An experimental study of the location of the grid bars cells installed under spiked cylinders in a cotton cleaner from small waste

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Abstract. The article presents materials of experimental studies on the installation of the grid bars surface of a cotton cleaner - raw from small waste. In this case, the grid bars surface is mounted perpendicularly, parallel to and at an angle of 45° relative to the center of rotation of the spiked cylinders. The research results of all options are analyzed in the form of a histogram. The experiments were conducted on breeding varieties of cotton - raw "Bukhara-6", "Namangan-77".

1. Introduction
In existing cleaners of cotton from small waste, the main working bodies are the spiked cylinders and the grid bars under it [1]. In order to increase the effect of cleaning cotton from small waste, it is necessary to intensify the effect of spiked cylinder on raw cotton, as well as to equip the heave net with cleaning activating elements, to create oscillating grid bars designs. At the same time, the necessary cleaning effect can be achieved with a minimum cleaning ratio that allows not only obtaining high-quality products, but also reducing energy costs [2]. At the same time, domestic and foreign researchers and specialists mainly pay great attention to the study and improvement of the spiked cylinder, in particular the design of the spike. Research and improvement of the design of the grid bars of cotton cleaners from small waste is not enough. High-frequency interactions of picks with cotton, as well as an increase in the shaking ability of the grid bars, are one of the main directions for improving the design of the working bodies of cotton cleaners from small waste. Thanks to this method, it is possible to separate small weedy impurities deeply embedded in the fibers of cotton flies [3,4].

2. Research source
To check the theoretical judgments, a perforated grid bars with 6x50 mm cells with three options for their location was tested on an experimental setup consisting of three spiked cylinders 1.3 m long. The raw cotton was passed through the unit for a time to judge the operation of six cylinders cleaners. The parameters of the working bodies were taken to be the same as those of the 1XK serial cleaner, i.e. [5]:
- The diameter and speed of the spiked cylinders corresponded to the same parameters of the 1XK cleaner, i.e. Diameter - 400 mm. Speed - 10 m / s.
- The gap between the grid bars and the ends of the spike and planks of the cylinders 15-18 mm.
- The grid bars is perforated with cells of 6x50 mm with the location of the major axis of their perpendicular movement of raw cotton.
• Step chess placement of spike and planks on the cylinders: Along the perimeter 104.7 mm, Length 103.3 mm.
• The number of rows of spike 8 and planks of 4 pieces.
The productivity of the installation, calculated on a length of 1.7 m of spiked cylinders of a serial cleaner, was 5 t / h. Tests were carried out at the Kyzyltepa brewery, Navoi region [6].

The parameters of the purifier and the mode of its operation were determined according to the technique adopted for the experimental bench [7]. All experiments were carried out in six replicates. According to TITLP [8], to carry out experiments on an experimental bench with a reliability of about 95%, the weight of a batch of raw cotton was taken for each experiment 250 kg. In the research process, after each experiment, the weight was determined:
• Peeled raw cotton.
• Allocated waste and its composition.

From the raw cotton - raw cotton sample selected after the experiments, clogging of raw cotton was determined, as well as the seed damage in it and the amount of free fiber. Based on the data on the clogging of the initial, cleaned cotton - raw and separated waste, the cleaning effect was calculate for each experiment according to the TITLP formulas [9]:

\[
K = \frac{\Delta C}{C_1 + \Delta C} \cdot 100 = \frac{\Delta C}{C_2' + \Delta C} \cdot 100
\]

where: \( C_1 \) – clogging of raw cotton.

\( C_2' \) – Clogged cotton after cleaning reduced to its original weight.

\( \Delta C \) – The amount of weed impurities in % by weight of the raw cotton.

\[
C_2' = \frac{C_1 (100 - \Delta C - \Delta x)}{100}
\]

where: \( \Delta x \) - the number of flocks of raw cotton falling out with the waste, in % by weight of the original cotton.

The experiments were conduct on cotton - raw material of the first sort of manual and machine fees. At the same time, a grid bars with a grid bars size of 6x50 mm was tested on raw cotton of the Bukhara 6 sort, and a grid bars with a size of 4.5x50 mm in cotton was tested on raw Namangan 77 [10,11].

3. Research results
The results of the tests are shown in table 1 on which diagrams are constructed (figure 1 and 2).

\[\text{Figure 1. The dependence of the cleaning effect on the location of the grid bars cells with cotton of the first sort.}\]
As can be seen from table 1 and figure 1, the greatest cleaning effect, both general and for large waste, was obtained with a grid with a large cell axis parallel to the movement of cotton. A slightly smaller cleaning effect was obtained when the large axis of the holes was placed at an angle of 45° to the movement of the raw cotton and the smallest - when the large axis of the grid bars cells was perpendicular to the direction of movement of the raw cotton (figure 1), which fully confirms the theoretical considerations.

![Figure 1](image1.png)

**Figure 2.** The dependence of the entry of volatiles into the waste on the location of the grid bars cells with cotton of the first sort.

For example, on raw cotton of the first sort Bukhara-6 machine harvest, the greatest effect - 60.6% was obtained with a grid bars whose cell is located along the major axis (50 mm) along the direction of the cotton, and the smallest effect (52.1%) with a grid whose cells were perpendicular to the movement of the raw cotton.

The largest number of flies 2.7 ÷ 4.8% fell when the large axis of the holes was parallel to the movement of the raw cotton (figure 2), and in other cases was almost the same. Such a significant number of flaps of raw cotton as 2.7 ÷ 4.8% cannot be allow and such a grid bars installation is unacceptable for cleaners of raw cotton from small waste.

A grid bars with cells that are located on the major axis at an angle of 45° to the direction of movement of the raw cotton provides a greater cleaning effect, on average 1.1 times, than a grid bars whose cells are perpendicular to the direction of movement of the raw cotton. At the same time, as already noted, when installing such a grid, an insignificant and almost the same number of flyers falls out.

Therefore, we recommend this particular grid bars for installation in cotton cleaners from small weed impurities.

### 3.1. The influence of the cleaning multiplicity on the technological indicators of raw cotton

The effectiveness of cleaning raw cotton in spiked cylinders cleaners is significantly relate to the number of spiked cylinders, i.e. from the multiplicity of processing [14].

To determine the optimal number of working bodies in one cleaner, the influence of the cleaning ratio of raw cotton on the technological indicators of its cleaning (cleaning effect, seed damage) was studied.

The experiments were carried out on a bench installation of a cleaner with 3 cylinders on cotton - raw material of the 1st sort of manual and machine harvesting, breeding varieties Bukhara-6 and Namangan 77, with a capacity of 5.0 t/h.
The experiments with 6, 9 and 12 cylinders were carried out by re-passing raw cotton through a bench installation.

It can be seen from the graph (figure 1) that, as one would expect, the cleaning effect increases as the exposure rate on the raw cotton of spiked cylinders increases.

An increase in the number of spiked cylinders from 3 to 12 for raw cotton of machine harvest at Bukhara-6 increased the cleaning effect from 50.5 to 69.8%, and at Namangan 77 from 53.2 to 77.0%.

As the test results show, seed damage in peeled raw cotton (figure 2) increases with an increase in the number of spiked cylinders, especially differently after 6 cylinders. Damage to seeds in peeled cotton - raw material of the 1st sort of manual and machine harvesting of the Bukhara-6 sort when passing through the bench unit once and twice (corresponds to 3 and 6 times cleaning on a spiked cylinder) was 0.01-0.02%. A further increase in the cleaning ratio on regimental cylinders caused an increase in seed damage, namely: after 9 cylinders 0.42-0.45% and after 12 cylinders 0.94-1.07% [12].

The optimal cleaning multiplicities for cotton - raw non-regimental cylinders with minimal damage to the seeds should be recognized 6 multiple cleaning. At the same time, the cleaning effect (61.2-64.5%) is significantly higher than on existing cleaners for small waste 6A-12M and 1XK (35-50%).

**Table 1. The influence of the multiplicity of cleaning on the cleaning effect and damage to seeds in peeled cotton - raw cotton of the 1st sort, in % [13].**

| Sort of raw cotton | Type of picking | Number of cylinders | 3 | 6 | 9 | 12 |
|-------------------|----------------|---------------------|---|---|---|----|
| Bukhara 6         | Hand           | Cleanin g effect   | 51.3 | 61.2 | 66.3 | 68.0 | 0.19 | 0.42 | 0.94 |
|                   | Machin e       | Seed damage        | 0.05 | 0.21 | 0.45 | 0.94 | 0.32 | 0.86 | 1.07 |
| Namangan 77       | Hand           | Cleanin g effect   | 53.0 | 64.2 | 70.5 | 74.6 | 0.10 | 0.36 | 1.53 |
|                   | Machin e       | Seed damage        | 0.12 | 0.36 | 0.91 | 77.0 | 0.32 | 0.45 | 1.70 |

**Figure 3.** The cleaning effect of the multiplicity of cleaning not spiked cylinder.
Further research was carried out with double cotton cleaning on a 3-cylinder bench stand.

4. Conclusions
The living area of a hundred square meters should be increase by bringing the angle of the cylinder to 180°.

Derived formulas of trajectories of motions of specks, which let you, go and the choice of a rational arrangement of grid bars cells.

Under the pecking - slatted cylinders of the cleaner, it is necessary to install nets with holes, the major axis of which is located at an angle of 45° along the direction of the raw cotton.

With an increase in the number of spiked cylinders from 3 to 12 per cotton - raw machine and manual picking, the cleaning effect increases, but the damage to the seeds also increases.

The optimal multiplicity of the cleaning of raw cotton on spiked cylinders with minimal damage to the seeds is recommended 6 short.

The calculated data show that a grid with a cell with a larger axis in the direction of movement of the raw cotton should better isolate weedy impurities. The smaller the grid bars cell size in this direction, the weedier impurities should be release worse.

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