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NEW TECHNOLOGY FOR MULTISTAGE CLEANING OF COTTON FIBER

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ABSTRACT

The article presents the research results of an innovative cotton fiber cleaning technology using a multi-stage fiber cleaning unit with adjustable cleaning frequency. The developed technology significantly increases the fiber cleaning efficiency to 36.15% compared to 25-30% in traditional single-stage fiber cleaners. Experimental data show a 2.5-fold reduction in air consumption and a decrease in pure fiber loss in waste. The proposed technology ensures improved fiber quality, energy savings, and more effective preservation of the natural properties of cotton.

Keywords: cotton, fiber, fiber cleaner, working chamber, cleaning effect, clogging, humidity, defect, litter, fibrous waste.

Due to the increase in the volume of difficult-to-clean selected varieties of cotton and the increase in the share of cotton harvested by machines, the cotton ginning industry is faced with priority tasks - the creation and implementation of new technologies, machines and materials that are superior to the best domestic and world analogues [1].

At the moment, the solution to this problem is carried out by improving all parts of the technological process of primary processing of cotton, from cotton harvesting to fiber pressing, and work is also underway to improve the quality of the fiber by improving the fiber cleaning process.

Unfortunately, foreign experience in the field of fiber cleaning is of little use, since abroad they mainly use fiber cleaners with clamping working bodies, which worsen its natural properties (length, strength).

Based on this, abroad, double and more than double fiber cleaning on fiber cleaners with clamping bodies and feeding tables is considered impractical and, moreover, harmful [2].

Previous studies have established that by increasing the frequency of cleaning raw cotton on serrated sections by more than four passes, it is impossible to improve the quality of the fiber, since with an increase in the frequency of cleaning, intensive formation of the most harmful defects of the fiber is observed - broken seeds and skins with fiber.

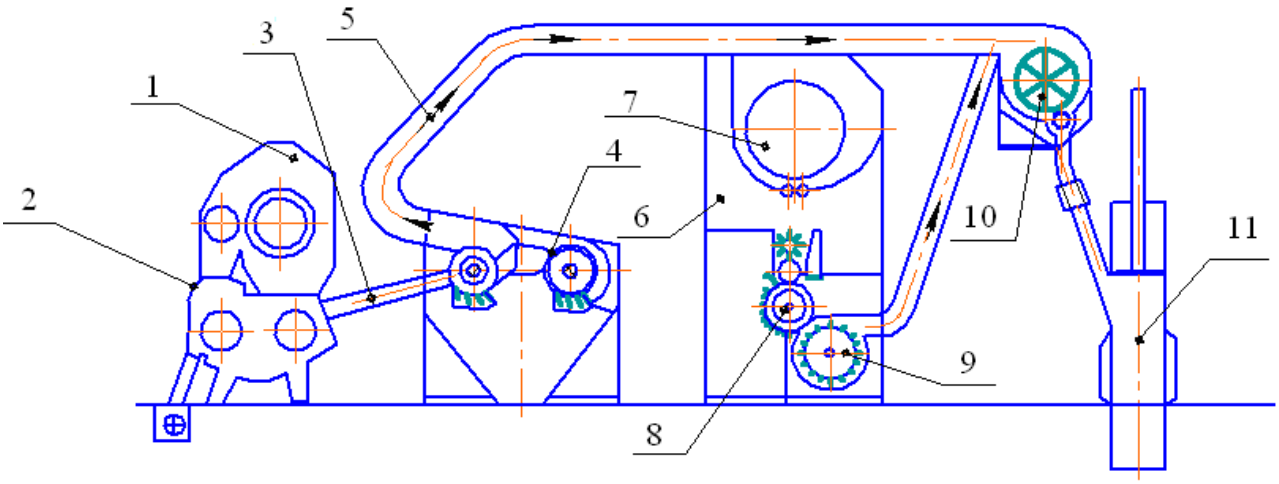
The most favorable area for promising searches in the technological chain of a cotton plant is fiber cleaning. If today, when cleaning raw cotton, the cleaning effect has already been achieved on the order of 95% or higher, then when cleaning the fiber in the single-drum fiber gins currently used in cotton factories, it is at the level of 20-25%. Consequently, the desire for a sharp increase in the cleaning capacity of fiber cleaning machines has a real basis [4-6].

All of the above served as the basis for conducting scientific research to create a more efficient multi-stage direct-flow fiber cleaner. This work is devoted to the development of such a fiber cleaner.

Taking into account the above, in this work, studies of the fiber cleaning production line were carried out.

Experimental part. In order to regulate the frequency of fiber cleaning depending on the initial content of defects and contamination in the fiber, maintain physical and mechanical properties and reduce fiber losses during the fiber cleaning process, increase the cleaning effect and save energy, a new fiber cleaning unit (Fig. 1.) with adjustable multiplicity of fiber cleaning.

To meet the modern high demands of the textile industry on the quality of cotton fiber, there is an urgent need to introduce innovative technologies into the production of primary processing of cotton, which would not only improve the quality of the fiber, but would also allow for significant savings in energy resources, improvement of working conditions and environmental protection.



1- gin feeder, 2- gin, 3- connecting pipes, 4 - two-cylinder fiber cleaner, 5 - fiber outlet, 6 - fiber cleaner with feeding table, 7 - mesh drum, 8 - saw cylinder, 9 - brush drum, 10 - general battery condenser, 11 - pressing unit.

Figure - 1. Layout diagram of a bench installation for cleaning cotton fiber

The technological process consists of a new gin with a new working chamber and mechanical fiber removal 2, a new two-cylinder fiber cleaner 4, a new fiber cleaner with a unit for combing fiber 6 and a press 11.

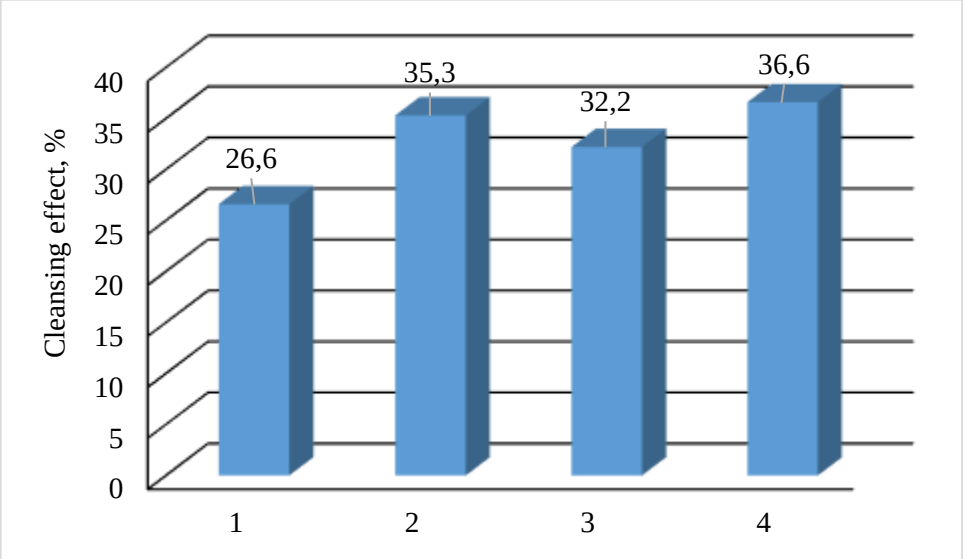
Technological studies of the experimental installation were carried out in four options for fiber cleaning:

- two-cylinder fiber cleaner with one saw cylinder;
- two-cylinder fiber cleaner with two saw cylinders;
- two-cylinder fiber cleaner with one saw cylinder and a fiber cleaner with a feeding table;
- a two-cylinder fiber cleaner with two saw cylinders and a fiber cleaner with a feeding table.

As a result of testing a two-cylinder direct-flow fiber cleaner, it was found that air consumption is reduced by 2.5 times, and the content of pure fiber in the waste is 24.57% versus 30.5% for the existing single-cylinder fiber cleaner. The cleaning effect of a two-cylinder fiber cleaner was 36.15% versus 25-30% for a single-stage fiber cleaner.

As the research results have shown (Fig. 2), when cleaning fiber, the mass fraction of defects and impurities in the fiber is 5.29% after gin, and 3.88% after a single-drum fiber gin, while the contamination of raw cotton from the gin tray is 1.36 %.

The cleaning effect of the single-drum fiber cleaner was 26.6%. On raw cotton of the same contamination, the mass fraction of defects and impurities was 4.87% after gin, 3.16% after a double-drum gin, and the cleaning effect was 35.3%. Pure fiber in the waste after a single-drum fiber cleaner was 33.7%, and after a double-drum fiber cleaner 24.5%. After the double-drum fiber gin, waste was collected separately for each saw cylinder. From under the first cylinder, the percentage of pure fiber in the fibrous waste was 37.22%, and from under the second saw cylinder - 11.93%, while the mass of waste after the first saw cylinder was 157.7 and after the second saw cylinder - 57.2 g. The air pressure during the formation of fiber waste when the fiber passes through the first cylinder is less than when the fiber passes through the second cylinder. Therefore, the fiber content of the waste after passing through the second saw cylinder is less.



1- two-cylinder fiber cleaner with one saw cylinder;

2- two-cylinder fiber cleaner with two saw cylinders;

3- two-cylinder fiber cleaner with one saw cylinder and a fiber cleaner with a feeding table;

4-two-cylinder fiber cleaner with two saw cylinders and a fiber cleaner with a feeding table.

Figure - 2. The cleaning effect of the experimental installation on four options for fiber cleaning

When connecting the fiber cleaner section with a power unit with a single-drum fiber cleaner, the mass fraction of defects and impurities was: after gin 3.36%, after the unit 2.51%, cleaning effect 32.2%, fiber content in waste 43.14%, when clogged raw cotton from a gin tray 0.81%. When operating a double-drum fiber cleaner and a fiber cleaner with a power unit, the mass fraction of defects and impurities was: after gin 4.867%, after the unit 3.11%, cleaning effect 36.10%, fiber content in waste 35.05%. With the same contamination of raw cotton, the fiber content in the waste decreases with the connection of the second saw cylinder. The cleaning effect remained almost unchanged with the connection of a fiber cleaner with a power unit compared to a double-drum fiber cleaner, since in this case, when the unit was operating, the contamination of raw cotton from the gin tray was 1.36% versus 0.81%. When comparing the fractional composition of the fiber after the unit, the results are better than after single-drum and double-drum fiber cleaners.

Large debris in the fiber after a single-drum fiber cleaner was 1.507% versus 0.836%, and in the fiber after a single-drum fiber cleaner + fiber cleaner with a feed unit, uluk 0.6% versus 0.403%, broken seeds 1.162% versus 0.560, peel with fiber 0.68% versus 0.45%, small litter 0.44% versus 0.36%. A comparison of a double-drum fiber cleaner with a double-drum fiber cleaner + a fiber cleaner with a feed unit shows the following results: large debris 0.892% versus 1.024%, uluk 0.484% versus 0.484%, broken seeds 0.596% versus 0.464%, peel with fiber 1.054% versus 0.625%, small debris 0 .64% vs. 0.513%.

Conclusions.

Based on the results of the developed technology for cleaning cotton fiber, the following conclusions can be drawn: modernization of the fiber cleaner allows you to reduce the air pressure at the outlet to zero, which leads to a decrease in air consumption, an increase in the cleaning effect and a reduction in the fibrous mass in waste by 35-40%, compared to single drum fiber cleaner. At the same time, the presence of a switch valve allows you to regulate the degree of fiber cleaning, at the same time, cleaning the fiber on two saw cylinders more fully preserves the properties, and the group of gin - fiber cleaners

on the reverse side towards elasticity is promising, and therefore research in this direction should be continued.

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