile drums, the mesh surface and the quality indicators of the cotton.

2.1. Experimental apparatus

In the process of cleaning cotton from small impurities, the same pile drums are used in the equipment for cleaning small impurities. It (Figure 1) consists of shaft 1, disc 2, and cover 3. The cladding is 3 ribbed, with a pile drum arranged in such a way that 75 pegs are welded in 150 mm increments in the middle of these ribs (Figure 1).

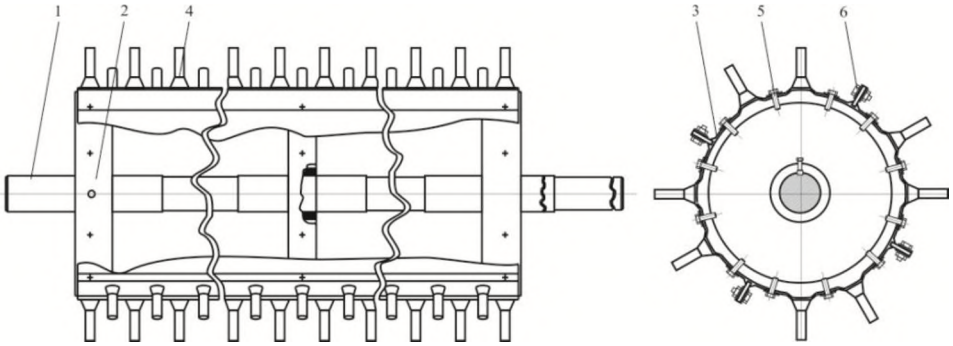

Figure 1. Pile-drum drum: 1-shaft, 2-disc, 3-cover, 4-pegs, 5-drum and rail fastening bolt, 6- two-rail fastening bolt, nut and washers

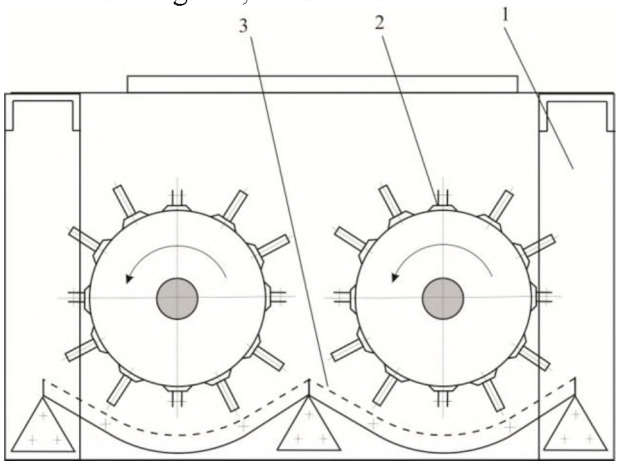

Figure 2. Cleaning unit type EN.178: 1- frame, 2- pile-bar drum, 3-mesh surface

The rotational speed of the vibrating pile-plank drums determines the increase in the mechanical damage of the cotton seed, and the useful surface of the mesh surface determines the release of contaminants from the cotton. All fine-grained cleaning equipment uses perforated mesh surfaces with dimensions of 6x50 mm

2.2 Formation of the problem

The number of bars on the drum is four. Of this number, the drum has a total of 300 pegs. The slats are fastened to the discs and to each other using bolt-nuts. Where they were fastened, bars were formed along the perimeter of the drum. In this regard, these cleaning drums are called pile-bar drums. The main disadvantage of these drums is the complexity of their manufacturing technology and the frequent replacement of the piles during operation due to the separation of the piles from the place of welding to the ribs [3]. As a result, the level of cotton cleaning will not be sufficient. A lot of scientific research has been done to prevent this.

Burnashev has deeply studied the impact of technological parameters of cotton on the process of cleaning and management of this process. In this scientific work, the term its structure (m) was introduced as a technological indicator of cotton. The structure of cotton (m) is an indicator of how many individual seed parts it consists of. This indicator is important in cleaning cotton from large and small contaminants. It has been proven that it is possible to increase the efficiency of the cleaning process by reducing this figure [4].

Sosnovsky theoretically analyzed the movement of cotton from one single-pile drum to another pile drum in the cleaning of cotton from fine impurities. The formula for the velocity of a piece of cotton at the time of hitting the pile was found, and the impact force acting on the piece of cotton at the time of hitting was calculated. The relationship between impact force, impact angle, and pile drum speed was determined. A study on cleaning cotton from fine contaminants found that the increase in cleaning efficiency did not change at a higher speed when the linear velocity of the pile-blade drum ranged from 5 to 11 m/s. A critical velocity of the pile drum was found to be the onset of cotton seed damage. This speed is practically recommended to be 9 m/s, which is equivalent to 420 rpm of a pile-rail drum. The speed of the pile drums on the current 1XK cleaners, which removes fine contaminants from cotton, is 8.8 m/s [5].

Jabborov studied the effect of rotational speeds of pile-bar drums on the cleaning efficiency of the equipment and seed damage. Experiments have shown that the cleaning efficiency of the equipment increases when the rotational speed of the pile-plank drums is 11 m / s, and when the rotation speed is higher than this value, the cleaning efficiency of the equipment decreases and the seed damage increases [6].

In the scientific work of Usmanov, it was theoretically found that the movement of the cleaned cotton on the surface of the pile depends on the height of the pile, the radius and speed of the drum. The differential equation of motion of a piece of cotton on the pile surface is formed. The process of separation of contaminants on the surface of the mesh in pile-bar drum cleaners has been studied. It has been found that the cleaning efficiency of the net surface hole increases from round to elongated shape when cleaning cotton from fine impurities [7]. This recommendation also works well on current 1XK cleaners.

Based on the analysis, it can be seen that no extensive research has been conducted on the use of the mesh surface. Studies have not yielded effective results either. That is why we conducted foreign technology analyses.

In the U.S.A, primary cotton processing technology, fine impurities are released into the fine-grained cleaning equipment by first passing the cotton through the top of the pile-drum drills, then crushing it, and then dragging the crushed cotton over the mesh surface using pile-drum drums. The separated contaminants pass through the mesh surface and fall into the contaminant bunker. The cleaned cotton is sent to the next process. Analyzes show that in the U.S.A, cotton ginning is mainly carried out by aeromechanical methods, with no special supply devices installed, and cotton is fed to air ginners [8]. It can be seen that with the help of existing cleaning drums without additional equipment, the cotton is

crushed and spread, that is, it is well prepared for cleaning, and there is a partial separation of impurities from the cotton. This initial spinning process eliminates the uneven transfer of cotton piece by piece within the existing unit of time in the air transfer of cotton and has a positive effect on the cleaning efficiency.

(CIRKOT) Cotton Technology Research Institute have developed oblique drum cleaners for the separation of impurities in the fiber, which consist of 6 drum cleaners with a working width of 1240 mm and used needle drums and a fan to clean cotton from contaminants. The overall cleaning efficiency of the newly created primary cotton cleaning equipment was 22% [8].

In the research, the use of pile drums was theoretically studied to analyze how many working surfaces were used by the pile drums and not how widely the pile drums were used.

3. Result and Discussion

The best result is obtained when the drum is placed at a distance of 50 mm along the axis and at a distance of 100 mm along the circumference. When evaluating the mesh surface, its useful surface coefficient is determined using the following formula.

$$K=\frac{F}{f} \quad (1)$$

where: F is the useful surface area of the mesh surface

f is the total surface area of the mesh surface

The authors have identified the useful surface of the mesh surface of the cleaning machine brand 1XK, which is currently used in ginneries. Figure 2 shows the location of the pile drum and mesh surface.

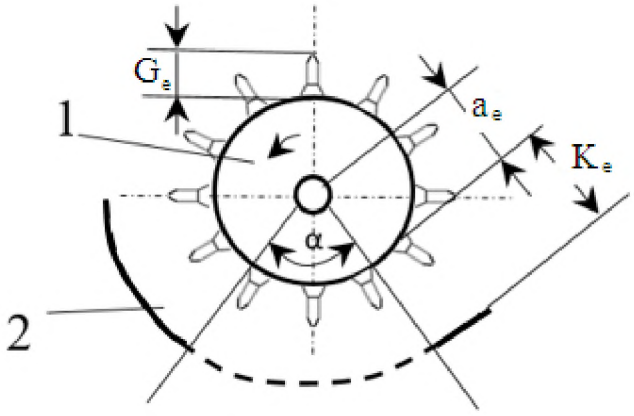

Figure 3. Schematic of a pile drum and mesh surface: 1 pile drum, 2 mesh surface

We determine the distance from the mesh surface in the center of the pile drum using the following formula.

$$R_e = G_e + a_e + K_e \quad (2)$$

where: G_e- drum radius

a_e-pile height

K_e-is the distance between the pile and the mesh surface

The width of the mesh surface under the pile drum is found from the following formula.

$$h_e = 2\pi R_e(G_e + a_e + K_e); \quad (3)$$

If we denote by M_e the length of the mesh surface in a cotton ginning machine, then the surface area of the mesh surface

$$F = h_e * M_e = 2\,\pi(G_e + a_e + K_e) * M_e\,; \quad (4)$$

where: h_e-is the width of the mesh surface;
M_e-is the length of the mesh surface;
In the ginning machine 1XK, which is equipped with a technological process in ginneries, the mesh surface will be located in the size of 60 degree [9, 10].
In this case, the useful surface area of the mesh surface is given in Table 1.

Table 1. Mesh surface are

O/n	The length of the mesh surface M_e (mm)	The angle of coverage of the mesh surface is a (degree)	Mesh surface width K_e (mm)	The mesh surface is a useful surface (sm^2)
1	1800	60	230	0.41
2	1800	65	251	0.45
3	1800	70	269	0.48
4	1800	75	288	0.51
5	1800	80	307	0.55
6	1800	85	325	0.58
7	1800	90	345	0.62

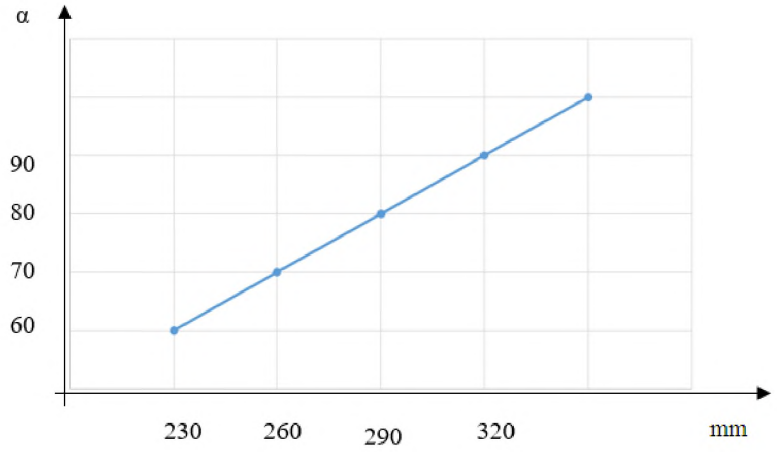

Figure 4. The relationship between the coverage angle of the mesh surface and the useful surface

As can be seen from Table 1, the actual occupied distance occupies its useful surface.
Based on Table 1, we see the graph in Figure 3. This graph is mainly represented by the coverage angle of the mesh surface, the relationship between its useful surfaces.
It is also necessary to check the location and length of the drum piles and the rotational speed of the drum by experiment.
In addition, the authors have created a new design that cleans the cotton from fine contaminants, which allows increasing the coverage area of the mesh surface (application № IAP 20190227). This working constitution is being examined by the Intellectual Property Agency [11].
Due to the structural structure of the pile drum and mesh surface, it would be expedient to obtain around 70 ÷ 80. An increase in the angle of inclination every 10 degrees results in a 10 per cent increase in the useful surface area of the mesh.

As well as, by improving the equipment, electricity consumption is saved, and with the installation of a new construction of the cleaning equipment, it will be possible to remove 20-30% of contaminants from the cotton.

4. Conclusions

In the process of cleaning cotton from small contaminants, several ways have been found to minimize the impact of pile drums as much as possible. This ensures high cleaning efficiency of the machine. This is achieved by increasing the useful surface area of the mesh. The new design has the ability to install the piles on an elastic base to reduce seed damage during the cotton cleaning process. This in turn ensures that the process of cleaning the cotton from fine contaminants is carried out in a gentle mode.

Acknowledgments

The authors gratefully acknowledge that the present research is supported by Ministry of Research and Technology and Higher Education Republic of Uzbekistan.

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