

JUSTIFICATION OF SCIENTIFIC FOUNDATIONS AND RESEARCH DIRECTIONS FOR IMPROVING THE LINTERING MACHINE FOR HAired SEEDS

Independent researcher A.B. Kurbanov Termez State University of Engineering and Agrotechnologies
e-mail: qanvar77@gmail.com)

Abstract. This article provides an analytical review of scientific research results regarding the process of depilation of cotton seeds and the improvement of related equipment. Additionally, a working hypothesis was put forward and a scientific research direction was defined to increase the productivity and improve the energy efficiency of the 5LP linter.

Key words: seed, linting, research, working chamber, lint, productivity, gasket, cylinder.

Currently, increasing the cross-sectional area of the working chamber in 5LP linters, which are widely used in the lint removal areas of cotton ginning plants, leads to an increase in the linter's productivity by only 5-8%. The expansion of the chamber volume did not accelerate the timely removal of dehaired seeds from the working chamber. As a result, the mass and density of the seed roller inside the chamber increased. This, in turn, led to an increase in the load on the saw cylinder from the seed roller [1]. An 18.5 kW electric motor is installed in the saw cylinder to overcome the overload, bring the seed shaft to the required speed, and ensure the depilation process proceeds without clogging.

To intensify the linting process of cotton seeds, numerous studies have been conducted at the Cotton Industry Scientific Center and the Tashkent Institute of Textile and Light Industry, where factors affecting linter performance were primarily studied [2, 3, 4, 5].

The researcher M.V. Pokras studied the effect of forces arising from the rotation of the seed roller on the linter working chamber. It is shown that the magnitude of the forces resisting the rotation speed of the roller from the surface of the working chamber depends on the magnitude of the forces transmitted by the seed roller to the chamber walls and the friction force. However, the dependence of the rotation speed of the seed roller, the structure of the seeds in the seed roller by fuzziness, and the state of timely

seed outlet from the working chamber into the grate zone on the structure and speed of the seed roller were not taken into account.

Before developing 5LP linter equipment and the designs of each working part affecting the seed linting process, scientists studied them in a theoretical direction. Based on theoretical research, the cross-sectional area and volume of the 5LP linter working chamber were studied, taking into account the mass of seeds in the chamber and the speed of the seed roller; the speed of the mixer with a saw cylinder was studied, taking into account the degree of seed damage when scraping lint from the surface of the seeds; and the time spent by linted seeds in the working chamber was studied, taking into account the degree of lint contamination.

In his scientific work, Yu.A. Makhmudov proposed a chamber 15% larger than the working chamber of the PMP-160 linter. When using the chamber in the linter, the productivity of the linter for seeds increased by 15-18%, and for lint by 8-10%. The author concludes in his scientific work that increasing the volume of the working chamber does not give a positive result to the rotation speed of the seed roller in the chamber, and to achieve a positive result, it is necessary to reduce the mass of linted seeds in the seed roller simultaneously with an increase in the volume of the working chamber.

As a result of theoretical research, researcher E.K. Nuraliev proposed a working chamber for the KL-7 linter, which was enlarged in volume. A mixer with an outer diameter of 240 mm is used in the chamber. At the end of the research work, it was found that the proposed working chamber and the mixer used in it had a positive effect on the productivity of the linter for seeds and lint due to the good mixing of the seed roller.

Researcher A.K. Kalimulin noted that the seed productivity of the linter depends on the position of the seed comb. In this case, the existing distance between the seed comb and the grate is moved forward and backward along the seed comb's axis and up and down around the comb's axis; changing this distance does not ensure the uniform removal of lint from the seed surface and the uniform fuzziness of the seeds leaving the chamber. To ensure the seeds emerge with uniform fuzziness, it is recommended to set the seed comb at a 15° degree angle relative to the horizontal plane and move it only in reciprocating motion.

As a result of his research, K.K. Iskandarov proposed an improved mixer design. To increase the efficiency of the saw cylinder in scraping seeds from the surface and the productivity of the linter, the mixer rotated the seed mass along the axis of the mixer. However, due to the absence of blades in the mixer design and the inability of the guide

used to direct seeds along the mixer axis at the required pressure, the rotation speed of the seed roller decreased, and the degree of saw teeth removal of lint from the seed surface was low. As a result, the amount of seeds leaving the working chamber decreased, the density of the seed roller increased, and the supply of ginned seeds from the feeding roller to the working chamber decreased. As a result, the productivity of the linter for cotton seeds and lint decreased.

Attempts were made by JSC "Cotton Industry Scientific Center" to innovate in the improvement of linter equipment [13, 14]. However, the main problem is that no results have been achieved that significantly increase the productivity of the linter.

As a result of the aforementioned brief analytical analysis, a working hypothesis was developed stating that replacing the inter-saw gaskets in the saw cylinder of the existing 5LP linter with relatively large-diameter ones (the width of the gaskets remains unchanged) can positively affect the processes in the linter's working chamber, relatively reduce seed density in the working chamber, and increase productivity through better mixing.

As a result of implementing the proposed working hypothesis, the following is expected: precise fastening of the saw shaft to the linter and the saw discs on it relative to the shaft is ensured, as well as the alignment of each grate section along the saw gap; consequently, the deviation of one saw from its nominal position in the grate gap is expected to be significantly lower than in the existing 5LP linter. Furthermore, it is possible to completely eliminate the deformation of saws compressed by large-diameter saw spacers, thereby eliminating the need for hammer straightening before assembling the saws onto the shaft.

The thickness of the seed layer in the working chamber of the developed improved linter can be reduced by an average of 1.4–1.5 times compared to the existing 5LP linter. Due to this factor, as well as the fact that the large-diameter saw spacers in the rotating saw drum at the bottom of the chamber support the seed layer, it is expected that the productivity of the produced linter will increase by 1.3-1.4 times compared to the current 5LP linter as a result of increasing the absolute and relative speed of the seed layers, their better mixing in the chamber, and accelerating mass transfer.

Conclusion: Calculations and measurements have shown that up to 85% of the energy consumption of the electric motor rotating the saw cylinder in an existing 5LP linter is spent on friction of the saw cylinder against the seed layer, and up to 15% is spent on friction of the saw cylinder against the grate bars. In the developed improved linter, the penetration of the saw cylinder into the seed layer can be significantly reduced; in the current 5LP linter, the penetration of the saw cylinder into the seed layer is 28 mm;

therefore, under all other conditions, it is expected that the energy consumption for friction of the lateral surfaces of the saws in the improved linter will be significantly reduced, i.e., by 10-15%.

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