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# Experimental Studies of the Operating Capacity of theCotton Cleaner with a Screw Pods

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**Abstract.** The article presents the design of the developed cleaner, where outfits with peg drums, a screw body is used, and the results of experimental studies of the operability of a screw working body with pegs located along a helical line for cleaning raw cotton from fine litter. The design and features of an experimental setup with a strain gauge measuring element are presented. It was found that the load on the tuning peg changes, depending on its position, in one turn of the screw. Moreover, this range of variation is from 50 to 300 cN, which is associated with the coefficients of friction, when interacting with the mesh surface. It is shown that the cleaning effect of the screw body decreases with an increase in the number of pegs along the perimeter, and the loads on the pegs also decrease with an increase in the filling factor and the number of pegs around the perimeter and increase with an increase in the working pegs.

## INTRODUCTION

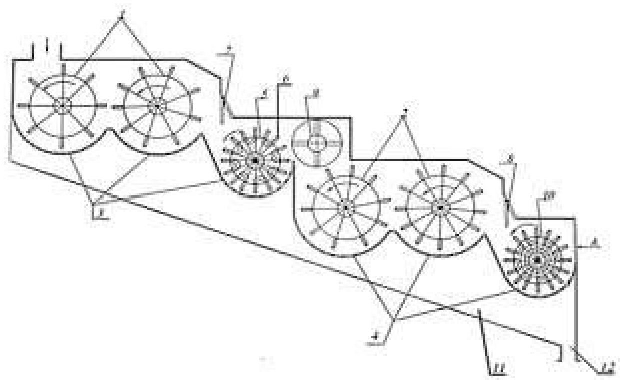
In the world, research work is carried out for the cotton ginning industry aimed at the development of innovative techniques and technologies that provide for the effective use of modern achievements of science and technology, and the modernization of existing ones. In this industry, including the implementation of scientific research in the direction of the development of highly efficient equipment for the process of cleaning raw cotton and the improvement of existing ones, is of great importance [1].

The analysis of the performed research and development work showed that to date, the working process of cleaning cotton with cleaners has been investigated and substantiated. At the same time, insufficient attention was paid to the issue of energy and resource conservation in the process of cleaning raw cotton from small trash impurities. Also, until now, the possibility of cleaning cotton using combined working bodies has not been studied. This indicates the need for carrying out, along with theoretical, and experimental research for the development of improved designs of fine litter cleaners that meet modern requirements [2].

Currently used cleaners of raw cotton from small impurities of the 1HK type have eight peg drums of the same design. The cleaning process is based on the shock-shaking effect of the pegs on the processed material, followed byits dragging along the screening surface. To improve the design of the cotton cleaner unit, it was proposed to use combined working bodies, while, along with the used peg drums, to use screw working bodies. A patent of the Agency for Intellectual Property of the Republic of Uzbekistan No. FAP01533 was obtained for such a device for cleaning fibrous material (Fig. 1).

The essence of the utility model is as follows: a device for cleaning fibrous material from trash impurities, containing a sieving surface, a pair of peg drums, a weed chamber equipped with an

additional pair of peg drums and augers located after each pair of peg drums, and the number of pegs on each drum, in the direction of movement of the material, is increased. The auger located after the first pair of tuners is made with double tuners. The auger located after an additional pair of peg drums is double-threaded.
In the bottom work, the results of experimental studies of the performance of a raw cotton cleaner with a screw arrangement of the pegs are presented.



1,2-head drums; 3.4-ret. Surface; 5-screw organ; 6-double tuners; 7.8-inclined trays; 9-distributor device; 10-threaded screw body; 11-bunker; 12-unloading hole.
**FIGURE 1.** Scheme of a combined fine litter cleaner.
In experimental studies, the dependences of the change in the load on the pegs at the moment of contact with the cotton mass were studied. Having analyzed the existing methods of measuring the parameters of machines and the instruments used for conducting experimental research, we have developed an experimental laboratory setup and a measurement technique that allows measurements to be carried out close to real conditions [3]. In the course of the development of the experimental setup, a number of disadvantages were excluded that were not taken into account in the previous designs of the experimental setup used for research. The experimental setup made it possible to carry out measurements in the operation of the machine with the simultaneous processing of the results obtained on a computer, for which a digital converter of the LTR-154 type was used.

## DESIGN AND FEATURES OF THE EXPERIMENTAL SETUP

The experimental setup was a section of a screw auger with a screw pitch H = 300 mm and a length L = 3.8 m with a screw shaft drive from a worm gear (on one side) using an electric motor. In addition, a pulley with different diameters is installed on the drive shaft of the gearbox, which ensured the selection of the optimal values of the speeds of the operating modes of the screw auger. General view, settings are shown in Fig. 2.

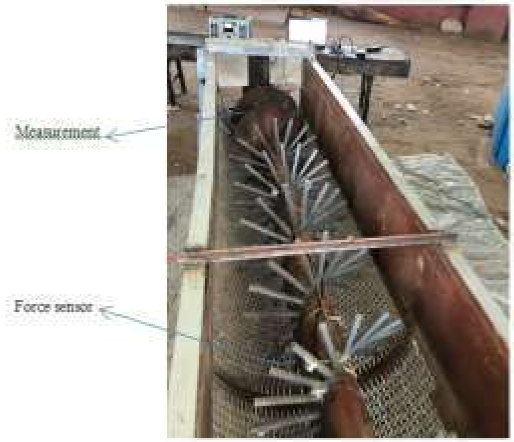



**FIGURE 2.** General view of the screw auger with a comb screw, on which sensors for monitoring the load on the tuning pegs are installed.

To measure the main technological and technical parameters of the screw operation, an experimental setup was developed and manufactured with the aforementioned technical characteristics and with a comb screw screw on which the main measuring devices and devices for recording the measured parameters are installed, the general viewof which is shown in Fig. 3.

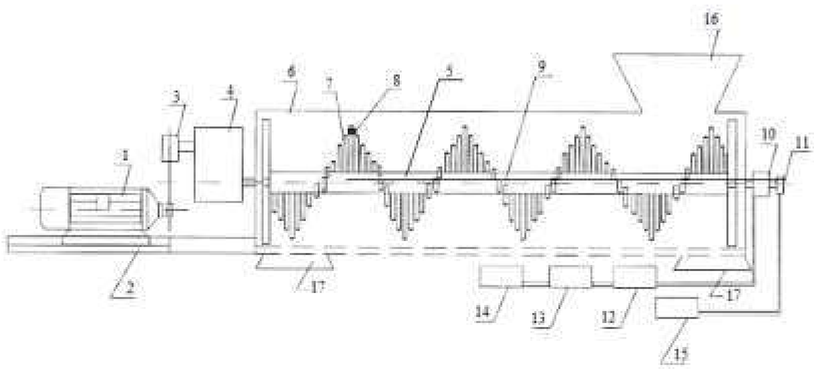



**FIGURE 3.** Kinematic diagram of the experimental setup.

An electric motor 1 is installed on the frame 2, the torque from the electric motor is transmitted by means of the pulley 3 to the reducer 4 of the screw drive driving the screw shaft 5 into rotation. The screw shaft, with the pegs located at a certain angle, rotating, moves the cotton and when it is pulled through, partial removal of weeds occurs, which are discharged through the sifting surface of the auger chute [4].

To feed the auger with cotton, at the beginning of the auger chute, a hatch 16 is provided, through which cotton is fed and transported to the outlet hatch 17.To measure the load acting on the auger pegs on one of them 7, a strain gauge 8 is attached, the signal from which is transmitted via cable 9 to current collector 10, which, in turn, is connected to the high-frequency amplifier 12. Since the measured parameter is analog, we used the ADC in the circuit number 13 of the LTR-154 group during the measurement, which made it possible to facilitate the processing of the results obtained using a computer at the position fourteen.

On the cantilever part of the auger shaft drive, a block of devices with a current collector is installed, which allows to remove signals from the sensors without errors [5]. The design and general view of the measuring deviceis shown in Fig. 4.


**FIGURE 4.** General view of the collector mounted on the end of the auger shaft.

## THE DESIGN AND PRINCIPLE OF OPERATION OF THE MEASURING SENSOR

In most of the studies cited, strain gauging with strain gauges glued to the working elements is used to measure the loads on the drive shafts. But in our case, the working elements are located at a certain angle and the loads actingon the pegs can consist of tangential and normal components of the loads, which has its own characteristics when measuring.

The reliability of the obtained parameters largely depends on the measurement accuracy and the installation location of the control sensors on the structural elements of the machine [6]. From this point of view, analyzing the work of the screw and the direction of the forces acting on the structural elements as shown in Fig. 5, we installed the sensors in the direction of the forces, depending on the direction of movement of the cotton mass. Figure 5 shows a diagram of the forces acting on the splitting element during the operation of the auger.

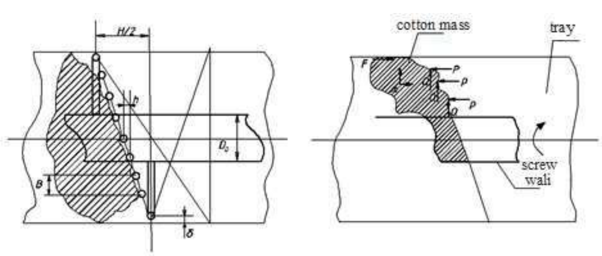



**FIGURE 5.** Scheme for measuring the loads acting on the auger splitters.

Where P is the force acting on the elementary mass of cotton in the direction of movement. Q-force acting in theradial direction, created by the rotation of the tuning pegs.

Analyzing the scheme of forces acting on the cotton mass when moving along the auger chute, we decided to install two sensors for monitoring the load on the splitters, assuming that one direction will be the X axis and the second radial Y. Since the force created by the rotation of the auger Q is spent on loosening mass and P-force to move the mass of cotton [7]. Considering that the number of pegs located on one span of length, with a screw pitch of 300 mm, is 24 pieces, with a peg diameter of 20 mm, on one of the installed pegs 8, strain gauge sensors are glued to control the force acting during the operation of the machine, the general view of which is shown in Fig. 6.

**FIGURE 6.** Place of installation of the sensor for monitoring the load on the auger splits.

To compare the results obtained when measuring the values along two axes taken according to the scheme shown in Fig. 6, we made a strain gauge squirrel for gluing sensors and allowing it to be installed at any section of the screw length and to simultaneously record in two coordinates.
The diagram of the proposed design of the beam is shown in Fig. 7. The beam has a total length L and the diameter of the bar equal to the diameter of the pegs. In sections 3 and 4, areas were milled, located relative to each other at an angle of 900, on which strain gauges 5 and 6 were glued along the floor bridge circuit of their connection to the measuring circuit. At one end of the sensing element, a thread is cut for its installation on the screw shaft in the required section for measuring parameters. At the second working end of the sensor, a platform was milled, the profile of which was changed as needed [8].

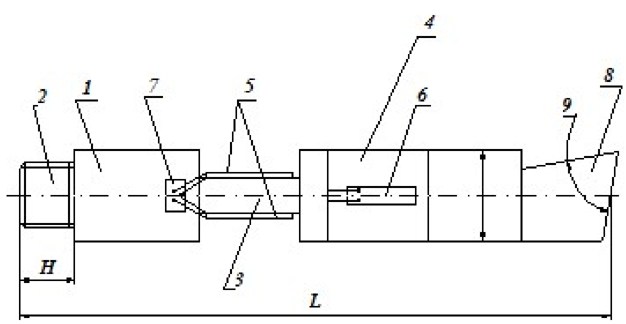



**FIGURE 7.** Load control sensor for tuning pegs.

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The experiments were carried out in triplicate, using raw cotton of a selection variety. Namangan-77, with an initial weepiness of 11% and a moisture content of 9%.
Figure 8. the experimental oscilogamma obtained is shown as given. Analysis of the obtained records of oscillograms shows that the loads on the pegs differ significantly in magnitude and nature in both measured axes of the planes.

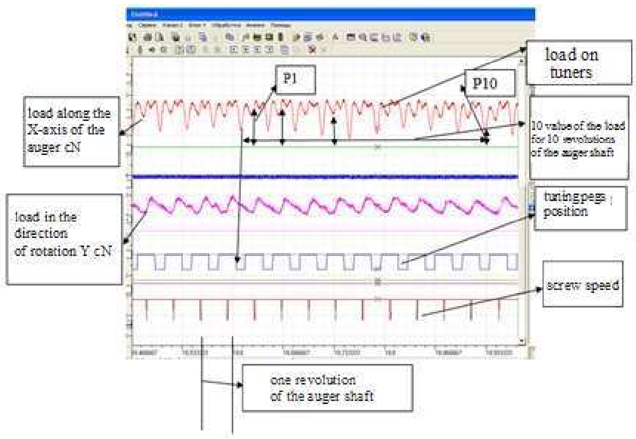


**FIGURE 8.** an example of decoding and obtaining data from oscillograms of recordings of the load on thetuners. The load P 1-10 is calculated according to the calibration data of the sensors.

From the analysis of the obtained approximate oscillograms, it can be seen that the load on the splitters changes depending on the position of the splitters during one revolution of the auger shaft. The peg with sensors in the working area can be located, depending on the filling factor, for a certain period of time or will pass the length of the section equal to the arc length of the auger chute. To determine the length of the pegs contact area with the chute, the pegs position sensors were installed on the experimental setup, which made it possible to determine the position of the pegs on the oscillograms, which are shown as rectangular lines [9].
If you compare the position sensor with the auger speed sensor, you can calculate the time and distance traveled by the pegs in the working area and determine the nature of the change in the load on the pegs. For example, load fluctuations, as can be seen from the oscillograms shown in Fig. 8. During half of one revolution of the screw changes from 50 cN to 300 cN. Apparently this is due to a change in the friction forces with the contact surface of the screw mesh [10, 11].
When conducting experimental studies, we have determined the dependences of the influence on the cleansing effect of cotton; the following factors are the angle of inclination of the head of the pegs on the ability to grip cotton; load force when acting on the cotton mass from the side of the pegs; number of tuners in the working area; the frequency of rotation of the auger shaft is the distance from the pegs to the surface of the auger chute, depending on the filling factor of the auger during operation, which is associated with the performance of the cleaning machine of the XK type. The experiments were carried out in triplicate and were calculated based on the average value of the readings obtained from the oscillograms. the results of experimental studies, the obtained values are shown in tables and in the form of graphical dependencies [12].

**TABLE 1.**
The size of the load on the pegs

| | | | | |
|---|---|---|---|---|
| Load on the splitters along the X axis, cN. | 15<br>2 | 168 | 1<br>85 | 196 |
| Load on the pegs along the Y-axis, cN | 71 | 79 | 8<br>6 | 95 |
| The angle of inclination of the tip of the tuning pegs, □ | 10 | 15 | 2<br>0 | 30 |
| Cleansing effect, % | 41<br>.52 | 42.<br>7 | 4<br>4,06 | 47.6 |
| Filling ratio, $\varphi$ | 0,<br>36 | 0,3<br>6 | 0,<br>36 | 0,36 |

As can be seen from the table, the load on the peg, both along the X-axis and along the Y-axis, increases with anincrease in the tilt angle of the pegs of the pegs, in different values: the load along the X-axis increases from 152 to 196 cN, and along the Y-axis from 71 to 95 sN. Also, in this case, an increase in the cleansing effect is observed: from 41.5 to 47.6%.The influence of the number of pegs along the perimeter at different filling rates on the cleaningeffect and on the magnitude of the loads on the pegs was investigated, the results of which are shown in Table 2.

**TABLE. 2**
Influence of the number of tuners along the perimeter on the load on them

| | | | | |
|---|---|---|---|---|
| Number of pegs per perimeter, pcs. | 16 | 20 | 24 | 30 |
| Cleansing effect, % | 37 | 40 | 42 | 400 |
| Peg load cH, for the fill factor:<br>0,3 | 300 | 260 | 240 | 220 |
| 0,4 | 320 | 300 | 260 | 250 |
| 0,5 | 360 | 320 | 290 | 270 |
| 0,6 | 400 | 356 | 310 | 300 |

Analysis of the results given in Table 2 indicates that with an increase in the number of pegs along the perimeter,the load on them decreases, with different filling factors.

Figure 8. the graph of the dependence of the cleaning effect on the number of pegs along the perimeter is shown.

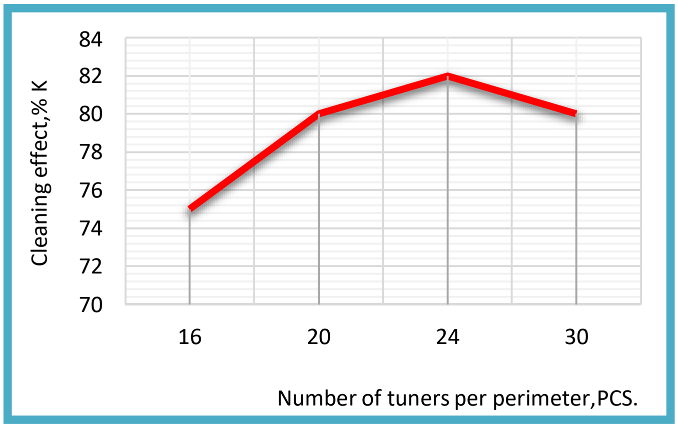


**FIGURE 2.** Influence of the number of pegs along the perimeter on the cleaning effect.

As can be seen from the above graph, with the increased number of pegs up to 24, the cleaning effect also increases proportionally, with a subsequent increase in the number of pegs to 28 but its decrease is observed, therefore it was proposed to install 24 pegs along the perimeter.

Figure 9. the graphs of the dependences of the loads on the pegs on the filling factors and the number of pegs along the perimeter are shown.

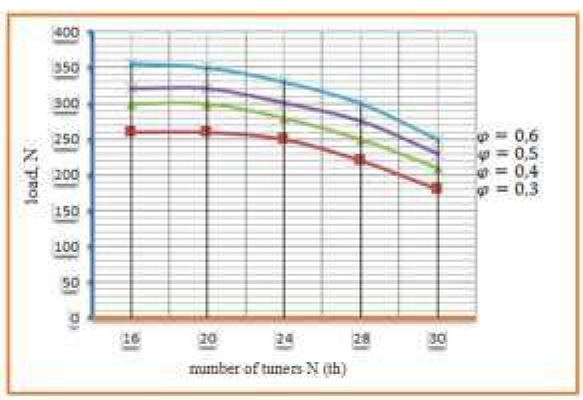


**FIGURE 9.** Graphs of the dependences of the loads on the tuning pegs on the filling factors and the number of tuning pegs along the perimeter.

As can be seen from Fig. 9, with an increase in the number of pegs along the perimeter, a decrease in the bottom loads is observed, for example, if, with the number of pegs around the perimeter of 16 and a fill factor of 0.3, the pegs load is 300 cN, then under the same conditions, with an increase the number of tuners around the perimeter is up to 24, the load of the tuning pegs is already 240 cN, which can be explained by reducing the distance between thetuning pegs.

It can also be noted that with an increase in the filling factor, the load on the peg also increases, for example, if ata filling factor of 0.3 and the number of pegs around the perimeter of 24, the load on the peg is 240 cN, then under the same conditions, at a filling factor of 0.6, the load per peg increases to 310 cN.

## CONCLUSIONS

1. It was found that the load on the tuning peg changes, depending on its position, in one turn of the screw.
2. It has been shown that the greatest cleaning effect is observed when the number of pegs along the perimeter isequal to 24 pieces.
3. The load on the peg also depends on the fill factor.

## REFERENCES

1. Scientific center of the cotton industry: Coordinated technology of processing of raw cotton: PDI-30- 2012: "Labor" .- 2017. Page 45.
2. Zikriyoev EZ Preliminary processing of cotton: Textbook: Mexnat.-T .: - 2002. Page 408
3. Xakimov Sh.Sh. Effective technology of the process of cleaning cotton raw materials from impurities Creating a rational design of working parts of cleaners: Doc. dissertation.- Tashkent: TTYESI, 2016. 29-30 pages.
4. Rajabov I.Ya., Safoev AA, Pardaev B. Collection of articles of the Republican scientific-practical conference "Acceleration of the process of cleaning cotton from small contaminants" Part 1. TTYESI .: 2018 y. May16-17. Pages 9-11.
5. Rajabov I.Ya., Safoev A.A., «Study of Cotton-Raw Movement in Screw Washer» Internaional Journal of Advanced Research in Science, Engineering and Technoliogy Vol 5, Issue 11, November 2018. ISSH: 2350-0328.
6. Safoev A.A. K voprosu ochistki trudnoobrabativaemix sortov khlopka-syrsia: Textile problems. -T .:2/2016. Pp. 41-43.
7. Kornecki T.S. Impact of rye rolling direction and different no-till row cleaners on cotton emergence and yield transactions of the asabe: Transactions of the ASABE.том.:52, vypusk: 2, mar 2009. 383-391-str.
8. Hevko.R. Development of design and investigation of operation processes of loading pipes of screwconveyors: INMATEH-AGRICULTURAL ENGINEERING. 2016.-89-96. sep-dec
9. Ryzszard M.Kozlowskiy Hanbook of natural fibres: USA Philodelfia. 2012.51-53 -page
10. Wankhade, Dabade Quality Uncertainty and Preceptionm: Germany. 2010. 51-53 –page.
11. Rajabov I.Ya., Safoev A.A., Research of methods of increase of speed of cleaning of cotton from smallwastes. Scientific and technical journal of NamMTI. Volume 4- №2, 2019. pp. 26-31.
12. Rajabov I.Ya., Safoev A.A., Research of methods of increase of speed of cleaning of

cotton from small wastes. Scientific and technical journal of NamMTI. Volume 4- №2, 2019. pp. 26-31.