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Influence of raw roller density of saw fiber separator on productivity and fiber quality

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Abstract. This article determines the possibility of ejaculation of bare seeds from the working chamber of the genie using auxiliary ejaculatory devices. Based on theoretical and experimental studies, results were obtained to improve the quality of fiber, seeds and gin productivity in the allocation of bare seeds from the working chamber. Based on the results of a full-factor experiment, graphs were constructed of the time spent on exposed seeds on gin productivity, the number of revolutions of vas differencing devices and the number of exposed seeds.

1 Introduction

Ensuring the competitiveness of cotton fiber produced in our country in the world market is mainly determined by the preservation of its natural quality in the technological process of primary processing of cotton, ie the appearance, length and content of minor impurities and defects in the fiber. One of the most important operations is the process of ginning cotton, which is at the required level of moisture and dirt, ie the separation of fiber from the seed, in which the length of the fiber, defects in its composition, flatness, undamaged and seed germination are important [1, 2].

In the process of separating the seeds from the fiber by the saw gin machine in the ginneries, the increase in the cracks in the workplace of the ginners leads to injury of the fiber and crushing of the seeds. It is known that the assembly of grating grate in ginneries is very difficult and requires highly skilled labor [3]. At the same time, it is difficult to ensure the required accuracy through the use of interlocking structural elements, such as the spacing of the columns and their correct placement between them [1-3].

When the sawmill systems are operated with a saw, if the hole size in the working area of the sawmill exceeds 3.2 mm, the fiber is stuck in the working area of the sawmill. During operation, when separating the fibers in the upper working part of the column, a part of the fibers is stuck in the gaps between the columns and rubbed on the side surfaces of the saws [4].

It is known that the separation of seeds from fibers is a very complicated process in the process of sawing. Because its performance depends mainly on the time the seed is in the working chamber and its release. This process depends on the structure of the working chamber, the condition of the seed comb and the efficiency of the work. These, in turn, lead

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to changes in the parameters of the raw material roller, ie the degree of fiber, frequency, density, quality of fiber and seeds, as well as the total yield of fiber [3, 4, 5-8].

2 Materials and methods

The working chamber of the sawdust separators consists of a ribbed grille, a roof beam, a cotton entrance to the chamber and a front apron bounded by a seed comb. These elements of the working chamber, their structure, size and location relative to the saw have a significant impact on the sawdust separation process.

The sawing fiber separation process is also based on cutting the fiber from the seed as it passes through the multi-stage saw blade disk by attaching the fiber to the edge of the grate grate. As this process continues, a raw material roller is formed in the working chamber.

The cotton that falls from the supply body of the saw machine into the working chamber separates 98% of the seed fiber in 50 seconds, 28-30% of the seed comes out through the comb, and more than 50% remains in the working chamber, resulting in multiple saw teeth and the quality of the seeds deteriorates (see Fig. 1).

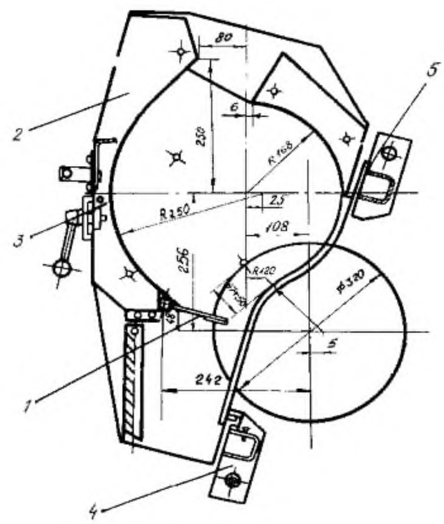

Fig. 1. Schematic of a sawmill working camera (1- seed comb; 2- apron; 3- stirrup; 4-downside brus; 5- upside brus).

The rotation of the raw roller in the working chamber of the sawing machine, the change of its density and many technological parameters are the mutual friction during the movement of the roller, which leads to high energy consumption for its rotation. Energy determines the state, speed, density and pressure of the interaction between the layers. This allows you to control the quality of the fiber and the seed [5].

Prolonged stay of hairless seeds in the working chamber affects the machine's productivity, fiber and seed quality. The efficiency of the working chamber can be increased by increasing the mass of the seed cotton in the chamber or by reducing the time the seed with the fiber stays in the chamber [6, 7].

To increase the cotton mass of the seed, it is necessary to increase the cross section of the chamber, which (if the diameter of the saw does not change) increases the friction force of the seed cotton roller on the walls of the chamber and prevents its rotation [8].

The hairless seeds in the chamber, which are ready to be completely separated from the fibers in the cotton roller, make up more than 50% of the mass of the roller. [9]. Therefore, the efficiency of the working chamber can be increased only by reducing the average time of the seed in the chamber [10].

The hairless seeds in the working chamber hit the saw teeth about 20 times before leaving the chamber and remain in the working chamber for 20 to 22 seconds, which leads to a decrease in the quality of the seed and fiber.

Theoretical and practical research has shown that the rapid removal of hairless seeds in the chamber with the use of auxiliary seed extractors in the working chamber of the 4DP-130 fiber separator has improved the efficiency of the machine, the quality of fibers and seeds.

3 Results and discussion

The results of the experiment show that the following factors affect the average ripening time of hairless seeds in the working chamber of the 4DP-130 saw. Machine productivity (X1), number of revolutions of auxiliary seed extracting equipment (X2) and amount of hairless seeds leaving auxiliary seed extracting equipment (X3).

Based on the results of the experiment, his mathematical model is represented by the following equation (1):

$$Y = 61.7 - 3.58 \cdot X_2 - 2.27 + 2.65 \cdot X_2 + 2.85 \cdot X_1 \cdot X_3 + 14 \cdot X_2 \cdot X_3 + 2.25 \cdot X_1 \cdot X_2 \cdot X_3,$$

where, Y - average time (seconds) of hairless seeds in the working chamber.

It can be seen from Equation (1) that the dependence of the average exposure time of the hairless seeds in the working chamber is the factor X2 and X3 with the greatest influence and X1, X2, X3 with the least influence.

Thus, using the equation, we calculate the average settling time of the seeds in the working chamber and see its graph (Fig. 2).

A graph of the relationship between machine productivity and the average stay time of hairless seeds in the working chamber is plotted. The graph consists of 5 Y = Y (X1) curves. The first curve represents X2, X3, the smallest of the factors, and the fifth curve represents the largest, and the remaining curves are intermediate.

As can be seen from the first curve, at X2 = 150 rpm, X3 = 140 kg, the average stay time of hairless seeds in the working chamber increases from 79.5 seconds to 83.5 seconds.

In the second curve, X2 = 200 rpm and X3 = 210 kg increase from 67.6 seconds to 68.5 seconds.

The third curve does not change when X2 = 250 rpm and X3 = 280 kg.

In the fourth curve, X2 = 300 rpm, X3 = 350 kg increase from 61.6 seconds to 62.9 seconds.

On the fifth curve, when X2 = 350 rpm, X3 = 420 kg, it increases from 67.4 seconds to 72.3 seconds.

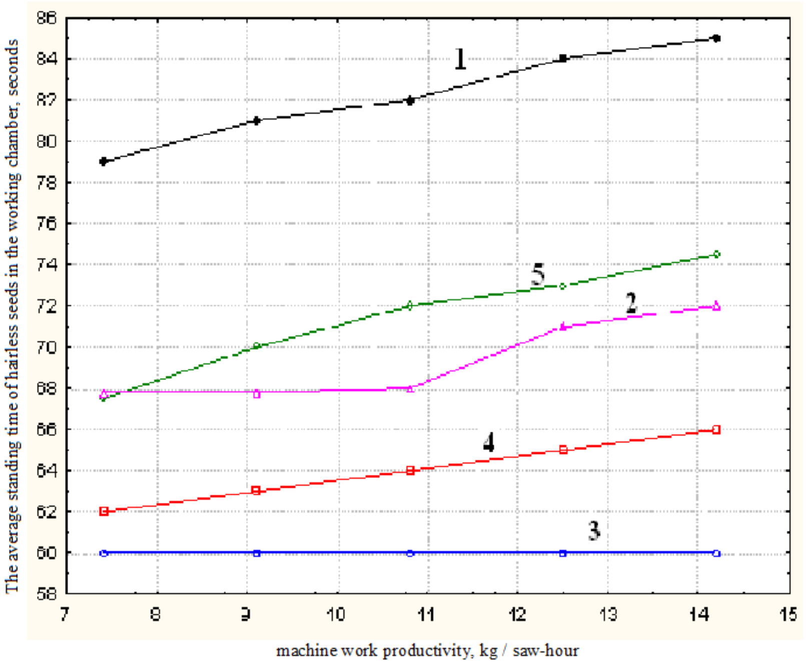

Fig. 2. The average standing time of hairless seeds in the working chamber.

Graphs of the relationship between the number of revolutions of the seed extractor and the average stay time of hairless seeds in the working chamber are given (Fig. 3).

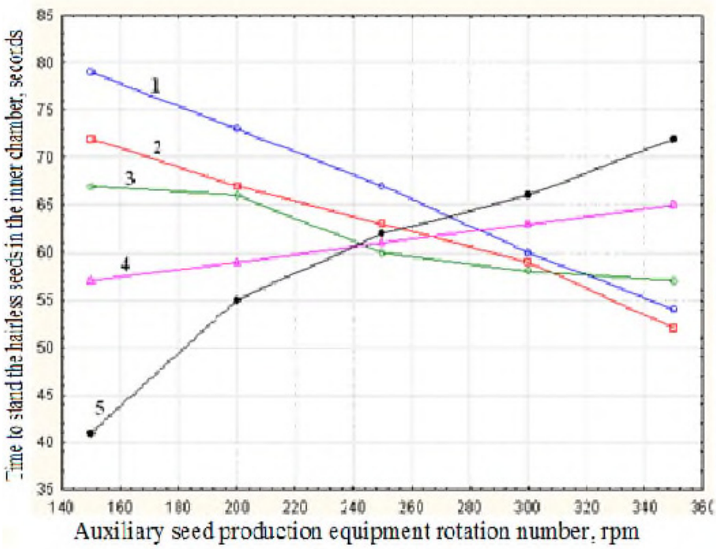

Fig. 3. Graph of the average time of the seeds in the working chamber on the auxiliary seeder.

As can be seen from the graph, the first curve shows that when X1 = 7.4 rpm, X3 = 140 kg, the average stay time of hairless seeds in the working chamber decreases from 79.4 seconds to 54.3 seconds.

On the third curve, X1 = 10.8 kg/hr, decreasing from 65.3 seconds to 58.1 seconds at X3 = 280 kg. In the fourth curve, X1 = 12.5 kg/hr, and X3 = 250 kg, which increases from 58.6 seconds to 63.9 seconds. In the fifth curve, X1 = 14.2 kg/hr, increasing from 52.3 seconds to 72.3 seconds when X3 = 420 kg.

The graph shows the relationship between the amount of hairless seeds coming out of the seed extractor and the average stay time of hairless seeds in the working chamber (Fig. 4).

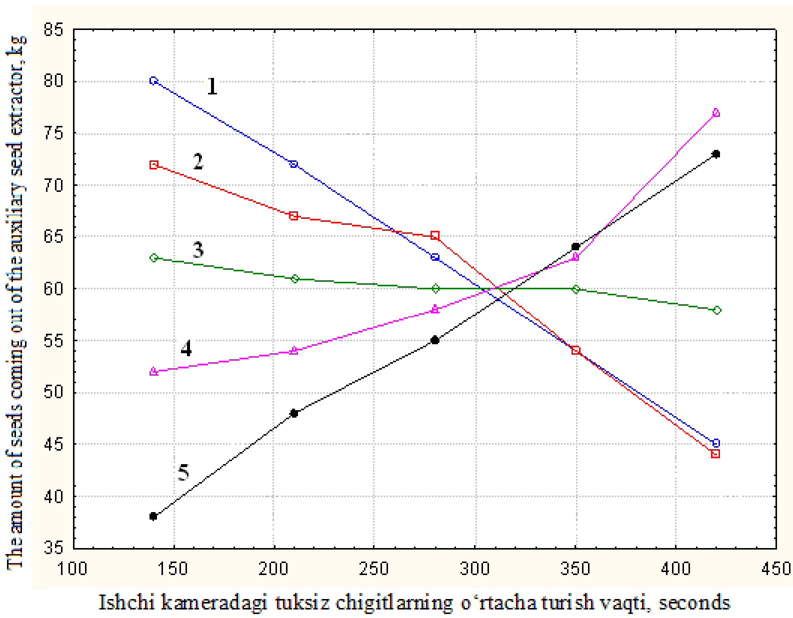

Fig. 4. Graph of the relationship between the amount of hairless seeds coming out of the seed extractor and the average stay time of hairless seeds in the working chamber.

In the first curve, when X1 = 7.4 kg/saw-hour and X2 = 250 rpm, the average standby time of hairless seeds in the working chamber decreases from 79.4 seconds to 45.7 seconds. On the second curve, X1 = 9.1 kg/saw-hour,

X2 = 200 rpm decreases from 72.9 seconds to 52.6 seconds. In the fourth curve, X1 = 12.5 kg/saw-hour and X2 = 300 rpm, increasing from 52.5 seconds to 65.9 seconds. In the fifth curve, X1 = 14.25 kg/saw-hour and X2 = 350 rpm, increasing from 38.7 seconds to 72.3 seconds.

4 Conclusions

According to the production results, the positive change in the composition of the raw material roller is due to the increase in its rotation speed, as well as a decrease in the time of seeds and fiber in the raw material roller, which leads to a decrease in mass and density of raw material roller. It can be said that only by reducing the average stay time of hairless seeds in the working chamber of the sawing machine, the machine can increase productivity, fiber and seed quality.

It can be concluded from Figures 1,2,3 that the best time for the average stand-alone time in the working chamber of hairless seeds is X1 = 12.5 kg/saw hour, X2 = 300 rpm and X2 = When it was 350 kg.

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