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EXPERIMENTAL CONSTRUCTION DEVELOPMENT OF THE DEVICE FOR CLEANING COTTON FROM SMALL IMPURITIES

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Abstract:
In the article, the working scheme and experimental design of the device for cleaning cotton from small impurities have been developed. In this study, the improved device was tested for its efficiency and energy efficiency, and corresponding results were obtained. This study focuses on optimizing the cleaning efficiency of cotton ginning by developing a device that reduces mechanical damage while improving the quality of the fiber. The experimental device includes a continuous slotted mesh surface and a pile drum system, which significantly enhances impurity removal.

Keywords: cotton, fine impurities, aggregate, cleaning, pile drum, device, seed, improvement, opening drum.

Introduction

At present, cotton ginning enterprises use the UXK complex unit for cleaning raw materials from large and small impurities. It is known that impurities are divided into small and large types, and during cleaning, various technological processes are carried out in the devices according to these types. Large impurities are cleaned in the zone of the saw and grid bar, and small impurities are cleaned in the zone of the pile drum and mesh surface. Cleaned raw cotton is sent to the ginning process.

Cotton raw materials may contain cotton leaves, husk residues, broken and broken seeds, and small mineral impurities. If the impurities in the cotton are not cleaned to the maximum during cleaning (usually the cleaning efficiency is 70-75%), the quality of the fiber produced after further

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processes may decrease [1]. Taking this into account, in the newly improved device for cleaning small impurities, small impurities from the content of cotton raw materials are prevented from being added to the air and passed to the next technological processes. The advantage of the newly proposed cleaning device is to increase efficiency and reduce mechanical impact on the raw material as a result of cleaning with a continuous mesh surface and belt piles.

The main working organs of the improved small impurity cleaning device are mesh surface with continuous slits [2] (the slits have no obstacles along the total area of the surface, the rings ensuring the strength of the wires are on the lower level of the mesh surface is located and does not interfere with the impurities falling on the ring) and consists of a drum with pegs mounted on a belt element (Fig. 1).

In the improved small impurity cleaning device, as a result of an increase of 12-14%, the improvement of fiber quality brings significant economic efficiency to the enterprise.

The device works as follows: From the supply rollers 1, through the drum 2, the cotton raw material meets the pile drums 3, which are installed on the strap base 5. Drums with piles carry the mass of raw cotton and bring it to the mesh surfaces 6, and the cotton is thoroughly crushed as a result of the influence of the piles and the drag over the mesh surface. As a result of cleaning, small impurities in the cotton raw material pass through the slits of the mesh surface.

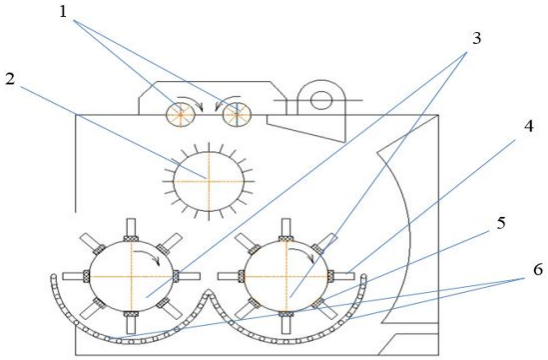

Figure 1. The technological scheme of the improved small impurities cleaning zone: 1-supply rollers, 2-opening drum, 3-pile drums, 4-piles, 5-belt base of piles, 6-continuous slotted mesh surface.

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The main technological difference of the device from other cleaners is that the mesh surface is made of smooth steel wires, and because the wires form continuous slits, the useful area of the mesh surface is almost doubled (54.2%), resulting in a significant increase in cleaning efficiency. In addition, due to the increased smoothness of the surface, it is possible to work easily without jams at the given maximum productivity, and since the piles are installed on a strapped base, as the intensity of opening increases, the condition of mechanical damage decreases.

When the amount of defects and impurities in the fiber content of the cotton ginning enterprise is within the set accounting standards, it is carried out based on a certain cleaning plan for the processing of cotton raw materials. The choice of cotton cleaning plan depends on its initial contamination, selection, and industrial type, and cotton cleaning is carried out in the next process.

Currently, the main technological equipment for cotton processing is the 1XK type cotton cleaner, the 1XK pile cleaner, and the UXK cleaning unit. The use of such machines in the cotton ginning industry makes it possible to obtain cotton fibers of the required quality [3].

Therefore, in practice, in some selected types of cotton, machines are used that provide high cleaning efficiency and have good performance, because the separation of different types of cotton from the fiber is different due to the strong attachment of dirt to the fiber.

The speed of rotation of the drums of the equipment for cleaning raw materials from impurities, the mode of operation, and their constructions were used for the processing of industrial varieties of previously grown cotton.

In addition, the recommendations given as a result of the research are used for previously grown cotton varieties and differ from some parameters for new cotton varieties, such as yield, ripening time, fiber length, and seed size.

One of the main decisive factors in the technological process of cotton raw material cleaning is the cotton seed size. The size of the cotton seed is reduced in the newly selected varieties of raw material. For example, in the experiments on determining the size of cotton seeds of the selection variety "Porlok-1, 2", the methodology was carried out as follows: the sizes of 100 seeds were determined for testing. After measuring the test samples, the

length and width of each seed were measured using a micrometer, then the width and length of the seed were divided into three groups, and the number of seeds in a certain group was determined [4].

From the information given in Table 1, it can be seen that the amount of seeds 0.0068-0.0072 m long is 14%, the amount of seeds 0.0075-0.0081 m long is 36%, 0, 0083-0.01 m long seeds amount was 50%. It should also be noted that the amount of seeds with a width of 0.0035-0.0040 m is 22%, the amount of seeds of 0.0041-0.0045 m is 55%, and the amount of seeds of 0.0050-0.0055 m is 23%.

The results of the experiment showed that the sizes of Porlok selection variety cotton seeds were 15-18% smaller than the sizes of previously grown cotton seeds [5]. This requires paying attention to the established technological parameters and procedures of cotton cleaning equipment.

First, small seeds are more susceptible to mechanical damage than relatively large seeds, and second, the size of the grooves of the cleaning surfaces (currently around 6 mm) should be reduced. For this, it is necessary to quickly replace the working parts of the cleaning equipment and adapt it to the working mode.

Table 1. The results of measuring the size of the seed.

Seed weight, g	Length, m	Seed amount, pcs	The width of the seeds in the cross section, m	Number of seeds, pcs
	0,0068-0,0072	15	0,0035-0,0040	25
10,12	0,0075-0,0081	37	0,0041-0,0045	49
	0,0083-0,010	48	0,0050-0,0055	26
	0,0068-0,0072	14	0,0035-0,0040	22
10,16	0,0075-0,0081	36	0,0041-0,0045	55
	0,0083-0,010	50	0,0050-0,0055	23
	0,0068-0,0072	37	0,0035-0,0040	36
10,18	0,0075-0,0081	23	0,0041-0,0045	38
	0,0083-0,010	40	0,0050-0,0055	24

It follows from this that during the processing of cotton raw materials with relatively small seeds, there are cases where the seeds are squeezed into the large slits or the raw material passes through the slits. When designing a new device, it is advisable to make the distance between the slots 5 mm or less.

To analyze the reason for the low cleaning efficiency of technological machines, the dependence of the total cleaning efficiency of the cleaner

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equal to the number of working bodies of the cleaning section was used, which has the character of geometric progression and is expressed by the following equation:

$$K_{\sum m} = K_1 \frac{1-q^m}{1-q}$$

Where, K_1 – cleaning efficiency of the first section, %;
q - the denominator of a geometric progression;
m – number of cleaning sections (working drums), pcs.

In general, the amount of working bodies in the cleaner is not very large. Also, the monotony of the process not only reduces the cleaning efficiency of each subsequent section but also leads to the deterioration of its appearance and the appearance of defects.

Thus, it is not advisable to use one type of working body in the cleaner. This idea is also based on experiences in the textile industry, where different working bodies are used in each pass of fiber processing (opening, beating, and carding), the same machines are never installed in a row [6].

In the cotton cleaning industry, the use of various working bodies for cleaning cotton, including the installation of pile drums on a belt base (rubber, metal, etc.) in the 1XK cleaners used for cleaning cotton from small impurities, has been studied in various researches, and all the proposed the working bodies work under the impact of the cleaning cotton. In addition, to increase the useful area of the cleaning surface, one of the main working bodies in the cleaning zone from small impurities was recommended to be installed with continuous slits, and continuous slits were developed using 4 mm steel wires.

Also, it is desirable to consider the possibility of using an adaptive technological system, which is effectively used in various fields of mechanical engineering, and cleaning it in an adaptive system depending on the selection and industrial grade, class, and initial contamination of cotton [7-8].

Conclusion

In short, as a result of the use of electronic devices such as photoresistors, tensor resistors, Whitson bridges, amplifiers, and oscillographs, it became possible to analyze the processes occurring in a short time. The accuracy of

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the obtained results is high, and they depend on the sizes of the used active electronic elements. The strength of the metal rods of the mesh surface, which was used to improve the device for cleaning cotton from small impurities, is durable even when the device is operated at maximum voltage, which does not adversely affect the operation of the device in a stable mode for a long time. The fact that the side wall of the rod is in the form of a cylinder causes it to reduce the resistance forces due to the permeability of the airflow compared to other forms. This leads to an increase in the useful work coefficient.

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