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Improving Fiber Quality Output by Improving the Roll Box of the Gin Saw

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Abstract

It has been proven that the increase in the productivity of the gin machine necessarily occurs along with the increase in the density of the raw material. However, with increasing density, productivity increases up to a certain limit, and then productivity begins to decrease. In this article, the authors analyzed the scientific work on improving the quality of fiber.

Keywords

Cotton, Fiber, Saw Gin, Density, Saw, Drum, Seed Husk, Seed, Fluff

1. Introduction

The analysis of the studies carried out so far shows that many aspects of the sawing process have not been revealed in them. Large-scale scientific research is being conducted worldwide to improve the technology of pre-treatment of cotton, including the process of separating (ginning) cotton fiber from the seed, techniques and technology.

2. Main Part

In this direction, among other things, the scientific basis for increasing the efficiency of the cotton ginning process is being developed, special attention is being paid to improving the quality of the product and reducing its cost by accelerating the widespread introduction of scientific and modern techniques and technologies into production. At the same time, in the process of separating cotton fiber from seed, maintaining the initial quality indicators of fiber and seed, creating compact technologies that can reduce process energy consumption, control product quality, and perfect constructions of cotton fiber separation equipment with low material and energy consumption are urgent issues [1].

The researchers conducted a study on Giza 86 (long fiber) cotton from Egypt in order to study the effect of ginning on the quality indicators of cotton. Jin machine (Lummus type) saw cylinder speed (3.14, 3.77, 4.4 and 5.03 m/s), four supply levels (*i.e.* 4, 6, 8 and 10 kg/ min) and moisture content (*i.e.* 10.2, 8.8, 7.4 and 5.9%) were performed on cotton. The results showed that cotton moisture content of 7% had the best fiber quality characteristics and the lowest percentage of impurities. Also, when the linear speed of the saw cylinder is 4.4 m/s, the speed of the feed rollers is 10 kg/min, and the moisture content is 8.8%, the highest cleaning efficiency is 86.7% and the least amount of fibers in the gin the rest was 0.4%. Also, it was determined that the relative tensile strength of the fiber is inversely proportional to the speed of the saw, and the elongation at break of the fiber is directly proportional to the speed of the saw.

In the research conducted by R. K. Byler, compared to cotton in natural moisture, during ginning of dried cotton, the percentage of short fibers in the fiber increased and the length of the fiber decreased. In the experiment, after cleaning the cotton, a water sprayer was installed on top of the gin-distributing auger. Wetting cotton (before ginning) has been found to improve fiber length. AFIS (Advanced Fiber Information System) analysis of soaked cotton fiber samples after ginning showed higher fiber length and lower short fiber index. When the same samples were examined in the HVI system, there were no significant differences in high average fiber length, specific tensile strength, contamination and length uniformity [2].

A characteristic feature of foreign cotton ginning equipment is that they have automatic cotton supply adjustment systems. They usually include two collecting hoppers, a main hopper with upper and lower level sensors and an additional hopper for excess cotton, as well as an atmospheric valve. The main reception hopper is installed after the pneumatic separator and is designed to create a stock of cotton in front of the technological machines.

There are three types of adjustment of the rotation frequency of the supply rollers in the sets of cotton cleaning equipment of US companies: Use of reducers with a variable number of transmissions. This type of adjustment is used in the equipment of "Murray" and "Continental Eagle" companies. The change of the transmission number of the reducer is performed by a two-way motor; Use of hydraulic drive for supply shafts. This method was used in the equipment of the "Lummus" company; Using a DC motor with a reducer. The number of revolutions of the motor is changed using a thyristor rectifier. Hardwicke-Etter company uses such adjustment. According to the author, the diameter of the rotating wheels installed on the side of the oven beam and the apron of the roll box is 63 mm, which has a positive effect on the fermentation process. Compared to XDD-1M, the efficiency of the new engine with a roll box is 34.2% higher, the speed of the raw material is 38.7% higher, and the power consumption is 8; 9; 10; 11 kg/saw hour. This, in turn, is 5.9%; 12.3%; 17.6%; 21.75% less [3].

t is shown in the researches that the consumption power (without taking into account the separation of fiber) is the energy spent on the pieces of cotton raw

material, which is transmitted to the roll box by the cotton supplier and the friction of the saws in the ginning zone, the change of the trajectory of the cotton raw material and in the coverage zone. It is equal to the sum of energies spent on the speed of movement of the raw material shaft.

In their research, M. T. Tillyaev [3] and others showed an increase in fiber mechanical damage with an increase in the density of the raw material. The density of the raw material decreases while the effectiveness of the gin increases when the raw material accelerator is used in the modified gin design. As a result, reducing the density of the raw material allows to reduce the level of fiber damage by 19% - 20%. Also, in his research, he justified the increase in the mechanical damage of the fiber with the increase in the density of the raw material. In his researches, the effect of the accelerator rotating the raw material on the following main parameters in the threshing process was shown: machine productivity, seed residence time in the roll box, composition, fibrousness, mass, density of the raw material and its impact on the walls of the roll box pressure.

The following main tasks were set by the author in the search for the solutions of scientific and technical tasks selected in accordance with these goals:

- Search for and development of special optimal constructions of technical means that provide experimental checks of the interaction of saws of fiber separation machines with fiber masses;
- To study the composition of the raw material formed in the roll box during the process of separating the fiber from the seed with the help of a chainsaw;
- Choosing the optimal dimensions of the elements of the fiber separation machine, checking their effects on the quality indicators of the seed and cotton fiber [3].

Today, the Republic of Uzbekistan is one of the leaders in the world in terms of cotton cultivation and its export, so the production of high-quality fiber that meets world standards is presented to our experts and scientists in this field to further improve the existing techniques and technologies.

It was determined by a group of researchers that the productivity of the gin machine mainly depends on the diameter of the saw disc and the speed of rotation of the raw material shaft and the distance between the saws.

For example, by increasing the diameter of the saw disk or by accelerating the rotation of the raw material shaft, the productivity of the gin machine can be increased due to the increase in the amount of fiber absorbed by the saw teeth in a certain time [4].

As a result of the research conducted by the authors, the productivity of the gin machine was increased in the following way.

In this case, a groove is placed in the lower part of the pipe installed in the roll box of the gin machine. When air is pumped into the pipe, the air flow coming out through this slot is directed towards the saw drum. As a result, the amount of fiber attached to the teeth of the saw drum increases under the influence of air.

The air stream directed towards the saw drum accelerates the exit of the seeds separated from the fiber from the roll box.

The fiber content of the raw material increases, which in turn leads to an increase in the productivity of the gin machine. In the studies carried out by the authors, it was thoroughly studied how to increase the productivity of the gin machine and reduce the stringiness of the raw material shaft, the mechanical damage of the seed and its time in the roll box.

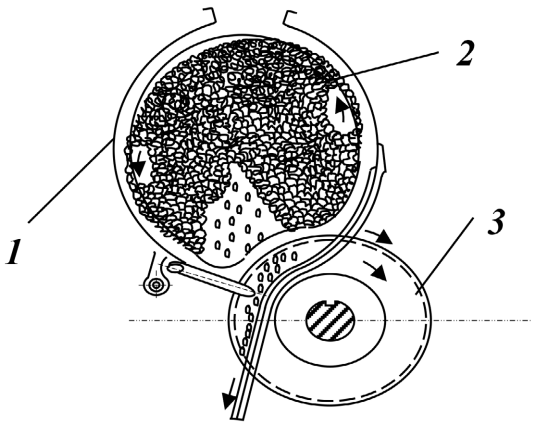
In addition, it is possible to prevent their damage by ensuring that the seeds separated from the fiber leave the roll box in time. This, in turn, reduces the formation of various defects in the composition of the fiber.

In sawing machines, the main working organ is a cylinder made from sawing discs. In these gins, the colosnik grid works together with the saw discs to separate the fiber from the seed.

The seeded cotton that has arrived in the gin's roll box is brought to the colosnik by hanging it with the teeth of a saw that rotates near the seed comb. In the roll box, the pieces of cotton adjacent to the teeth are attached to other pieces of cotton, pulling them as well and forming a roll of raw material. This roller rotates in the opposite direction to the rotation of the saw, and it continuously supplies the saw teeth with cotton fiber. This article presents the results of research conducted by the authors on the study of the composition and condition of this raw material.

One of the ways to increase the efficiency of the gin machine is to quickly remove the seeds separated from the fiber in its roll box. It was shown by the researchers that the roll box of the raw material in the gin machine passes through the profile of the saw cylinder along the surface of the front apron. One of the ways to increase the efficiency of the gin machine is to quickly remove the seeds separated from the fiber in its roll box. It was shown by the researchers that the roll box of the raw material in the gin machine passes through the profile of the saw cylinder along the surface of the front apron (Figure 1).

According to the results of observations through the plastic window installed



1: apron; 2: raw material roller; 3: saw cylinder.

Figure 1. Roll box of the chainsaw demon

on the side of the demon machine, the above opinion was proved to be wrong. In this case, it was observed that the gin machine is formed as a result of the movement of the raw material in the roll box along the colossal grid on the surface of the apron [5].

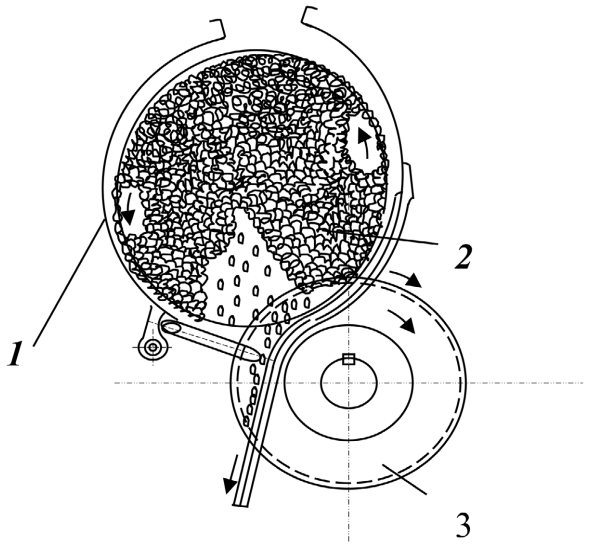
Due to this situation, there is a possibility that a part of the seeds separated from the fiber, moving downwards along the surface of the colostrum under the influence of its own weight, will stick to it and move upwards under the influence of the raw material roller.

Under the influence of the raw material roller rotating in the opposite direction to the saw cylinder, these seeds gradually accumulate in the middle of the roll box of the gin machine and form a drum-shaped pile of seeds separated from the fiber (**Figure 2**).

In addition, the seeds separated from the fiber hitting the side of the saw cylinder move towards the center of the roll box. When the density of the seed bundle exceeds the density of the raw material shaft, there is a chance that it will break through it and fall down [5] (**Table 1**).

With the increase in productivity, the density of the raw material also increases, which leads to an increase in deformation defects. When comparing the work of two gins, it can be seen that as a result of reducing the density of the raw material, the total number of defects and fiber contamination is reduced by 0.5% - 0.6% mainly due to ginning defects. Based on the results of the experiment, according to the conclusions of the authors, it is necessary to reduce the density of the raw material in order to reduce the deformation defects. The information on the quality of the yarn spun from the obtained fiber of the spinning laboratory of "Pakhtasanoat Scientific Center" JSC within the framework of this research confirms this opinion [3] [6] (**Figure 3**).

Therefore, the amount of seeds that leave through the colosnik is equal to the



1: apron; 2: raw material roller; 3: saw cylinder.

Figure 2. Roll box of the chainsaw demon.

Table 1. The influence of the density of raw material on fiber quality in the processing of I- and III-type medium fiber cotton.

I-grade cotton		Grade III cotton	
Density of raw material, kg/m³	The amount of bending defects in the fiber, %	Density of raw material, kg/m³	The amount of bending defects in the fiber, %
171.8	2.12	183.6	3.1
196.4	1.67	248.1	2.05
314.9	1.24	255.7	1.97
326.3	1.15	280.5	1.96
328.2	1.33	288.2	1.94
344.5	1.81	293.9	1.86
349.2	2.48	301.5	2.02
364.5	2.73	314.9	2.35
		337.8	2.8
		351.1	3.04

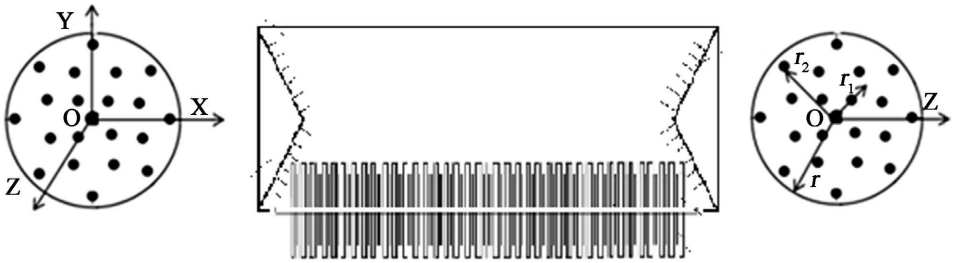


Figure 3. Scheme of movement of the raw material.

amount of seeds collected in the raw material. It is known that the rotational speed and linear speed of the saws is 12 m/s, the number of saws, the working productivity of the gin is 6000 kg per hour for seeded cotton, and it is 100 kg per minute. That is, 100 kg of cotton is spun in 730 revolutions.

As a result of the experiments, the influence of accelerators on the rotation speed of the raw material shaft, the output of seeds separated from the fiber from the roll box, and the density of the raw material shaft were studied. In the preliminary experiments, it was found that in the third option, the speed of rotation of the raw material does not change as required. Therefore, the effect of pile accelerators was studied in subsequent studies [7] [8]. It was found that the working efficiency and product quality of the gin machine differ when the speed of rotation of the accelerator is 150 - 250 rpm and the length of the accelerator pegs is different (**Figure 4** & **Figure 5**).

When the rotation speed of the accelerators installed on the side of the engine roll box is 150 rev/min, it was found to be in the range of 120 rev/min in the process of measuring the rotation speed of the raw material through the slit of

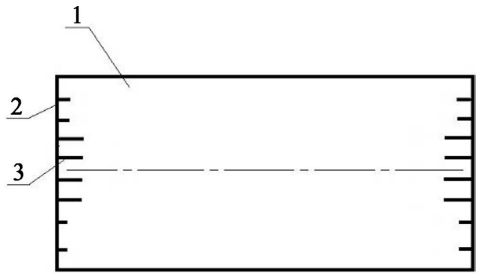


Figure 4. A diagram of the piles installed on the side of the roll box of the genie 1: roll box, 2nd side of the roll box, 3rd pegs.

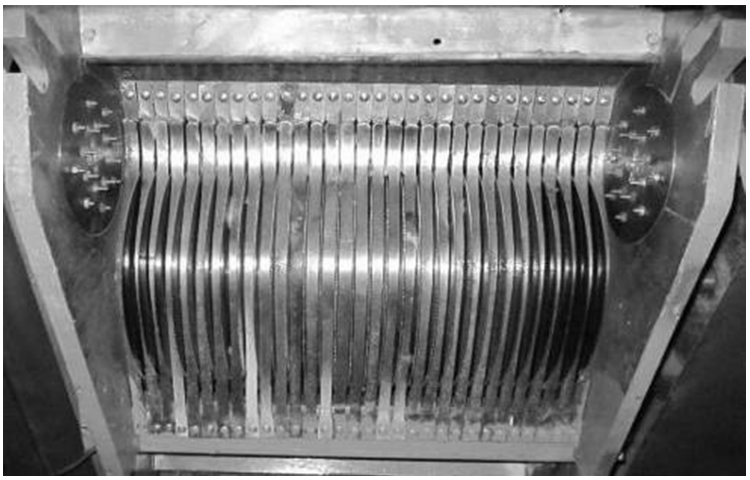


Figure 5. A diagram of the piles installed on the side of the roll box of the gin.

the front apron of the roll box with a tachometer. When the rotation speed of the accelerators installed on the side of the engine roll box is 200 rev/min, it was found to be in the range of 160 rev/min in the process of measuring the rotation speed of the raw material shaft through the slit of the front apron of the roll box with a tachometer.

3. Conclusions

In order to improve the quality of fiber, the following conclusions were obtained as a result of the research on the improvement of the structure of the saw gin machine and the improvement of the roll box of the saw gin:

It has been theoretically proven that the proposed accelerator, which is installed in a conical shape on the side of the working chamber, can mix the raw material more.

As a result of significantly increasing the rotation of the raw material roller, it is possible to accelerate the exit of the seeds separated from the fiber from the roll box.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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