

## Investigation of the Effect of Linter Mixer Blade on Seed Lintering Process

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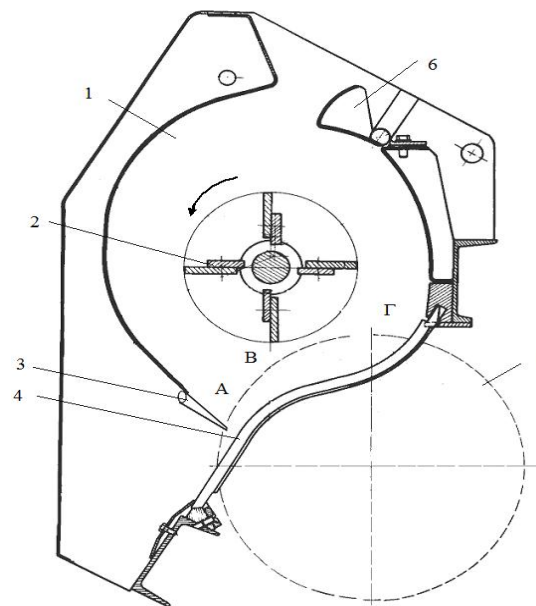
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**Annotation:** In order to increase the productivity of the linter, improve the quality of the resulting seeds and fluff, the metal blades of the 5LP linter mixer were equipped with rubber, which is a viscous element, and the mixer was improved. The improved paddle mixer was installed on a 5LP 30-saw linter in the technological laboratory of Pakhtasanoat Scientific Center JSC and comparative studies were carried out with a mixer of a simple design with metal blades. Experiments were carried out with mixing blades and saw teeth in a saw cylinder with a change in distance from 8 mm to 12 mm. During the research period, when using a mixer with blades of a viscous element in the linter, the fluffiness of the seeds after the linter ranged from 6.84% to 8.4%, and the quality of the seeds produced was from 6.84 (abs.)% to 8.4 (abs.)% . , down quality improved from 0.24 (abs.)% to 0.03 (abs.)%. At the same time, the performance of the proposed linter is higher than the performance of a linter with a mixer of a simple design: for seeds from 22 kg/h to 12 kg/h, for seeds from 0.47 kg/h to 0.33 kg/h. fluff, and the output of lint seeds from the working chamber is accelerated, there is an effective implementation of the linting process.

**Keywords:** Linter, working chamber, seed comb, mixer, viscous element, blade, performance, seed, lint, quality index.

**Introduction.** Linter type 5LP is used for earthing up seeds in cotton gins. In these linters, technical and seed seeds are linted [1]. Based on the design of the linter, the rotation speed of the saw cylinder is 730 rev/min, and the rotation speed of the mixer is 500 rev/min [2]. In the zone of working bodies with two different speeds of rotation, the layer of seeds moves with the third speed of rotation. In the area between the seed comb and the upper part of the grate, the seeds in the layer closest to the saw cylinder are under the influence of the teeth of the saw cylinder.

**Level of study of the problem.** In the process of linting, the saw teeth in the cylinder act on the seed mainly in three places [3,4]. First, near the seed comb of the saws, where it enters the working chamber, the seed changes the direction of its movement, touching the teeth of the saw, and moves in the direction of movement of the teeth (Fig. 1, zone A) . In this case, due to the low density in the area of the seed comb, the mixer blades cannot exert the necessary pressure on the seed mass. In this case, the tufting efficiency is low, and the lint is partially scraped off the surface of the seed. The second - when the seed passes through the gap between the mixer and the saw cylinder (Fig. 1, zone B), i.e. when it moves along the plane connecting the center of the mixer and the center of the saw cylinder. In this case, the process of scraping the fluff from the surface of the seed is greatly influenced by the speed of rotation of the mixer blades and the speed of the tip of the saw teeth, and an efficient process of piling is carried out.



**Figure 1. Scheme of the working chamber of the linter 5LP**

**1 - working chamber, 2 - mixer,**

**3-seed comb, 4-column, 5- saw cylinder, 6- density valve.**

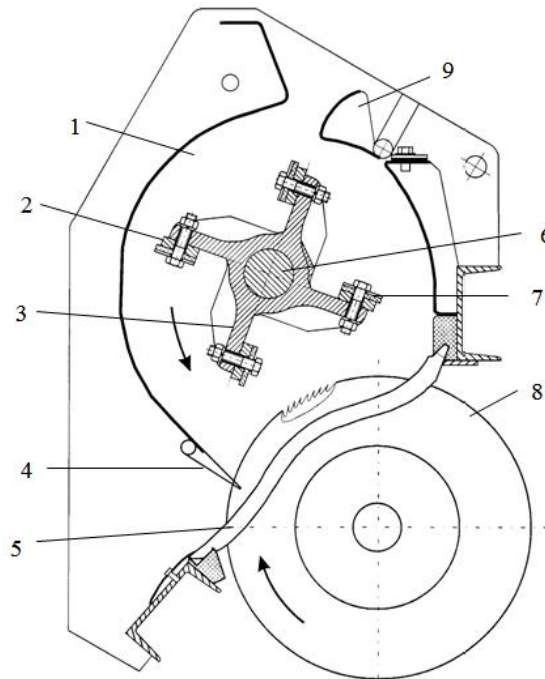
In modern 5LP linters, the linear speed of the saws in the saw cylinder is 12.3 m/s, and the linear speed of the mixer blades is 4.2 m/s [5]. Based on this, the saw teeth act on the mass of seeds at a speed of 8.1 m/s. Since the blades of the mixer and the teeth of the saw are metal, as a result of the impact of the saw on the seed at high speed, when the fluff is scraped off the surface of the seed and the seed roller hits the pile, the seeds are damaged in the process of scraping the fluff from the surface of the seed, and the level of damage in this zone higher than in other zones [4].

In the zone of the cylinder of the saw with a mixer and the lower part of the petal brush, the third zone of teasing appears, and effective teasing also takes place in this zone (Fig. 1, zone  $\Gamma$ ).

**Put of assignment.** The linter equipment of the USA, China, India and Turkey, developed in the field of cotton growing, has a low productivity and due to high mechanical damage during seed combing, only technical seeds are combed in these linters.

When preparing seeds, the process of extracting fluff from the surface of seeds is carried out by a chemical method [6, 7].

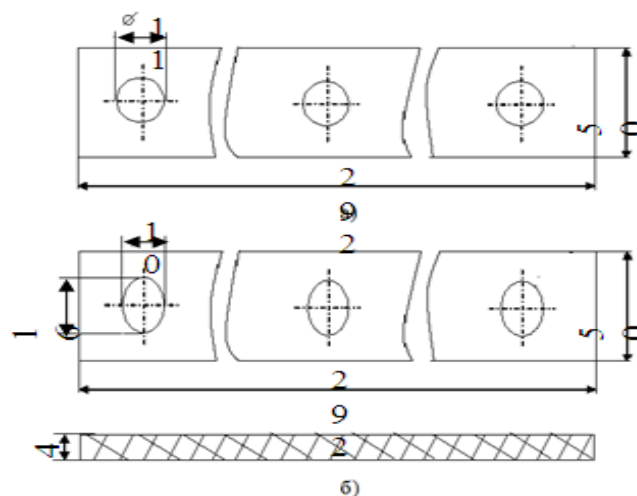
In order to reduce mechanical damage to seeds by accelerating the scraping of fluff from the surface of the seeds in the shedding zone, to increase productivity by accelerating their exit from the working chamber, to improve the quality of seeds and fluff, a mixer scheme was used for the 5LP linter, improved blades were developed based on selected theoretical studies (2-figure). On the basis of the developed scheme, drawings of a prototype mixer were prepared in the design department of the scientific center (Fig. 3, 4).



1 - working chamber, 2 - blades, 3 - cross, 4 - seed comb, 5 - column, 6 - axle, 7 - rubber, 8 - saw cylinder, 9 - density valve. Figure 2. Scheme of the working chamber with an improved paddle mixer

Based on the prepared drawings, a prototype of the mixer was manufactured at the “RIM Workshop” LLC, which was installed on a 5LP linter with 30 saws in the lint separation system of the technological laboratory of the scientific center, and the linter was improved.

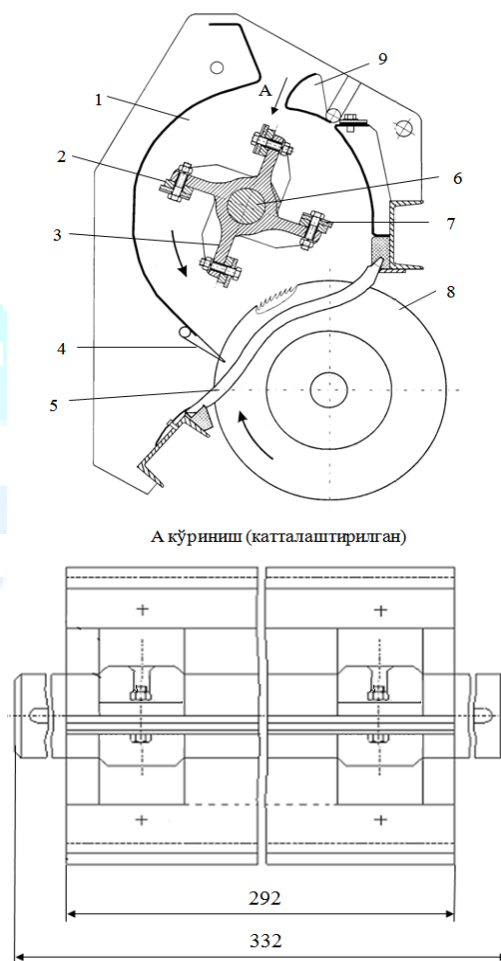
**Methodology of problem solving.** According to Linter's passport, the distance between the saw teeth in the saw cylinder and the agitator blades is 9–12 mm [8]. Taking this into account, in order to study the effect of the elastic element-rubber on the blades on the linting process, experimental studies were carried out to change the gap



**Figure 3. a) metal plate, b) rubber tape**

between the saw tooth in the saw cylinder and the elastic element on the mixer blades. by 8-12 mm. Experimental research work was carried out on the seeds of the 1st grade, obtained by cleaning cotton of the selected grade C-6524 of the 1st grade (Table 1).

In order to study the effect of the improved paddle mixer on the performance of the seed and fluff linter, the laboratory of the Institute analyzed the quality indicators of seeds and fluff, seed samples before and after the linter, and the resulting fluff. The productivity of lint by seeds and lint was determined by the timing method. At the same time, seed and fluff formed during the operation of the linter were weighed and averaged every 5 minutes. In order for the results of the analysis to be accurate, samples were taken 9 times and their average values were determined.



**1 - working chamber, 2 - blades, 3 - cross, 4 - seed comb, 5 - column, 6 - axle, 7 - rubber, 8 - saw cylinder, 9 - density valve. Figure 4. Scheme of the working chamber with an improved paddle mixer**

**Table 1 The result of a laboratory analysis of the quality indicators of the seed entering the linter.**

Seed's		Seed quality indicators, %			
breeding variety	industrial grade	hairiness	damage	dirtiness	humidity
C-6524	I	10,34	3,16	1,78	8,35

**Table 2 The influence of the distance between saw teeth on the parameters of seeds and pile of a saw cylinder with metal mixer blades of a simple design**

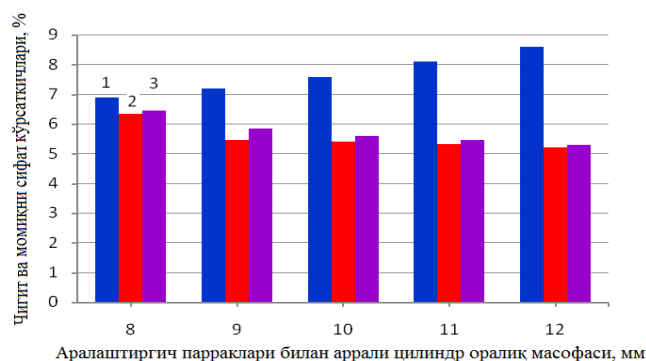
Indicators	Unity	The distance between the mixer blades and the saw cylinder, mm				
		8	9	10	11	12
Post linter seed						
- hairiness,	%	6,9	7,2	7,6	8,1	8,6
- damage	%	6,34	5,48	5,41	5,32	5,21
Mass fraction of impurities and whole seeds in fluff	%	6,45	5,86	5,6	5,47	5,31
Linter seed productivity	kg/hour	161	152	140	136	124
Linter fluff productivity	kg/hour	5,87	5,62	5,45	5,29	4,96
Fluff staple length and type	mm	7/8, A	7/8, A	7/8, A	7/8, A	7/8, A
Type and grade of fluff		I, Medium	I, Medium	I, Medium	I, Medium	I, Medium

First, experimental work was carried out on a 30-saw linter 5LP with a mixer of a simple design with metal blades. The results of the experimental study are presented in table. 2 and in fig. 5.

**Analysis of results.** The hairiness of the seeds that came out of the linter increased from 6.9 to 8.6% when the distance between the metal blades of the table mixer and

the saw teeth in the saw cylinder changed to 8–12 mm [9].

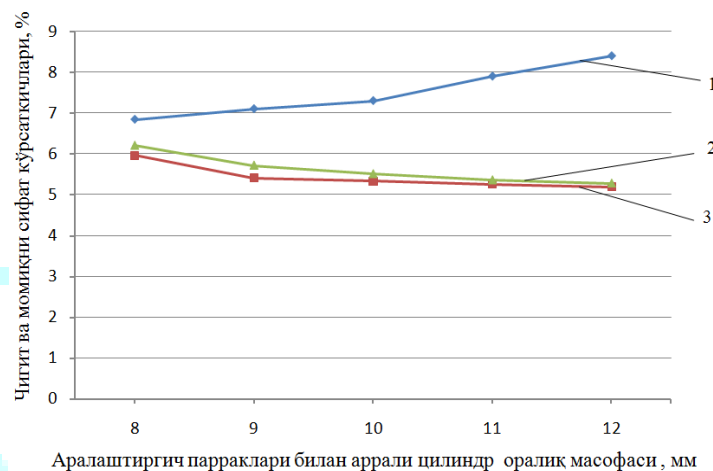
Seed damage decreased from 6.34% to 5.21%, the mass fraction of impurities in lint and whole seeds decreased from 6.45% to 5.31%. At the same time, the productivity of the linter for seeds decreased from 161 kg/h to 124 kg/h, and for down from 5.87 kg/h to 4.96 kg/h. According to GOST UzDST 645:2016, according to GOST UzDST 645:2016, the produced down corresponded to type A and class "Medium" [10].



1 - seed hairiness, %, 2 - seed damage, %, 3 - mass fraction of impurities in fluff and whole seeds, %.

**Figure 5. Dependence of the quality of seeds and pile on the distance between the saw cylinders when using a simple paddle mixer**

Then, the mixer blades were improved with rubber, and the distance between the blades and saw teeth in the saw cylinder was changed to 8-12mm, and research work was carried out. The results are presented in Table 3 and Figure 6. The table shows that when the pitch changes from 8 mm to 12 mm, the hairiness level of seeds obtained from lint increases from 6.84 (abs.)% to 8.4 (abs.) %. The level of seed damage decreased from 5.96 (abs.)% to 5.19 (abs.)%, and seeds obtained from the fluff of conventional paddle mixers had mechanical damage from 0.38 (abs.)%



**1 - hairiness of seeds, %, 2 - mass fraction of impurities in fluffed and whole seeds, %, 3 - damage to seeds, %. Figure 6. Dependence of the quality of seeds and pile on the distance between the saw cylinders with an improved blade mixer**

to 0.02 ( abs.) % compared with seeds obtained from the fluff of mechanical mixers.) decreased by [11]. The mass fraction of impurities and whole seeds in the fluff decreased from 6.21 to 5.28%, and the quality of the fluff improved from 0.24 to 0.03% [12]. The productivity of the linter, determined by the timing method, ranges from 183 kg/h to 136 kg/h for seeds, from 6.34 kg/h to 5.29 kg/h for linter when changing the distance between the mixer blades and the saw cylinder from 8 mm to 12 mm compared to the paddle linter, it was higher from 22 kg/h to 12 kg/h for seeds and from 0.47 kg/h to 0.33 kg/h for fluff (Table 2, 3).

**Table 3 The effect of changing the distance between the saw teeth on the sawdust and fluff performance of the saw cylinder with an improved blade mixer**

Indicators	Unity	Distance between saw cylinders with advanced blade mixer, mm				
		8	9	10	11	12
Post linter seed						
- hairiness,	%	6,84	7,1	7,3	7,9	8,4
- damage	%	5,96	5,41	5,33	5,25	5,19
Mass fraction of impurities and whole seeds in fluff	%	6,21	5,72	5,51	5,36	5,28
Linter seed productivity	kg/hour	183	172	150	144	136



Linter fluff productivity	kg/hour	6,34	6,12	5,76	5,56	5,29
Fluff staple length and type	mm	7/8. A	7/8, A	7/8, A	7/8, A	7/8, A
Type and grade of fluff		I, Medium	I, Medium	I, Medium	I, Medium	I, Medium

**Conclusion.** The results of the research showed that the performance of the linter when wrapping seeds in a linter with an improved blade mixer is higher than that of a linter with a blade mixer of a simple design, and the quality of the resulting seeds and pile is improved.

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