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To cite this article: A Usmankulov *et al* 2023 *IOP Conf. Ser.: Earth Environ. Sci.* **1142** 012080

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# Creation of improved UXK equipment for cleaning cotton from large impurities

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**Abstract.** This article establishes a number of requirements for cotton fiber processing enterprises to improve production efficiency and rational use of resources and maintain high rates of natural quality of cotton fiber during processing. In addition, as a result of the research, it was found that changing the impact pressure of the scraper brush, creating a new shape of the scraper device, changing the relative position of the grate and the scraper brush, placing an additional scraper device after the scraper brush, so as not to be part of the dirty mixture that separates the piece of cotton, were found some positive results. The proposed design of the cotton cleaning section of the UXK purifier, due to the above features, makes it possible to increase the cleaning effect compared to the existing purifier, since in the proposed version, the process of cleaning cotton from large impurities is carried out twice in each section of the USC, which cleans cotton from large impurities. The proposed technical solution was taken as a basis and a plan was developed for preparing its structural diagrams and working drawings, manufacturing a laboratory stand for the cleaning section, conducting laboratory experiments with it, substantiating the main parameters of the working bodies according to the proposed scheme, and introducing the proposal into production.

## 1. Introduction

The introduction of new economic systems in the republic on a large scale, that is, the creation of cotton-textile clusters, increasing the efficiency of managing the production of cotton fiber processing enterprises, rational use of resources, maintaining the natural quality indicators of cotton fiber at a high level during its processing. This can be achieved only through the development of resource-saving, modern technologies and techniques, using the achievements and experience of cotton-producing countries. The issue of improving the quality of the fiber and reducing its cost indicates the relevance of the research work.

An analysis of current research has shown that research on the purification of cotton raw materials from impurities was carried out in two directions - to study the process of purification from small and large impurities. In the process of cleaning cotton fiber, the cleaning efficiency, labor productivity, seed damage and the amount of cotton in the waste were determined as the main indicators. Technological processes of cleaning raw cotton from impurities Boldinsky G., Burnashev R., Lugachev A., Budin E., Safoev A., Miroshnichenko G., Khakimov Sh., Borodin P., Agzamov M., Guliyev T., B. Yakubov and scientists of other directions carried out scientific research.

In the fundamental work of R. Burnashev, devoted to the study of the theoretical foundations of cotton cleaning, the interaction of the main factors influencing the increase in the cleaning efficiency of the machine was studied, and practical recommendations were developed [1, 2, 3].

R. Burnashev studied the influence of technological indicators of raw cotton on the cleaning process and the management of this process. In this scientific work, the term composition (m) is introduced as



a technological indicator of raw cotton. The texture of raw cotton ( $m$ ) is an indicator of how much of it is made up of seeds. This indicator is important for cleaning raw cotton from small and large impurities. It is proved that the reduction of this indicator increases the efficiency of the cleaning process [4, 5].

A. Lugachev considered the technological processes of cleaning in the cotton stream mainly in the section of alternative designs of equipment and technological machines of the main working bodies [6, 7].

In the scientific research of A. Lugachev, two fixed combs with pile were installed in front of the softening brush and their influence on the quality indicators of cleaning raw cotton was studied [8].

E. Budin theoretically established the relationship between the number of revolutions, the diameter, the number of brushes and the number of revolutions and the diameter of the saw drum to determine the technological parameters of the dividing drum. Based on these relationships, in currently used saw drum cleaners with a diameter of 480 mm, the number of revolutions is  $290 \text{ min}^{-1}$ , the number of knives in a dividing drum with a diameter of 300 mm, the number of revolutions is  $960 \text{ min}^{-1}$  is enough to have 14 blades. But there are 20 of them in the existing separating drum, which increases the reliability of its operation. The study noted that the complete separation of raw cotton depends on the uniformity of the fabric [9].

G. Miroshnichenko determined the technological parameters of separation efficiency of 98-99% for separation drums with rubber blades and brushes. In addition, on a theoretical basis, a formula was derived for the ratio of the speeds of the connecting, cutting and saw drums of the kinetic elements of the cutting drum [10]:

$$\frac{V_2}{V_1} = \frac{D_2}{(B_1 D_1) \left( \frac{\eta}{Z} + B_2 \right)}$$

In this  $V_1, V_2$  and  $D_1, D_2$  – respectively sawing speed and diameter of the separating drum.

$Z$  – number of separating drum blades, piece

$\eta$  – таъсир коэффициенти.

$B_1$  and  $B_2$  - half of the angle of the center of the arc in the area of impact of the saw and separating drum.

In studies carried out by Sh. Khakimov and others [11], a purification plant of consistent technology was created, which cleans cotton raw materials from large and small impurities. A long pile drum was created for cleaning cotton raw materials from small impurities and its technological parameters were determined; on the surface of the sawn drum, a drum is created that separates and guides the raw cotton, and a movable device; the main technological parameters of the working bodies with low elasticity of the new cleaner were determined; an effective purification flow was created, which cleans the cotton raw material from small and large impurities.

In the studies of A. Usmanov [12, 13], the process of preliminary cleaning of raw cotton harvested by a skimmer in mobile cleaners was considered. It has been established that the raw cotton is first dried and then cleaned in the UPX-1.5 cleaner, and in the process of subsequent cleaning, the amount of raw cotton in the waste decreases by 2-3 times and the cleaning efficiency increases, the number of fiber defects in the final product is practically reduced by 1 -3% as a result of tests. In a scientific study, it was proposed to clean cotton raw materials with a pile drum together with blowing its piles with air. As a result of approbation of this proposal on a mobile cotton cleaner UPX-1.5, it was proved that when using this lint drum, the cleaning efficiency of the cleaner UPX-1.5 from fine dirt increases by 1.3 times. Based on the studies carried out, it is recommended that the speed of the pile drum in the UPX-1.5 cleaner be 11 m/s, the air speed - 12 m/s, the distance between the pile drum and the roller - 15-18 mm.

A large-scale study of the connection of a piece of cotton with the teeth of a saw drum with a moving brush showed that the reason for the detachment of a piece of cotton from the saw teeth is the transfer

of its potential energy, which is formed as a result of deformation under the action of a moving brush, to kinetic energy. The advantage of triangular columns over round columns is that the speed of the saw drum increases from 5 m/s to 9 m/s, and the impact force of a piece of cotton on the column increases from 0.39 N to 0.72 N.

B. Yakubov investigated the reasons for the presence of pieces of raw cotton in the dirty mixture separated by saw cleaners, and the possibility of controlling this process, taking into account the characteristics of raw cotton. As a result of the research, the number of saw teeth, the speed of saw tooth immersion in cotton fiber, the resistance of the cleaning brush, which ensure a reliable grip of cotton raw materials, were determined. These results make it possible to evaluate the process of getting pieces of raw cotton into the dirty mixture. As a result of theoretical studies, the following was determined:

- the law of interaction of a piece of cotton with a moving brush;
- the optimal distance between the saw drum and the moving brush, the length of the arc of interaction between the piece of cotton and the brush, which ensures a strong fit of the piece of raw cotton to the saw teeth of the saw drum;
- regularity of movement after leaving the zone of the brush, moving raw cotton, before impact with the first grate.

In addition, as a result of the research, it was found that changing the impact pressure of the scraper brush, creating a new shape of the scraper device, changing the relative position of the grate and the scraper brush, placing an additional scraper device after the mop so that it does not get into the dirty mixture that separates the piece of cotton. The first column is recommended to be installed 40 mm after the brush. The alternative speed of the additional countershaft was determined to be 7.4 m/s. However, in recent years, the revival of machine cotton picking in the production process in our republic has led to an increase in problems, and it is necessary to pay great attention to reducing the collection of cotton by force and accelerating the mechanization of harvesting. Considering that the amount of large impurities in machine-harvested cotton increases by 30-40% [14] compared to common impurities, ensuring the quality of cotton cleaning at the level of regulatory requirements in existing UXK installations is one of the problems that have not been solved to date.

## 2. Methods

On the basis of what was stated by the scientists of the Jizzakh Polytechnic Institute and JSC "Paxtasanoat ilmiy markazi", a scientific solution was proposed to improve the UXK machine in the process of cleaning the cotton raw materials selected by the machine from impurities [15].

The main disadvantage of the existing gin is that it does not provide a potentially high cleaning efficiency of the machine picking gin, which mainly depends on the number of cylinders of the gin saw. As a result, when using the present cleaner, the cleaning effect is limited by the number of cleaning saw cylinders used therein. In addition, the large dirt cleaning section has two guiding brush drums, which complicates the structure and increases energy consumption.

Our goal is to improve the cleaning efficiency of the UXK cotton streamer from coarse dirt.

The trajectories of movement of the pieces of cotton ejected from the surface of the drum heaps in the cotton-cleaning units depend on a number of parameters, the weight of the cotton and the value of the initial linear speed are considered important.

Expressing the movement of a piece of cotton placed on the surface of the pile, we obtain the following equation, which takes into account the forces acting on the piece of cotton, inertial forces, centrifugal force, Coriolis, friction between the piece of cotton and the pile surface, air resistance, reaction and bonding forces of a piece of cotton with other pieces of cotton:

$$\frac{G}{g} \left( \frac{d^2(x + R_b)}{dt^2} \right) = m_n g \cos \alpha + \frac{G_n \omega_b^2 D_b}{2g} + f_{nk} \left[ m_n g \sin \alpha + (F_b + F_{nT}) \cos \beta - k v_x^2 - 2\omega_b \cos \gamma \frac{d(x + R_b)}{dt} \right] + (F_b + F_{nT}) \sin \beta$$

here:  $G_n$  – the weight of a piece of cotton;

$\omega_b$  – pile drum angular velocity;

$D_b$  – drum diameter;

$g$  – free fall acceleration;

$m_n$  - the mass of a piece of cotton;

$f_{nk}$  – coefficient of friction between a piece of cotton and the surface of the pile;

$x$  – the distance of moving a piece of cotton on the surface of the pile;

$R_b$  - drum radius.

$k$  – proportionality coefficient;

$v_x$  – air flow rate;

$F_b$  - the force of binding a piece of cotton with other pieces of cotton;

$G$  - gravity;

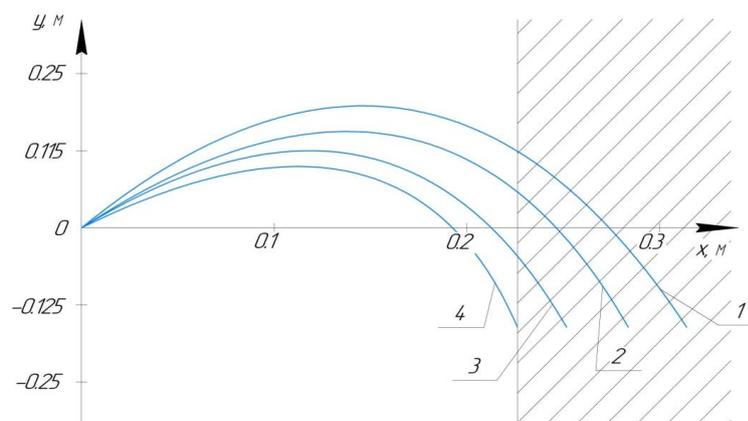
$F_{nT}$  - air resistance force;

### 3. Results and Discussion

As a result of the calculations, motion trajectories were obtained, which are shown in Figure 1. For example, according to the analysis of the trajectories shown in Figure 1, with a cotton swab mass of  $0.2 \cdot 10^{-3}$  kg, i.e. it consists of one seed fiber, and the angular velocity of the drum is  $38 \text{ s}^{-1}$ , the cotton ball rises along the  $u$  axis to 0.134 m, and along the  $x$  axis it reaches up to 0.3 m. Accordingly, with a piece of cotton weighing  $0.85 \cdot 10^{-3}$  kg, i.e. it consists of at least four fiber seeds, the trajectory of movement increases to 0.073 m along the  $u$  axis and reaches 0.221 m. along the  $x$ -axis. In this case, the impact zone of the saw drum must be taken in the shaded part in Figure 1, that is, the distance between the axes of the pile and the saw drum is:

$$X = x_0 + 0,227 \text{ m} + R_{ap} \quad (1)$$

along the  $x$  axis.



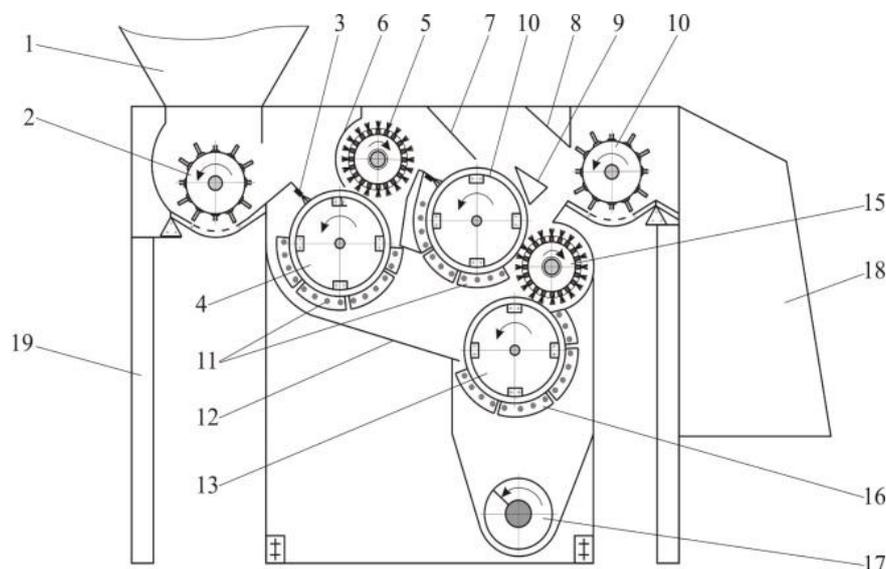
**Figure 1.** Laws of changes in the trajectory of the cotton piece after it is thrown from the surface of the pile depending on its mass

If the radius of the saw drum is 0.24 m, then  $x = (0.54-0.61)$  m.

So, to increase the distance between the axes, it is desirable that the cotton has been sufficiently stretched first. It is also necessary to increase the angular speed of the pile drum to the appropriate value [16, 17].

By installing an additional saw drum and feed brush drum in the large decontamination section of the UXK cotton gin, the double cleaning of heavily soiled machine-made raw cotton is solved. The proposed design of the cotton cleaning section of the UXK purifier, due to the above features, makes it possible to increase the cleaning effect compared to the existing purifier, since in the proposed version, the process of cleaning cotton from large impurities is carried out twice in each section of the UXK, which cleans cotton from large impurities.

The essence of the technical solution is explained by a drawing showing the scheme of the proposed cotton cleaner in Figure 2.



**Figure 2.** Scheme of the cleaning unit of the UXK cleaning unit for cleaning cotton from large impurities: 1- cotton hopper, 2- pile drum, 3- grasp brush, 4, 10, 13- sawed drums, 5, 15- brush drum, 6- cojux, 7, 8- obstacle, 9- directioner, 11, 16- column fence, 12- inclined plate, 17- dirt auger, 18- outlet hole for cleaned cotton, 19- includes ram



**Figure 3.** Improved equipment for cleaning cotton from large impurities of the UXK cleaning unit

The work of the cleaning department of machine raw cotton from large impurities is carried out as follows. From the department for cleaning from fine dirt UXK, the cotton pile drum 1 is directed by a cotton hopper to the first sawing drum 2, which rotates counterclockwise, and with the help of a kneading brush 3, hitting the drum 6, the cotton is pulled together with teeth, and when it collides with cotton colostrum rods 11 cleared of large contaminants. The cotton cleaned by the saw cylinder 4 is removed by a drum with a brush 5 and sent to the second saw drum 10 using a stopper 7, which also rotates counterclockwise and is clamped by the teeth of the kneading brush and is cleaned of large impurities when it collides with the cotton colostrum mesh 11.

The cotton cleaned by the saw cylinder 10 is sent to the pile drum 10 in the next section of cleaning from small contaminants of the UXK cleaner using the brush drum 15. Separated mud mixtures with cotton balls and grate nets

After passing 11, the regeneration is sent to the saw cylinder 13 along the oblique comb 12. The cotton is cleaned from large impurities from collisions with the colossal mesh 16, after which the pieces of cotton cleaned from the saw drum 13 are removed in the brush drum 15 and sent to the pile drum 10 in the next section cleaning from fine dirt cleaner UXK. Separated impurities, getting through the grate 16, are removed from the cleaner through the screw 17.

#### 4. Conclusions

In a word, due to the installation of an additional saw drum and a feeding brush drum in the cleaning section of the UXK cotton gin, the efficiency of cleaning machine-picking cotton raw materials with a high degree of contamination is doubled. Due to the above features, the proposed design of the cotton cleaning section of the UXK cleaner increases the cleaning effect compared to the existing cleaner, since in the proposed version, the process of cleaning cotton from large impurities is carried out twice in each section. UXK, cleaning cotton from large impurities.

The proposed technical solution was taken as a basis and a plan was developed for preparing its structural diagrams and working drawings, manufacturing a laboratory stand for the cleaning department, conducting laboratory experiments with it, substantiating the main parameters of the working bodies according to the proposed scheme, and introducing the proposal into production.

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