Study on the improvement of the device for cleaning low-grade cotton with high- moisture

M T Khodjiev\textsuperscript{1}, and Sh Sh Isaev\textsuperscript{2}

\textsuperscript{1}Gulistan State University, Gulistan, Uzbekistan
\textsuperscript{2}Engineering and Technology Institute of Namangan, Namangan, Uzbekistan

Email: glsu_rektor@edu.uz

Abstract. This article analyzes the importance of the process of ginning cotton with high pollution before ginning, the operation of the ginning device before ginning, the impact of the device nodes with the raw cotton. At the same time, the cleaning efficiency of the machine in the cleaning equipment from small and large contaminants, the basic control developments and calculation processes in the selection of the technological parameters of the cleaners are considered. It was suggested and analyzed that before the cotton was ginned, the cleaning device should be replaced with cone-tipped piles and a new belt extension to remove impurities instead of fine-grained drum piles. The impact strength and impact of the proposed conical-tipped pile drums on cotton have been studied.

1. Introduction

The results obtained during the testing of the proposed low-grade cotton ginning plant showed that it was suitable and functional. During the study, a device based on the following scientific and practical developments was recommended [1].

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure1.png}
\caption{Schematic diagram of a cotton gin: 1-wheel, 2-device base, 3-collecting tape, 4-roller, 5-type surface, 6-pile drum, 7-pin feeder, 8-cotton receiving hopper, 9- saw drum, 10-ribbed grille, 11- brush drum, 12-cleaned cotton pipe, 13- brush drum, 14- saw drum, 15- ribbed grille}
\end{figure}

A supply device for the smooth delivery of raw cotton will be installed at the initial stage of the cleaning process. Productivity of the supplier and the process of simultaneous supply of different types of raw
cotton (construction, speed modes) were studied. The supplier drum ensures that the raw cotton is delivered to the drum drums to be cleaned of minor contaminants at the same time. The process of processing the supplier, the raw cotton arrives at the mine, which is mounted on the supply rollers. The rotating supply rollers of the raw cotton collected in the mine ensure that the cotton is evenly distributed on the pile drums. Theoretical research was carried out on the methods of determining the efficiency of cleaning of the pile drum and the fixed surface under the influence of mechanical force on the raw cotton. The theory of the probability of sticking of raw cotton to the saw drum, the interaction of ribbed bars with the raw cotton stuck to the saw teeth during cleaning, the mode of operation, the speed of rotation of the drums, the diameter, the distance between the bars and the distance between the bars were all studied carefully. The newly improved construction dimensions, structural design and cleaning efficiency of the device for the separation (regeneration) of cotton, which is added to the waste from the ribbed grid in the process of cleaning from large contaminants were discovered with theoretical study [2].

The working bodies of the device were powered by gears and conveyors in order to reduce the number of transmissions through the shaft. The rotational motion of the working drums was provided mainly by electric drives and gearboxes or by means of belt mechanisms. As a result of theoretical and scientific research on the effective cleaning of raw cotton from impurities before processing, main goal is to change the size in order to increase the cleaning efficiency of the device, the mode of operation of all its cleaning units, drum parameters, line speed, line speed, diameter. [3].

In order to increase the efficiency of technical and technological cleaners, before preparing the cleaning process for processing, the cleaning of raw cotton was carried out according to the following technological process:
- The research was carried out using devices based on the following scientific developments.
- A supply device for the smooth delivery of raw cotton will be installed at the initial stage of the cleaning process. Productivity of the supplier and the process (design, speed modes) of simultaneous supply of different types of raw cotton were studied.
- Theoretical research has been conducted on the methods of determining the efficiency of cleaning of the newly modeled pile drum and fixed surface under the influence of mechanical force on the raw material of cotton.
- The theory of the probability of sticking of raw cotton to the saw drum, the interaction of ribbed bars with the sawdust attached to the saw teeth during the cleaning process, the mode of operation, the speed of rotation of the drums, the diameter of the grille and the distance between the bars were explored and studied theoretically.

Here the cotton is delivered to the rotating supply rollers in the supply hopper. The speed of rotation of the rollers is determined by the performance of the machine that comes from the raw cotton supply chamber to the pile drum (Figures 1 and 2). The cotton is then sprinkled with a cotton swab, a bowl, and a blue-leafed cotton raw material on a pile drum, and as the cotton passes between the drum and the various surfaces, the fine contaminants come out through the various surfaces. The remaining large mixtures (husks and bowls) are transferred to the drum through the next step. In the fine cleaning section (small and large), when the cotton is cleaned, the cotton layer is flattened and transferred to the saw drum. As a result of the interaction of the ribbed grids of cotton raw material hung on the teeth of the saw drum, large contaminants are thrown into the collection hopper through the cracks of the standard grids. If the raw cotton is not cleaned of small contaminants at the beginning of the technological process, it will pass from passive to active contamination and will be difficult to separate in the fiber cleaner. As a result, these pile-cleaning cleaners have a "wind movement" on the drums, which has a positive effect on the cleaning efficiency.

A double-peg drum, small contaminants passing through various surfaces, go out into the collection hopper. Cotton raw material cleaned of small contaminants is transferred to the next large-scale cleaning process. The cotton drum is directed to the drum by the first axle drum, the second axle drum by the brush separator drum, where the saws are tilted to the saws by means of brush drums. Cotton sawdust was removed with the help of drums, and then removed from the washing machine. Cotton waste, which has
been lost along with filosites from the colossal windows, is transferred to the regenerating drum by a tape conveyor [4].

Figure 2. Appearance of an effective portable cleaning device for low-grade raw cotton

The cotton particles that have been added to the contaminants are removed by the regeneration drum. The separated contaminants are removed from the machine and with its help the raw cotton is separated from the waste, separated with a brush separator drum and added to the cotton leaving the gin through the air duct.

Cotton pieces firmly attached to the saw teeth create a dynamic impact process when a free piece of cotton is hit or processed by a ribbed grid during movement.

2. The effect of forces between the pile drum and the cotton

In the ginning industry, the ginning of raw cotton is carried out mainly with the help of drums with different surfaces and piles [5, 6]. The effectiveness of this process depends on the mass fraction of organic compounds in the cotton and the intensity of the movement of cotton on different surfaces and the interaction with the pile drums. The existing equipment is inefficient in detecting minor impurities in the raw cotton, mainly due to the fact that the size of the pins is larger than the size of the cotton components. As a result of the impact of the piles on the dirt in the cotton, they are crushed and get into the cotton fibers [7].

Let's analyze this situation. To do this, we consider the relationship between different types of pile drums and cotton.

Influence on cotton in a cotton gin with a drum key factors (see Figure 3):

1. Surface friction force of a piece of cotton - "F1"
2. Transfer power from the center - "G1"
3. Weight of a piece of cotton - "G"
4. Friction force of a piece of cotton on a pile surface - "F2"
5. Resistance of air flow in vacuum - "P"

The cleaning mechanism is as follows:

The external friction force of the cotton section and the resistance of the air flow in the vacuum on one side, the centrifugal force on the pile surface of the cotton section on the other side creates a pair of forces and the cotton section moves in the direction of the surface and exits through holes in the surface.

The function of the pegs in the pile drum is to vibrate the cotton inserted into the drum.
From the above study and analysis, it can be concluded that the main function of the peg mounted on the drums is to gin cotton. Therefore, if the surface of the pegs mounted on the drum is reduced, that is, the titanium end is conicalized:

1) Increases the efficiency of cotton picking;
2) Reduces energy consumption;
3) The load on the cleaning drum is reduced.

![Figure 3. The effect of forces between the pile-drum surface and the cotton](image)

For this reason, we suggest that the pins of the pile drum be in a conical shape.

The above device has a lot of technological impacts, the degree of damage to cotton is high and the proportion of fiber produced has increased. To solve this problem, a new impeller is proposed, as well as a belt drive with a conductive surface instead of the sawdust and brush drums, which separate the contaminated cotton.

The proposed conveyor with a working drum and a conductive surface leads to an increase in the efficiency of ginning cotton and a reduction in electricity consumption. Also, the drum is made of velvet cylindrical, the working part of its pins is conical and interchangeable. This ensures that the equipment is repairable and the service life is extended.

The base of the pile cone is designed to be equal to the diameter of the existing piles and the height equal to the length of the existing piles.

Because the peg is conical, the impact force on the cotton during the cleaning process is directed at a right angle to the net relative to the peg. Under the influence of impact force, gravity force and centrifugal force, cotton hits different surfaces. Due to the fact that cotton is an elastic material, when it is hit, the cotton is deformed and quickly returns to its original state, that is, the cotton vibrates. As a result, the contaminants on the surface of the cotton are removed from it. Then the next peg is hit on the cotton and the process is repeated.

Due to the different surface of the cotton, the lower part of the net is trapped, then the part in contact with the net is braked under the influence of gravity and friction from the center of gravity, and the upper part is forced to move under the impact force. Under the influence of these forces, a moment of force is created, which forces the cotton to rotate around the center of gravity, and the cotton rolls on the net, that is, moves in a circle. As a result, the side of the cotton that is not affected by the net is also affected by the net. This ensures that the entire surface of the cotton is exposed to the net and is highly cleaned.

The small diameter of the piles makes it less polluting, but more intense, and more and more intense with the cotton mass. This also leads to more intensive cleaning of cotton.

The proposed device consists of the following main elements: pneumatic pipe 1; separator 2; supply rollers 3; working drums with conical pointed pegs for cleaning small contaminants 4; different surface 5; saw drums 6; brush drums 7; grate 8; outgoing nov 9; roller 10; blinds with conveyor belts 11; hopper 12; pneumatic tube 13 (Figure 4).
An important feature of the device is the installation of working drums with conical, interchangeable pegs in place of the pile drums to increase the cleaning efficiency. The drum is made in the form of a cylindrical drum, the working part of the pegs is conical and interchangeable. The base of the pile cone is designed to be equal to the diameter of the existing piles and the height equal to the length of the existing piles. In order to save electricity and increase the efficiency of cotton extraction from contaminants, a tapered slotted transmission will be installed to separate contaminated cotton. As a result, the efficiency of ginning cotton increases and energy consumption decreases.

3. Performance of the proposed device
Cotton comes to the separator (2) via a pneumatic pipe (1), separates the cotton from the air and transmits it to the supply rollers (3). The supply rollers deliver the cotton to the working drums (4), which have a three-point cone separator, and the drums drag the cotton through various surfaces (5), leaving the filth filthy. The tiny filthy drums were passed through the cotton drums (6) and these drums beat the cotton woolen grill (8) and separated them from the large filths. From saw drum brush drum is taken and cotton (7), is protruded from the teeth of the drum, and sent it out through the output drum (9). Fossilized cotton fibers are subjected to a stretched stretcher (11), and in this strain, small weeds fall into the filing bunker (12). The extension is extended to the return pneumatic pipe (13) and the large pneumatic pipes fall to the bottom, which can be dragged through the pneumatic pipeline to the primary cotton train (Figure 4).

![Figure 4](image-url)  
*Figure 4. Appearance of the proposed new device*

![Figure 5](image-url)  
*Figure 5. Recommended view of the transmission*
Figure 5 shows the blindfold extension of the ribbon. Figure 6 shows the working drums with the conical tip motors. The proposed device is widely used in the field of pre-processing of cotton. In order to increase the efficiency of cleaning the small contaminants in the cotton in the proposed improved device, the drum is made in the form of a cylindrical drum, the working part of the pegs is conical and interchangeable. This ensures that the equipment is serviceable and service life is extended. The base of the pile cone is designed to be equal to the diameter of the existing piles and the height equal to the length of the existing piles.

![Image of drum with spool](image)

**Figure 6. Recommended view of the drum with a spool**

4. Conclusions
Because the peg is conical, the impact force on the cotton during the cleaning process is directed at a right angle to the net relative to the peg. Under the influence of impact force, gravity force and centrifugal force, cotton hits different surfaces. Due to the fact that cotton is an elastic material, when it is hit, the cotton is deformed and quickly returns to its original state, that is, the cotton vibrates. As a result, the contaminants on the surface of the cotton are removed from it. Then the next peg is hit on the cotton and the process is repeated. Because the cotton is on the surface of the net, the lower part of the net is trapped, and the part in contact with the net is braked under the influence of gravity, centrifugal and frictional forces, and the upper part is forced to move under the impact force. Under the influence of these forces, a moment of force is created, which forces the cotton to rotate around the center of gravity, and the cotton rolls on the net, that is, moves in a circle. As a result, the side of the cotton that is not affected by the net is also affected by the net. This ensures that the entire surface of the cotton is exposed to the net and is highly cleaned. In order to save electricity and increase the efficiency of cotton extraction from contaminants, a tapered slotted transmission will be installed to separate contaminated cotton. As a result, the efficiency of ginning cotton increases and energy consumption decreases.

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