

PRODUCTION TESTS OF AN IMPROVED SAW SPACER OF A LINTER MACHINE**A.B. Kurbanov, O.SH. Abdurakhmonov**

Termez State University of Engineering and Agrotechnologies, Termez city, Uzbekistan

The article presents the results of comparative tests of an improved 5LP linter equipped with increased-diameter saw spacers and the existing 5LP linter. The spacers were designed to increase the productivity of the linter and reduce energy consumption during seed linting. The mechanical damage of the seed cottonseed during the linter process, the degree of saturation, and the process of producing high-quality cottonseed products according to the established technical requirements were studied. The article analyzed that the actual productivity of the existing 5LP linter under current production conditions averaged 672 kg/h for cottonseed and 29.56 kg/h for lint, while the improved linter achieved 712 kg/h for cottonseed and 34.17 kg/h for lint. Information is provided on the manufacture of saw spacers with increased outer diameters in three variants for conducting experiments, as well as on the results of testing to determine the quality indicators of lint and linter seeds.

Keywords: lint, experiment, saw spacer, quality, layer, productivity, damaged.

ПРОИЗВОДСТВЕННЫЕ ИСПЫТАНИЯ УСОВЕРШЕНСТВОВАННОЙ МЕЖДУПИЛЬНОЙ ПРОКЛАДКИ ЛИНТЕРНОЙ МАШИНЫ**А.Б. Курбанов, О.Ш. Абдурахмонов**

Термезский государственный университет инженерии и агротехнологий, г.Термез, Республика Узбекистан

В статье представлены результаты сравнительных производственных испытаний усовершенствованной линтерной машины 5ЛП, оснащённой пильными прокладками увеличенного диаметра, и существующей линтерной машины 5ЛП. Прокладки разработаны для повышения производительности линтерной машины и снижения энергозатрат при линтеровании семян. Изучены механические повреждения зерна в процессе линообразования, степень насыщения и процесс производства высококачественной хлопчатобумажной продукции в соответствии с установленными техническими требованиями. В статье анализируется, что фактическая производительность существующего линтера 5ЛП в текущих условиях производства составляла в среднем 672 кг/ч для семян хлопчатника и 29,56 кг/ч для линта, в то время как усовершенствованный линтер достигал 712 кг/ч для семян хлопчатника и 34,17 кг/ч для линта. Представлены данные по изготовлению трех вариантов промежуточных прокладок пильного полотна увеличенного внешнего диаметра для проведения экспериментов и результаты испытаний по определению показателей качества пуха и семян, полученных из линтера.

Ключевые слова: линт, опыт, пила, качество, прокладка, производительность, повреждённость.

САНЧИШҲОИ ИСТЕҲСОЛИ ҚАБАТИ ТАКМИЛЁҒТАИ БАЙНИАРАҒИ ТИБИТЧУДОКУНАК**А.Б. Курбанов, О.Ш. Абдурахмонов**

Донишгоҳи давлатии муҳандисӣ ва технологияҳои кишоварзии Термиз, Термиз, Ҷумҳурии Ўзбекистон

Дар мақола натиҷаҳои озмоишҳои муқоисавии истеҳсоли мошини линтерии такмилёфтаи 5ЛП, ки бо прокладкаи арраи диаметрашон калоншуда мучаҳҳаз шудааст ва мошини линтерии мавҷудаи 5ЛП пешниҳод шудаанд. Прокладкаи барои баланд бардоштани маҳсулнокии мошини линтерӣ ва кам кардани масрафи энергия хангоми линтеркунии тухмӣ таҳия шудаанд. Осеби механикии донаи тухмӣ хангоми раванди линткунӣ, дараҷаи сершавӣ ва раванди истеҳсоли маҳсулоти пахтаи баландсифат мувофиқи талаботи муқарраршудаи техникии омӯхта шуданд. Дар мақола таҳлил карда шудааст, ки маҳсулнокии воқеии линтери мавҷудаи 5ЛП дар шароити кунунии истеҳсолот ба ҳисоби миёна 672 кг/соат барои чигит ва 29,56 кг/соат барои линт буд, дар ҳоле ки линтери такмилдодашуда ба 712 кг/соат барои чигит ва 34,17 кг/соат барои линт мерасид. Маълумот дар бораи омода кардани се варианти прокладкаи миёнаи арра бо диаметрҳои берунии калон барои гузаронидани таҷрибаҳо ва натиҷаҳои санчиш барои муайян кардани нишондиҳандаҳои сифатии пашм ва тухмиҳои аз линтерҳо гирифташуда оварда шудаанд.

Калидвожаҳо: тибит, таҷриба, арра, сифат, қабат, ҳосилнокӣ, зарардида.

Introduction

In the 5LP linters, which are currently widely used in the linting shops of cotton ginning enterprises, increasing the cross-section of the working chamber allowed to increase the linter's productivity by only 5-8%. However, increasing the volume of the chamber did not accelerate the timely exit of linted grains from the working chamber. As a result, the mass and density of the grain roller in the chamber increased. This, in turn, led to an increase in the load from the grain roller to the saw cylinder [1]. To overcome the overload, give the grain roller the required speed and ensure the linting process without jamming, an 18.5 kW electric motor was installed on the saw cylinder.

Researcher E.K. Nuraliev [2], as a result of theoretical research, offers a KL-7 working chamber for the linter with an increased volume. The chamber uses a mixer with an outer diameter of 240 mm. At the end of the research work, it was found that the proposed working chamber, due to the good mixing of the mixer with the grain roller used in it, had a positive effect on the productivity of the linter in terms of grain and lint. There have been attempts to improve the linter equipment by the "Cotton Industry Scientific Center" [3, 4]. However, the main problem is that the results that would significantly increase the productivity of the linter have not been achieved.

The purpose of our research is to increase the productivity of the linter and reduce the energy consumption spent on the linter process, which is to increase it by increasing the diameter of the saw cylinder spacer in the working chamber, thereby increasing the linter productivity.

The following are expected as a result of the implementation of the proposed working hypothesis: Accurate fastening of the saw shaft to the linter and the saw blades in it relative to the shaft, as well as alignment of each grid section along the saw gap, is ensured, due to which the deviation of one saw from the nominal position in the grid slot is expected to be much less than in the current 5LP linter. In addition, the deformation of the saws compressed by the intermediate gaskets of large-diameter saws can be completely eliminated, and as a result, the need to straighten the saws by hitting them with a hammer before assembling them on the shaft can be eliminated. The thickness of the sawdust 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 current 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 grain layer, the absolute and relative velocity of the grain layers increases, their better mixing in the chamber, and mass exchange accelerates, and the productivity of the developed linter is expected to increase by 1.3-1.4 times compared to the current 5LP linter.

Materials and methods

As a result of the analytical analysis, a working hypothesis was developed that replacing the saw spacers in the saw cylinder of the current 5LP linter with increased-diameter saw spacers (the width of the gaskets remains unchanged) can positively affect the processes in the linter's working chamber, reduce the grain density in the working chamber, and increase productivity due to better mixing [5, 6].

Calculations and measurements have shown that up to 85% of the energy consumption of the electric motor rotating the saw cylinder in the current 5LP linter is spent on the friction of the saw cylinder against the grain layer and up to 15% on the friction of the saw cylinder against the grate bars. In the improved linter under development, the penetration of the saw cylinder into the grain layer can be significantly reduced, in the current 5LP linter the penetration of the saw cylinder into the grain layer is 28 mm, therefore, all other conditions being equal, it is expected that the energy consumption for the friction of the side surfaces of the saws in the improved linter will be significantly reduced, i.e. by 10-15%.

Results

To determine the quality indicators of the seeds during processing according to the existing methodology, primary seeds, separated seeds, and lint samples were selected [1]. During the testing period, the productivity of the linter was determined by the mass of the lint and seeds produced during continuous operation. The productivity values presented in this study were determined experimentally under actual production conditions and do not represent the nominal passport productivity of the 5LP linter. The tests were carried out under the current technological scheme, in which linting is performed in the first removal. For comparison, the existing 5LP linter and the improved linter were tested under the same production conditions using the same type and grade of cottonseed. The productivity was determined from the mass of cottonseed processed and the mass of lint obtained during continuous operation. Thus, the obtained values characterize the actual operating productivity of the linter under the specified production conditions. In this case, the initial seeds, separated seeds, and lint masses were recorded. The results of the laboratory analysis of the primary seeds are presented in Table 1.

Table 1 – Results of laboratory analyses of the quality indicators of primary seeds

Seeds		Quality indicators of seeds, %			
Variety		hairiness	damagedness	pollution	humidity
Breeding	Industry				
Sultan	I	10.8	3.8	3.2	8.6

To study the performance and quality indicators of the proposed improved linter machine, comparative tests were conducted on ginned cotton seeds of industrial grade Sultan I from the existing 5LP linter in the wool seed preparation workshop of the cotton ginning enterprise in the Jarkurgan district of the Surkhandarya region (Fig. 1). Before conducting the tests, the technological parameters were adjusted in accordance with the technical specifications of the machines. During the work, the influence of the linter on the quality indicators of the manufactured products and the machine's productivity was studied.



Figure 1 – The process of conducting production research on an improved saw drum linter

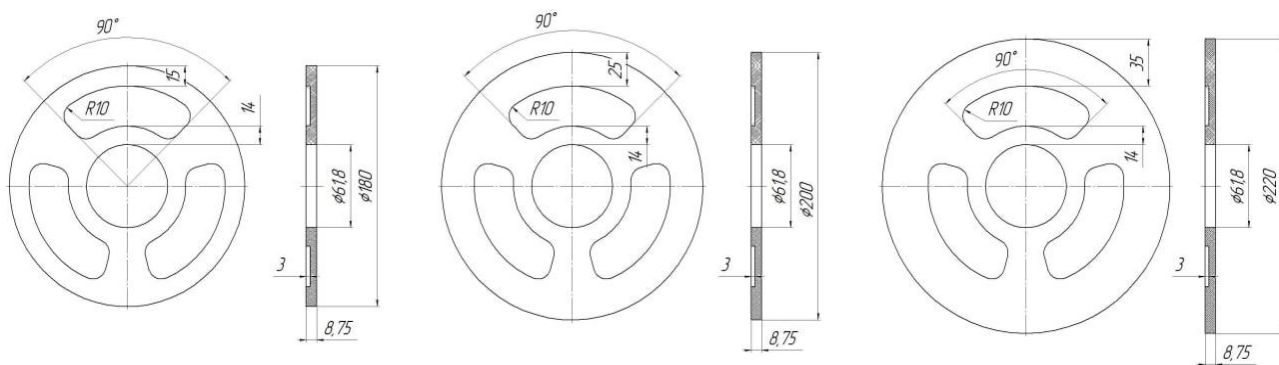


Figure 2 – Schematic drawing of the experimental saw spacers planned to be manufactured to improve the saw cylinder of the 5LP linter





Figure 3 – Scenes from the process of assembling the prepared saw spacers into the saw cylinder

Table 2 – Results of comparative studies of the experimental linter under production conditions at the cotton ginning plant with the existing 5LP linter

Indicators	Unit of measurement	Comparable cars	
		Existing 5LP linter	Improved linter
Seeds after ginning:			
- hairiness	%	10.8	10.8
- injury	%	3.8	3.8
Seeds after lint separation:			
- hairiness	%	7.81	6.9
- injury	%	4.46	4.3
Lint:			
- mass fraction of impurities and whole seeds in the lint;	%	6.44	5.94
- staple length	mm	6/7	6/7
- variety		I	I
- type		B	B
- class		"Dirty"	"Medium"
Productivity of the linter:			
- regarding seeds	kg/hour	672	712
- about lint		29.56	34.17

As shown in Table 2, the hairiness of the seeds obtained from the existing 5LP linter is lower than that of the experimental linter, averaging 7.81%, which, according to the current standard, is higher than the standard for grade I. Mechanical damage to the seeds was 4.46%. The mass fraction of impurities and whole seeds in the lint obtained from the 5LP linter averaged 6.44%, the staple length was 6-7 mm [2, 3], and according to the quality index, it corresponds to Class I type B of Class "Filt" according to the O'zDst 645:2016 state standard [1]. Under the current production conditions, the experimentally determined actual productivity of the existing 5LP linter averaged 672 kg/h for cottonseed and 29.56 kg/h for lint.

Discussions

In the improved linter, which is equipped with a saw cylinder with an increased diameter of the saw spacer, the hairiness of the separated seeds obtained from grade I ginned seeds averages 6.9%, which corresponds to the requirements of O'zDst 596:2016 "Technical seeds. According to the requirements of the state standard, grade I corresponds to class 1. The mechanical damage of the separated seeds was 4.3%,

which is 0.16 percentage points lower, corresponding to a relative reduction of 3.58%, compared with the existing 5LP linting machine. The mass fraction of impurities and whole seeds in the lint averaged 5.94%, which was less than the mass fraction of impurities and whole seeds obtained from the 5LP linter by 7.76% (abs.).

Under the same production conditions, the improved linter demonstrated an actual productivity of 712 kg/h for cottonseed and 34.17 kg/h for lint, which is 40 kg/h higher for seeds and 4.61 kg/h higher for lint compared with the existing 5LP linter.

The reduction in the penetration of the saw cylinder into the seed layer is also important for the operating conditions of the machine. In the existing 5LP linter, the saw cylinder penetrates approximately 28 mm into the seed layer, which increases the frictional interaction between the saw surfaces and seeds. The use of increased-diameter saw spacers changes the geometry of the seed layer in the working chamber and creates conditions for its less dense arrangement and more intensive movement. As a result, the saw cylinder can interact with the seed flow more effectively, which helps explain the higher lint productivity observed during the production tests.

The observed improvement in the performance of the experimental linter can be explained by the change in the working conditions of the saw cylinder caused by the increased-diameter saw spacers. According to the working hypothesis, the larger-diameter spacers reduce the density of the seed layer in the working chamber and improve the mixing and mass exchange of the seed flow. Experimental results showed that increasing the saw-spacer diameter from 160 mm to 220 mm reduced the volumetric density of the seed layer from 314 kg/m³ to 284 kg/m³, while its linear velocity increased from 1.13 m/s to 1.48 m/s. This change in the seed-layer characteristics created conditions for more intensive mixing and mass exchange in the working chamber, thereby contributing to the increased productivity of the improved linter. The reduced penetration of the saw cylinder into the seed layer also decreases the frictional interaction between the saw cylinder and the seed layer. This is particularly important because calculations and measurements showed that up to 85% of the energy consumption of the saw-cylinder drive in the existing 5LP linter is associated with friction against the seed layer. Therefore, the observed increase in productivity and the improvement in the quality indicators of the separated seeds and lint are consistent with the previously established theoretical and experimental relationships for the effect of saw-spacer diameter on the working process.

Thus, the results of the industrial research work on an improved linter with a saw cylinder with a saw spacer with increased diameters showed the reliability of the justified parameters obtained from theoretical and experimental studies presented in the previous chapters of this scientific work.

Reviewer: M.V. Izatov — Candidate of Technical Sciences, Associate Professor of the Department of "Technology and Equipment of Textile Industry", Tajik Technical University named after Academician M.S. Osimi.

References

1. O'zDst 645:2016. Lint. Technical Specifications. – Tashkent, 2016.
2. O'zDst 660:2016. Lint. Methods for Determining Length. – Tashkent, 2016.
3. O'zDst 662:2016. Lint. Methods for Determining the Mass Fraction of Impurities and Whole Seeds. – Tashkent, 2016.
4. Abdurakhmonov, O.Sh. Substantiation of the Scientific Research Direction for the Improvement of the 5LP Linter / O.Sh. Abdurakhmonov, A.B. Kurbanov // Scientific and Technical Journal (STJ FerSTU, FarDTU ITJ, NTJ FerGTU). – 2025. – Vol. 29, No. 5.
5. Kurbanov, A.B. Ways to Improve the Performance of the 5LP Linter / A.B. Kurbanov, O.Sh. Abdurakhmonov, N.K. Safarov // Current Issues of Increasing the Competitiveness of Uzbekistan's Light Industry: Innovative Solutions and Digital Integration: Proceedings of the Republican Scientific and Practical Conference, Namangan, October 23–24, 2025.
6. Abdurakhmonov, O.Sh. Results of Preliminary Experiments Conducted on the Laboratory Stand of the UCHDM Machine / O.Sh. Abdurakhmonov, D.I. Artikova, A.B. Kurbanov // Current Issues of Increasing the Competitiveness of Uzbekistan's Light Industry: Innovative Solutions and Digital Integration: Proceedings of the Republican Scientific and Practical Conference, Namangan, October 23–24, 2025.
7. Nazirov, R.R. Preparation of Experimental Saw Intermediate Insets for the 5LP Linter and Methodological Procedures for Conducting Experiments / R.R. Nazirov, O.Sh. Abdurakhmonov, A.B. Kurbanov // Development of Science and Technology. – 2026. – No. 2.
8. Sulaymonov, R.Sh. Finding Ways to Improve the Efficiency of the Seed Lintering Process / R.Sh. Sulaymonov, B.Ya. Kushakeev, D.U. Madrakhimov. – Research report. – Tashkent: OJSC Paxtasanoat Ilmiy Markazi, 2011. – 65 p.
9. Kamalov, N.Z. Studying the Compatibility of Imported Equipment with Domestic Linters / N.Z. Kamalov, R.Sh. Sulaymonov. – Research report. – Tashkent: OJSC Paxtasanoat Ilmiy Markazi, 2011. – 86 p.
10. Sulaymonov, R.Sh. Studying Foreign-Made Technologies and Equipment for Raw Cotton Ginning, Seed Lintering, Fiber and Linter Cleaning Used at Domestic Ginneries, with Recommendations / R.Sh. Sulaymonov, U.K. Karimov, B.Kh. Marufkhanov. – Research report. – Tashkent: JSC Paxtasanoat Ilmiy Markazi, 2016. – 28 p.

Information about the authors:

Kurbanov A.B., (Eng.), Independent researcher, Department of Light Industry and Food Technologies, Termez State University of Engineering and Agrotechnologies, Termez city, Uzbekistan. ORCID: <https://orcid.org/0000-0002-6893-4198>. Email: qanvar94@mail.ru

Abdurakhmonov O.Sh., Ph.D. (Eng.), Associate Professor, Department of Light Industry and Food Technologies, Termez State University of Engineering and Agrotechnologies, Termez city, Uzbekistan. ORCID: <https://orcid.org/0000-0002-2532-5923>. Email: olim9201@mail.ru

Сведения об авторах:

Курбонов Анвар Баходир угли, Независимый исследователь, кафедра легкой промышленности и пищевых технологий, Термезский государственный университет инженерии и агротехнологий, г.Термез, Республика Узбекистан. ORCID: <https://orcid.org/0000-0002-6893-4198>. Email: qanvar94@mail.ru

Абдурахмонов Олим Шойкулович, кандидат технических наук, доцент, кафедра легкой промышленности и пищевых технологий, Термезский государственный университет инженерии и агротехнологий, г.Термез, Республика Узбекистан. ORCID: <https://orcid.org/0000-0002-2532-5923>. Email: olim9201@mail.ru

Маълумот оид ба муаллифон:

Курбонов Анвар Баходир угли, Таҳқиқгари мустақил, кафедраи саноати сабук ва технологияи хӯрокворӣ, Донишгоҳи давлатии муҳандисӣ ва технологияи кишоварзии Термиз, Термиз, Ҷумҳурии Ўзбекистон. ORCID: <https://orcid.org/0000-0002-6893-4198>. Email: qanvar94@mail.ru

Абдурахмонов Олим Шойкулович, Номзади илмҳои техники, дотсент, кафедраи саноати сабук ва технологияи хӯрокворӣ, Донишгоҳи давлатии муҳандисӣ ва технологияи кишоварзии Термиз, Термиз, Ҷумҳурии Ўзбекистон. ORCID: <https://orcid.org/0000-0002-2532-5923>. Email: olim9201@mail.ru