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CONDUCTING EXPERIMENTS BY INSTALLING A DIFFERENT MESH SURFACE ON LABORATORY EQUIPMENT THAT CLEANS FROM SMALL IMPURITIES

Abstract. This article presents a study on a machine designed for cleaning cotton from small impurities, focusing on its main components. A laboratory version of the cleaning equipment was developed, and its operating principle is described. Various mesh surfaces were prepared in different sizes and shapes, and their effective surface areas were measured. The research objectives were defined, and experiments were conducted using mesh surfaces of different geometries installed on the laboratory equipment. The impact of mesh surface shape on cleaning efficiency, seed damage, and the presence of fiber defects and residual impurities was analyzed. The obtained results were analyzed, and the compliance of the equipment's cleaning efficiency and the levels of fiber and seed damage with state standards was studied. Based on the analysis, it was established that the cleaning efficiency had increased.

Keywords: cotton, clean, fiber, mesh surface, pile drums, efficiency, small impurities, defects, seed, contamination, grade, saw gin.

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Introduction. During the years of independence, a wide range of measures have been implemented in our republic to improve the consumer properties of cotton products, to create technological processes for the initial processing of cotton and high-efficiency production management systems. In this regard, significant results have been achieved, including in obtaining cotton products of a certain quality from raw materials processed at cotton ginning enterprises, depending on their initial indicators, and in improving the techniques and technology for cleaning cotton from small impurities. At the same time, the low efficiency of cotton ginning and production productivity remain an urgent issue [1].

The separation of small impurities from the cotton is mainly carried out using a pile drum and a mesh surface [2].

The main disadvantage of the device is that since the process of cleaning cotton raw materials from small impurities is mainly carried out on a fixed mesh surface and a pile drum, the degree of damage to cotton increases and productivity is low [3].

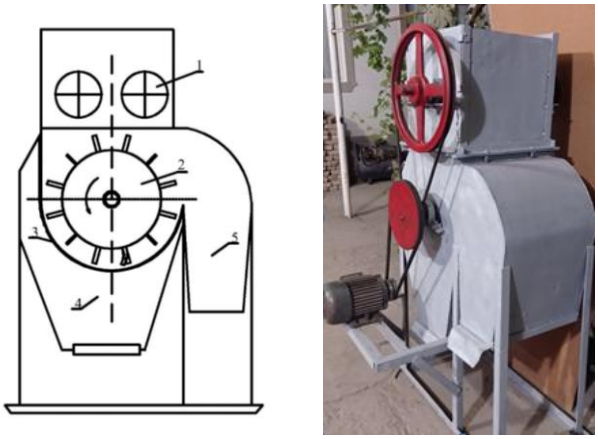
Materials and methods. Drawings of the proposed equipment for cleaning small impurities from cotton with an improved elastic pile drum were prepared, and a laboratory device was developed based on these drawings. The elastic pile-plate drum is transferred to the elastic pile-plate drum *2* using feed rollers *1* located in the improved cleaner body, with the help of which the cotton is passed through a mesh surface *3*, and as a result, the process of separating small impurities from the raw materials is carried out. The impurities separated from the cotton raw material fall into the impurities bunker *4*, and the cleaned raw material falls into the cleaned cotton bunker *5*.

In the laboratory version of the cleaning equipment, the effects of the working parts, the geometric dimensions of the pile-slatted drum, the shape of the feed rollers, the speeds and the distance between the pile-slatted drums and the mesh surface, and the shape of the mesh surface made in different sizes on the cleaning efficiency were experimentally determined [4].

A general view of the experimental equipment is presented in Figure 1.

The width of the proposed laboratory equipment for cleaning small impurities from cotton is 400 mm, the height is 1700 mm, the distance between the supply rollers and the pile-slatted drum axes is 300 mm, and the distance between the pile-slatted drums and the mesh surface is 14-18 mm.

The experimental equipment works as follows: the feed rollers *1*, rotating relative to each other, transfer the cotton to the pile-slatted drum *2*. The drum with pegs and slats separates small impurities from the cotton by dragging and dragging it on the surface of the mesh surface *3*. The impurities separated from the cotton fall into the impurity bunker *4* through the holes of the mesh surface. The cleaned cotton is collected in the cotton bunker through the outlet throat *5* [5].



1 – feed rollers; 2 – pile-slatted drum; 3 – mesh surface; 4 – dirt hopper; 5 – cleaned cotton outlet.

Fig. 1. General view of the experimental equipment

Research results and discussion. The experiments were conducted in the following variants:

– in the existing cleaning process on the peg-and-slat drums;

– without changing the number of revolutions of the existing peg-and-slat drum and in the proposed technological process;

– without changing the existing mesh surface and in the technological process with the proposed mesh surface shape installed;

– the effect of the shape and dimensions of the mesh surface on the cotton raw material, in the technological process;

– the effect of the size of the mesh surface holes, the distance of 14-18 mm between the mesh surface and the peg-and-slat drum, on the cleaning efficiency of the equipment. Each experiment was repeated 8 times and the average values of the results were obtained.

Samples were taken before and after the cleaner. The moisture content and dirtiness of each cotton sample were determined. During the research work, the useful surface area of the mesh surface and the effect of mesh surfaces on cotton raw materials were studied. Sample analyses obtained during the experiment were performed in the laboratory of the Department of "Natural Fibers and Fabric Processing Technology" based on the methods given in the state standards UzDst 632:2016, UzDSt 644:2006, UzDSt 592:2018 [6].

Initially, a laboratory copy of the pile-slat drum 400 mm long and 400 mm in diameter, available in cleaning equipment, was prepared and experiments were conducted (Figure 1). The experimental results are presented in Table 1.

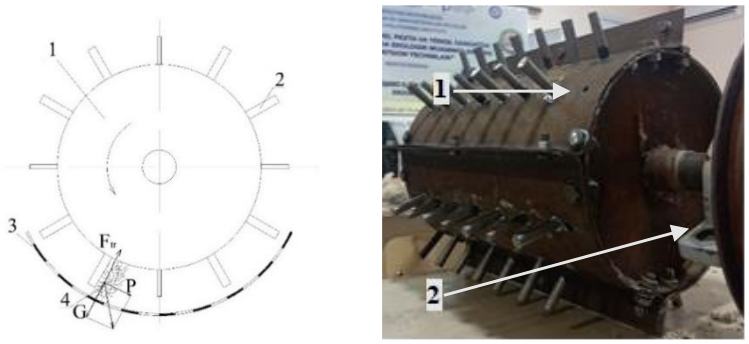
Table 1

Results of test work conducted on laboratory equipment with pile-slat drums

№	Indicators	Unit	Pile-plank drums	
			Existing	Modified
1	Cotton selection – variety – grade		Ravnak I 2	Ravnak I 2
2	Before cleaning (Input cotton parametrs) – moisture content – trash content	 % %	 9.2 6	 9.2 6
3	After cleaning (Output cotton parametrs) – moisture content – trash content	 % %	 9.2 2.4	 9.2 2.2
4	Cleaning efficiency of the equipment	%	42.2	46.7
5	Equipment performance	kg/hour	7075	7075
6	Mass fraction of defective fibers and residual impurities in the fiber after cleaning	%	2.24	1.96
7	Seed condition after ginning – seed fuzziness (hairiness of the seed) – degree of seed damage	 % %	 10.9 3.44	 10.5 3.15

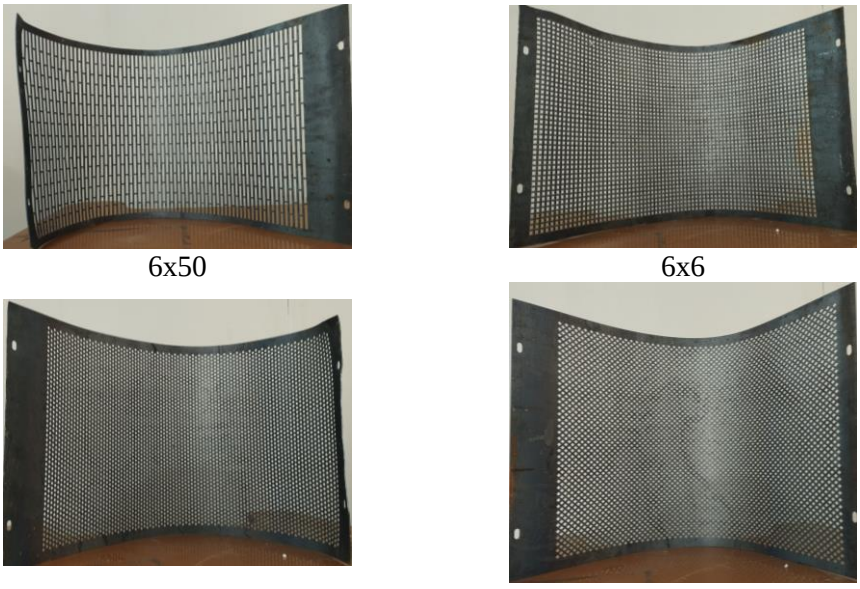
After obtaining results in the laboratory equipment with the existing pile-and-slat drum and mesh surface, experiments were conducted in the laboratory with the shape and dimensions of the mesh surface changed (Figure 2). The experimental results are recorded in Table 2.

The mesh surfaces in Figure 3 were prepared in different sizes. The separation of fine impurities and the condition of the cotton after cleaning are presented in Figure 4.



1 – pile-barrel drum; 2 – piles; 3 – mesh surface; 4 – cotton piece.

Fig. 2. Scheme and general view of the existing pile-barrel drum of the cotton cleaning equipment



6x50 6x6

A polygon with sides of 6 mm rhombus with a spacing of 6 mm

Fig. 3. Mesh surfaces prepared in different sizes

a) b) c)

a) appearance of unpolished cotton; b) appearance of cleaned cotton; c) separated fine impurities

Fig. 4. Fine impurities separated from cleaned cotton and appearance of cleaned cotton

Comparative experimental research was carried out on industrial varieties of Ravnak selected cotton I/1 and Sultan selected cotton II/2.

Experimental research was carried out on the basis of the established methodological methodology.

As is known, the new technology for separating fine impurities from cotton differs from its predecessors in its constructive advantages.

When choosing the geometric dimensions of the piles of the fine impurities separation equipment, experiments were conducted with different values of the diameter of the pile and the distance between the mesh surface and the mesh surface dimensions. In order to study the effect of the improved mesh surface in the cleaning equipment and the movement of cotton on it on fiber and seed damage, the mesh surface shape and size, the distances between the pile tip and the mesh surface were selected.

First, the existing mesh surface was installed and the experiment was conducted. In this case, when Ravnak selected I-industrial grade cotton with a moisture content of 9.2% and an average impurity of 6% was cleaned in the machine, the average impurity of the cotton after the machine was 2.4%, and the cleaning efficiency of the machine was 42.2%. When the efficiency of the machine was determined by the chronometry method, it was 7075 kg/hour on average. To determine the quality of the fiber in the cleaned cotton, the cotton was ginned on a 10-saw gin in the laboratory, and then cleaned in a fiber cleaner in the laboratory. To determine the quality of the cleaned fiber, samples were taken 8 times, analyzed, and the average was taken. It was determined that the mass fraction of defective fibers and impurities in the fiber after the fiber cleaner was 1.95% on average, and the quality indicator belonged to the I-grade "Oliy" class according to the state standard UzDst 632:2016.

Conclusion. To determine the quality of the cotton content, samples were taken from the post-ginned seed and analyzed in laboratory conditions. The average hairiness of the post-ginned seed was 10.9%, and the average damage was 3.44%. This indicator was achieved when using an elastic pile-slatted drum in the equipment. When cleaning Ravnak selection I-industrial grade cotton with a moisture content of 9.2% and an average dirt content of 6%, the average dirt content of the post-ginned cotton was 2.4%, and the quality of the cotton improved by an average of 0.2 (abs)% compared to the quality of cotton produced by the existing drum equipment. It was found that the cleaning efficiency of the equipment in cleaning cotton was 45% on average, which is 2.8 (abs)% higher than the cleaning efficiency of the existing drum equipment. In this case, the average productivity of the equipment was 7075 kg/h, and it was found that the cleaning efficiency of the equipment was improved by an average of 3% compared to the existing mesh surface taken for the experiment.

To determine the quality of the fiber in the cleaned cotton, the cotton was first ginned on a 20-saw gin. In this case, the hairiness of the seed after ginning was 10.5% on average, and the seed hairiness level decreased by 0.4 (abs)%. The average damage of the seed was 3.15%, which was 0.29 (abs)% less than the damage of the seed obtained from the gin produced by the existing gin, and the quality of the seed was improved.

The fiber produced from the ginned cotton was transferred to the fiber cleaner through the gin nozzle and cleaned. The mass fraction of defective fibers and impurities in the cleaned fiber was on average 1.96%, and the quality improved by 0.38 (abs)%, which determined its belonging to the II-grade "Oliy" class according to the state standard UzDst 632:2016.

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ҰСАҚ ҚОСПАЛАРДАН ТАЗАРТУҒА АРНАЛҒАН ЗЕРТХАНАЛЫҚ ЖАБДЫҚҚА ӘРТҮРЛІ ТОР БЕТТЕРДІ ОРНАТУ АРҚЫЛЫ ЭКСПЕРИМЕНТТЕР ЖҮРГІЗУ

Аңдатпа. Мақалада мақтаны ұсақ қоспалардан тазартуға арналған машинаның құрылымы мен негізгі элементтеріне бағытталған зерттеу ұсынылады. Тазарту жабдығының зертханалық нұсқасы жасалып, оның жұмыс істеу принципі сипатталған. Тор беттер әртүрлі өлшемдер мен пішіндерде дайындалып, олардың тиімді жұмыс беті өлшенді. Зерттеудің мақсаттары айқындалды, әртүрлі геометриядағы тор беттерді зертханалық жабдыққа орнатып, тәжірибелер жүргізілді. Тор бетінің пішіні тазалау тиімділігіне, тұқымның зақымдануына, талшықтағы ақаулар мен қалдық қоспаларға әсері талданды. Алынған нәтижелер жабдықтың тазалау тиімділігі мен талшық пен тұқымның зақымдану деңгейінің мемлекеттік стандарттарға сәйкестігін анықтау үшін талданды. Зерттеу нәтижелері бойынша тазалау тиімділігі артқаны анықталды.

Тірек сөздер: мақта, тазарту, талшық, тор беті, ине барабандары, тиімділік, ұсақ қоспалар, ақаулар, тұқым, ластану, сорт, тісті джин.

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ПРОВЕДЕНИЕ ЭКСПЕРИМЕНТОВ С УСТАНОВКОЙ РАЗЛИЧНЫХ СЕТЧАТЫХ ПОВЕРХНОСТЕЙ НА ЛАБОРАТОРНОЕ ОБОРУДОВАНИЕ ДЛЯ ОЧИСТКИ ОТ МЕЛКИХ ПРИМЕСЕЙ

Аннотация. Статья посвящена исследованию машины, предназначенной для очистки хлопка от мелких примесей, с акцентом на её основные конструктивные элементы. Была создана лабораторная версия очистного оборудования, описан принцип его работы. Представлена информация о сетчатых поверхностях. Сетчатые поверхности были подготовлены в различных размерах и формах, и была определена их эффективная площадь. Были поставлены исследовательские задачи, проведены эксперименты с установкой сетчатых поверхностей различных форм на лабораторное оборудование, получены результаты. Проанализировано влияние изменения формы сетчатой поверхности на эффективность очистки хлопка, повреждение семян, а также количество дефектов и примесей в волокне. Полученные результаты были проанализированы, изучено соответствие эффективности очистки оборудования, уровня повреждения волокна и семян государственным стандартам. По результатам анализа было установлено, что эффективность очистки повысилась.

Ключевые слова: хлопок, очистка, волокно, сетчатая поверхность, игольчатые барабаны, эффективность, мелкие примеси, дефекты, семена, загрязнение, сорт, пильный джин.