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Currently, there is no scientific justification for improving the geometric parameters of the genie saw and the standards of accuracy of functional parameters. However, despite the success achieved in separating fiber from seeds during ginning, there are major disadvantages in that most cotton plants produce cotton fiber and seeds with increased ginning vices. The study on change of geometric parameters of various authors is considered. The issue of improving the geometrical parameters of the saw is important and therefore requires urgent resolution. The article discusses issues related to improving the profile of the teeth of the genie saw and increasing its productivity.

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I. INTRODUCTION

Since the most ancient times, people have used cotton mainly after separating the fiber from its seeds. Initially, the separation of cotton fibers from seeds was carried out manually. At the same time, the productivity of one person did not exceed 1 kg per day [1].

The development of the history of mankind has led to the fact that the separation of cotton fiber from seeds has been carried out by machine.

Especially in such areas, the achievement of science is the improvement of the main working bodies of the profile of the laser saw [2].

Taking into account the prevailing influence of the state of the teeth of the saw blade on the quality of processed raw cotton products, it is necessary to ensure high-quality production of the disk in compliance with both the geometric parameters of the tooth and the roughness of its working surfaces.

The articles of E. A. Normatov [3] and A. A. Ismailov et al. [2] were published on the change in the geometric parameters of the tooth.

In both articles, the questions of the geometry of the saw tooth were considered in more detail and the following conclusions were made:

Akhmedova S. came to the conclusion that " With a shorter tooth with a constant pitch and a cavity having the most rational shape, i.e. the shape of an isosceles triangle with the largest gripping area, the gripping ability does not decrease, and the tooth becomes more stable and more economical in operation. Based on this, you can find the height."

According to Normatov E. A., the tooth height is equal to 2.6 mm [3].

Ismailova A. A. and others on the basis of theoretical research came to the following main conclusions:

The maximum value of the fiber capture area will be at the angle: $\alpha = 90^0 - \gamma$;

where: γ is the angle between the guides of the relative speed of the fiber and the circumferential speed of the saw. Note that the article does not address issues related to the height of the tooth and does not draw appropriate conclusions, it is not agreed with the statement of the authors, we note that to the angle α=45°, the corresponding height of the tooth is h=2.6 mm (at r=0.4 mm and the angle of sharpening δ=20°) [4].

Makhkamov R. G., based on the analysis of the literature [3], as well as on the basis of his previous theoretical assumptions, considers the issue of the geometry of the tooth of a chain saw and makes the following proposals: Reduce the height of the saw teeth to 2.6 mm; keep the gap between the grates within 2.8–3.2 mm; the tooth chamfer should be removed.

However, despite the success achieved in separating fiber from seeds during ginning, there are major disadvantages, they are that most cotton mills produce cotton fiber and seeds with increased ginning defects.

In order to determine the optimal variants of the profile of the teeth of the laser saw, a laboratory installation was tested. The optimal profile of the saw tooth was determined, aimed at reducing its height. Then the teeth with such profiles were tested in production jeans and some results were obtained to reduce the amount of fiber defects and seed crushing.

When analyzing the results of ginning and with the same tooth profiles on the laboratory and production gin, we found some changes.

For example, when ginning "VL-10", intense cotton motes occurred with a long tooth, and when testing saw blades with a height of 2 mm on a production gin, the opposite results were obtained, i.e. intense cotton motes occurred with a short tooth [7].

II. EXPERIMENTAL PROCEDURES

E. A. Normatov, on the basis of logical assumptions, considered the work of the tooth in relation to the work of the grate, the raw chamber and the brush drum. The author did not consider the issues of tooth geometry.

He [4], in the article "Points of ginning saws", also considered the geometry of the tooth of a gin saw; " ... the slope of the back of the top of the tooth is not needed today, and the saw tooth can have a trapezoidal shape with a flat top, rather than a triangular one ...". The author proposed to obtain such a flat top at a point due to a slight shortening of the tooth height. In conclusion, the author suggests that the proposed method allows for the possibility of repeated tooth points, since the analysis of its operation proves that the working face of the tooth, i.e. the face, which is really necessary for work and gives products, does not exceed 3/3 of its entire height, therefore, there is no danger of deterioration in productivity, even if the saw tooth is worn off and ½ of its height."

In the collection No. 4 of the Pilot Plant, an article was published by U.A. Sapaev, "Evaluation of the use of various devices for ginning wet snapper", in which an attempt was made to install a stirrer in the raw gin chamber to ensure normal rotation of the raw roller when ginning cotton from a wet snapper. The author came to the conclusion that the use of agitators does not provide significant assistance. Therefore, they have not found application in industry.

During the same period, a researcher at Central Research Institute of the Cotton Industry (CRICI) Tilabov B. N. studied the influence of the quality of steel used for the production of saws and the properties of raw cotton on the service life of saws in the work "The influence of hardness and strength of steel on the main indicators of ginning". As a result of the research, the author came to the conclusion that the service life of the saw cylinder is determined not by the wear resistance of the saw steel, but solely by the amount of foreign impurities that got into the working chamber of the gin, the size of the tooth and the mechanical qualities of the steel from which the saw is made.

In 1989, No. 5 of the Textile Industry magazine published an article by Gulidov N. G. "On the profile of the tooth of a genie saw", in which the idea is expressed about determining the rational profile of the tooth, according to which an increase in the angle α (front face) should be accompanied by a decrease in the height of the tooth.

According to Gulidov's proposal, the angle α and the height h should mean that an increase in the angle α (the front face) corresponds to a decrease in the height of the tooth (the other parameters do not change).

In 2008, an article by R. G. Makhkamov "On the theory of fiber separation" was published, which deals with the issues of deducing the shape of the tooth of the parabolic form of its anterior face, the author wrote "Based on the optimal conditions of tooth strength to increase its gripping ability by increasing the angle of inclination of the working face, we build a parabola with a vertex at the base of the working face of the tooth".

Note that a tooth with a parabolic construction of the front face has not found application in industry due to the complexity of its manufacture.

This contradiction is explained by the design features of the laboratory and production gins, that is, the first fiber is removed by a brush drum, and the second by an air-removing device. There are also differences in power, speed, working bodies, and much more [5].

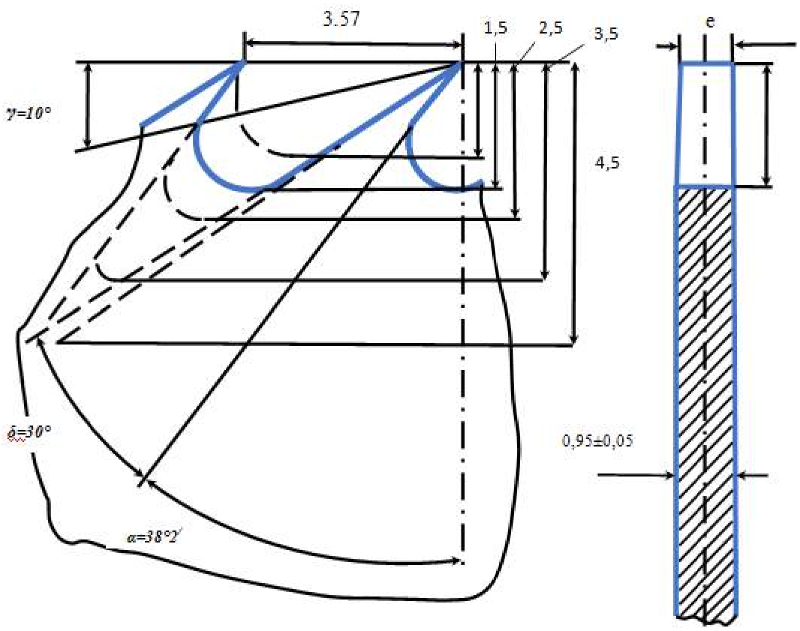


Fig. 1: Schemes of the tooth of a chain saw with different thickness at the top

e-I option-saw blades had teeth of thickness at the top = 0.2-0.3 mm, i.e. on both sides of the tooth, the chamfer was removed on abrasives

This was the objective reason that forced us to conduct further experiments only in production conditions - on existing gins.

Further, on the basis of experiments conducted only on production gins, the issues of the influence of different tooth heights of a genie saw on the technological properties and on the nature of ginning are highlighted.

Experiments of some factories have shown that the work of teeth with an increased thickness of the tooth tip against GOST 1413-48 gave some improvements in product quality. In this regard, the first task was to determine the thickness of the tooth at the top, and then to determine the rational height of the tooth.

When determining the optimal thickness of the top of the saw tooth, the remaining parameters of the tooth remained in accordance with GOST 1413-48.

The peculiarity of our tests was to conduct them in production conditions.

Saw blades with a diameter of 312 mm with different thicknesses at the tops of the teeth were prepared in five versions of 100 saws each (Fig. 1).

Option II - at e= 0.4-0.5 mm, the chamfer is removed from both sides of the tooth.

Option III - at e= 0.6-0.7 mm, the chamfer is slightly removed from both sides of the tooth.

Option IV - at e= 0.8-0.9 mm, only the burrs were removed from the exit side of the punch.

V option - at 0.95 > e > 0.9, i.e. the teeth after the intersection were not processed for chamfering or burr removal, only grinding was carried out in sand baths according to the existing operating instructions of the saw shop equipment.

The saw blades of the I-IV variants were also subjected to grinding under different conditions, in a sand bath according to the existing instructions.

The saw blades of each variant were separately mounted on certain shafts for a separate battery genie. Thus, each gin was completed with saws of a certain variant, after which all gins underwent the same adjustment.

The tests were carried out under the same conditions and different ginning modes. All gins worked mainly on the fourth tooth of the power supply, which corresponded to a productivity of 9-10 kg of fiber per saw per hour. The pressure in the air chamber was maintained equal to 180-140 water column. The duration of the test on the II, III and IV variants was 48 hours, on the I and V variants 4 hours. The reason for the short duration of the I and V variants was a noticeable deterioration in the quality of fiber and seeds due to an increase in the density of the raw roller and poor removal of fiber from the teeth, especially in the V variant. In the II, III and IV variants, the ginning process proceeded normally and the fiber was also eaten normally.

Further research was carried out at sawmills of cotton gins.

The object of the test work was laser saws of various shapes and parameters. The tests were carried out in 3 stages.

At the first stage of research work, saws were installed on the sewing machines according to the PDI 64-2016 standards, and during one shift, the operation of the machine and the quality indicators of the products were monitored. The obtained data are summarized in a table.

At the second stage of the study, the object of the study was 5 types with different thickness of the tooth tip ("e"): 0,2-0,3; 0,4-0,5; 0,6-0,7; Laser saws of 0.8-0.9 and 0.95 ± 0.05 mm were obtained. The remaining parameters of the pil gin were adopted in accordance with the current PDI 64-2016 guidelines.

The different height in the third direction was achieved by changing the angle of penetration of the tooth, the radius of the tooth was 0.4 mm, and the difference in the height of the tooth in the third direction was associated with a change in the angle of penetration of the tooth. the radius of the tooth (in all variants, the cutting angle was about 20°).

In all variants, the thickness of the tooth tip was 0.8 ± 0.1 mm, the tooth pitch was 3.57 mm, the disc diameter was 312 mm, the tooth thickness was 0.95 ± 0.05 mm. As a result, 1 in the first line; 1,5 ± 0,2; 2,5; 3,5; 4.5, 1.5 on the second line; 2.0 ± 0.1; 2.5; 3.5; Divided into teeth with a height of 4.5. From saws with such teeth, saw cylinders were made in the current order, placed in a denim machine and the cleaning process was carried out.

In the initial test, the quality of cotton fiber obtained with a tooth tip thickness of 0.8 ± 0.1 mm, a tooth height of 1.5 ± 0.2 and 2.0 ± 0.1, and a tooth rounding radius of 0.6-0.8 mm, showed that they changed for the better. The results confirmed that the direction of the study was chosen correctly.

The third chapter of the dissertation, entitled "Fundamentals of the design of the teeth of the gin saw", is devoted to the parameters of the saw, which is the main working organ of the gin saw, and its teeth. In fact, the main working surface of the saw is the tooth profile. The geometric parameters of the tooth profile determine the efficiency of the saw, that is, increasing the service life of the saw teeth, improving the quality and quantity of cotton products largely depend on the parameters of the saw teeth.

While the main parameters of the saw blade are its diameter, thickness and number of teeth, the main geometric parameters of the tooth profile are its height, pitch, angle of the front blade, the radius of rounding of the sub-tooth and the thickness of the tooth.

Changes in the geometric parameters of the teeth of the saw blade significantly affect the speed of the roller of the initial material of the saw blade and the composition of the cotton layer on its periphery, the size of the arc in contact with the saw blade, and the distance of penetration of the saw blade inside. untreated roller. Therefore, the height of the tooth has long been the subject of study of scientific and production personnel.

As a result of theoretical and practical studies of pil gin, equations were obtained for determining the optimal geometric parameters of pil gin.The theoretical height of the tooth can be determined from the following equation:

$$h = \frac{t \cdot sinsin\,\gamma \cdot coscos\,\alpha}{coscos\,(\alpha+\gamma)}$$

where: γ is the angle of inclination of the leading edge of the saw;
α - angle of inclination of the rear edge of the saw;
t-tooth pitch

A graphical analysis of the obtained equation showed that the most active factor affecting the height of the tooth is the distance between the teeth. As the tooth pitch increases, the tooth height increases linearly. As the slope of the front edge of the tooth increases, the height of the tooth increases, decreasing with decreasing. The angle of inclination of the posterior edge of the tooth, on the contrary, negatively affects the height of the tooth, i.e. its increase leads to a decrease in the height of the tooth.

Experimental studies on the justification of dental parameters were carried out on a 30-caliber denim device in the scientific laboratory of the Namangan Institute of Engineering and Technology. To facilitate the experiments, one factor was selected for each experiment. In the first experiment, the effect of the height of the saw tooth on the mass fraction of impurities and defects in the fiber was studied. An empirical equation of the following form was chosen for the study:

$$y = ax + b_0$$

where: a is the angular coefficient of the straight line;

x is the height of the gin saw tooth;
b is the section of a straight line from the ordinate axis

Based on the results of the experiment, we determine the value of the parameters "a" and "b" in the equation by the least squares method from the following equation:

$$a = \frac{n\sum x_i y_i - \sum x_i \sum y_i}{n\sum x_i^2 - \left(\sum x_i\right)^2} = 0{,}181$$

$$b = \frac{n\sum x_i y_i - \sum x_i \sum y_i}{n\sum x_i^2 - \left(\sum x_i\right)^2} = 2{,}41$$

where: n is the number of variants of the condition being checked, that is, 5.

Thus, the empirical equation that we are looking for is the relationship between the mass fraction of impurities and defective impurities in the fiber " y "and the height of the tooth "x" of the gin saw:

$$y = 0,181x + 2,41$$

In the same way, the effect of the height of the saw teeth on the mechanical damage of cotton seeds was studied. The empirical equation obtained as a result of the study represents the effect of mechanical damage to a tooth with a height of "x" on mechanical damage to "y":

$$y = 0,0696\ x + 0,3589\ ,$$

III. RESULT AND DISCUSSION

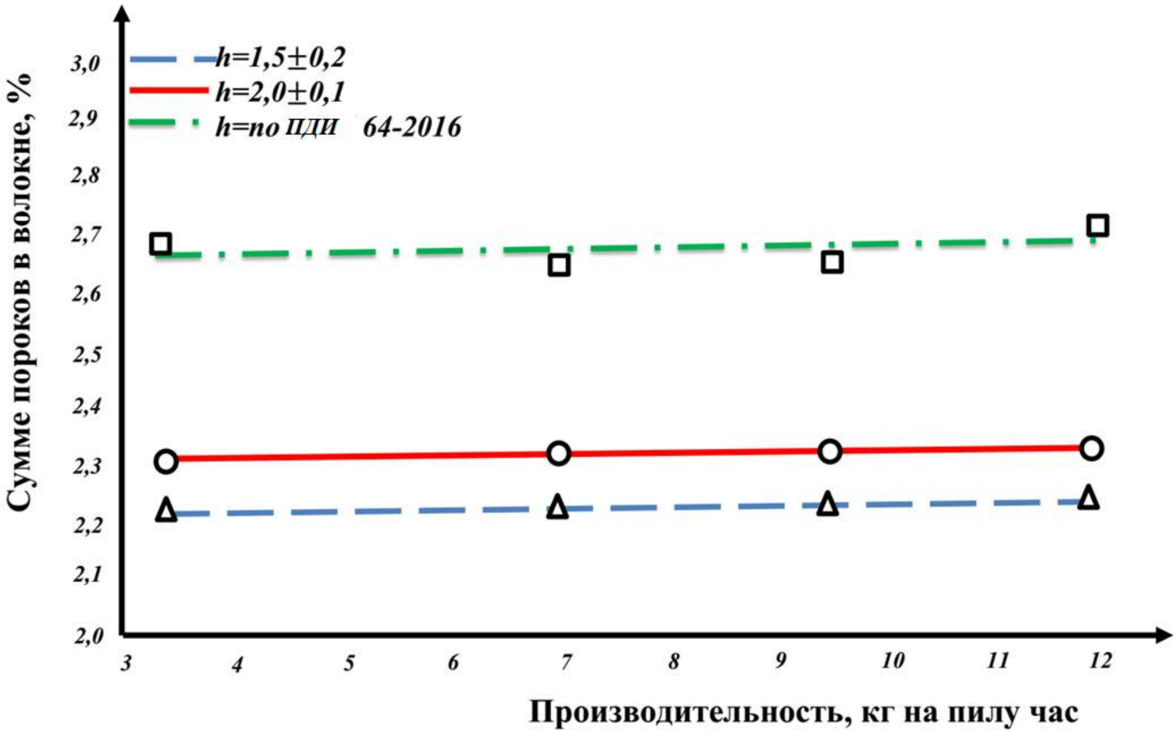
To assess the technological properties of fiber and seeds, the plant's laboratories were sampled under our control and according to the developed methodology [10].

Fiber samples were taken from the neck of each gin for each variant, seed samples from the seed trays of each gin. The sample was taken three times per shift, i.e. for the II, III and IV variants 18 times, and for I and V-3 times.

Technological analyses were carried out in the laboratory of the plant according to the existing rules.

At the time of sampling, the current strength in the phases of the electric motor of the gin saw cylinder was also measured.

For clarity, the results are presented in the form of graphs 1-3.



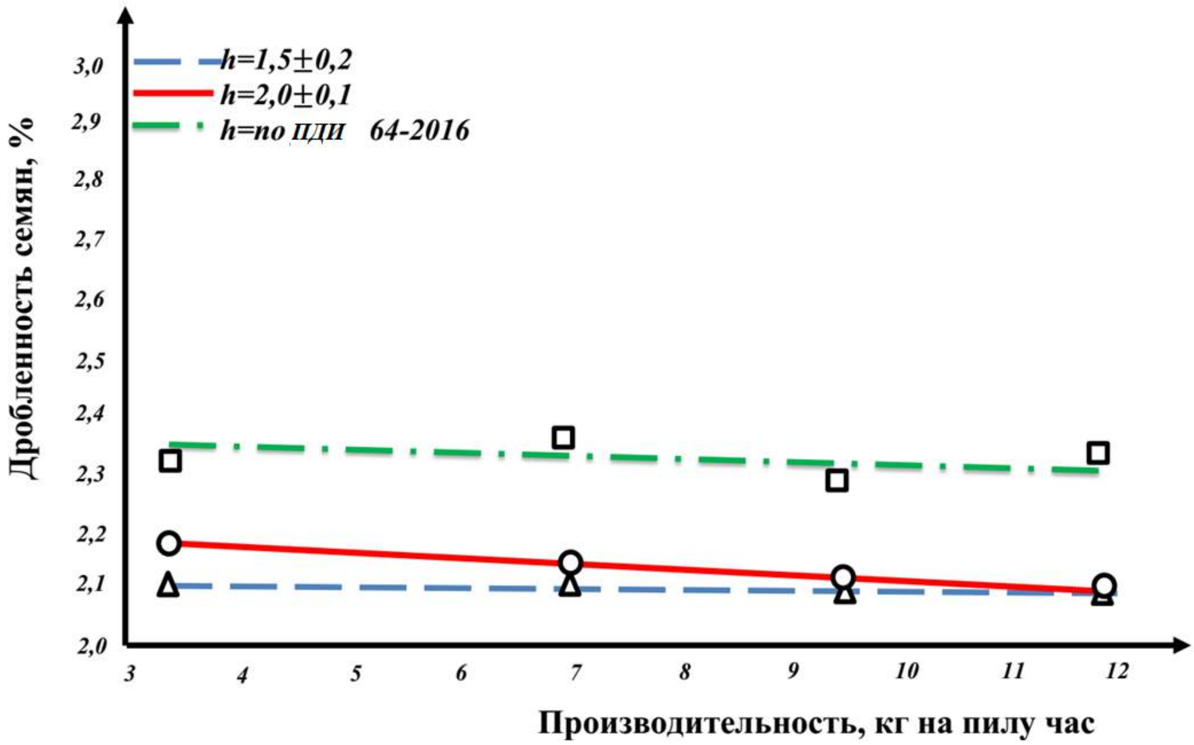
Graph 1: The dependence of the amount of fiber defects on the effectiveness of gin

From Graph 1, it can be seen that with an increase in the thickness of the tooth vertices, the amount of defects in the fiber decreases, which occurred mainly due to a decrease in broken seeds in the fiber. At the same time, the content of litter and motes in the fiber almost does not change.

The explanation that an increase in the thickness at the top of the tooth causes a decrease in the amount of defects in the fiber, apparently, is that the specific pressure of the tooth edge on the fiber and seeds decreases and this was accompanied by a decrease in the damage of the latter.

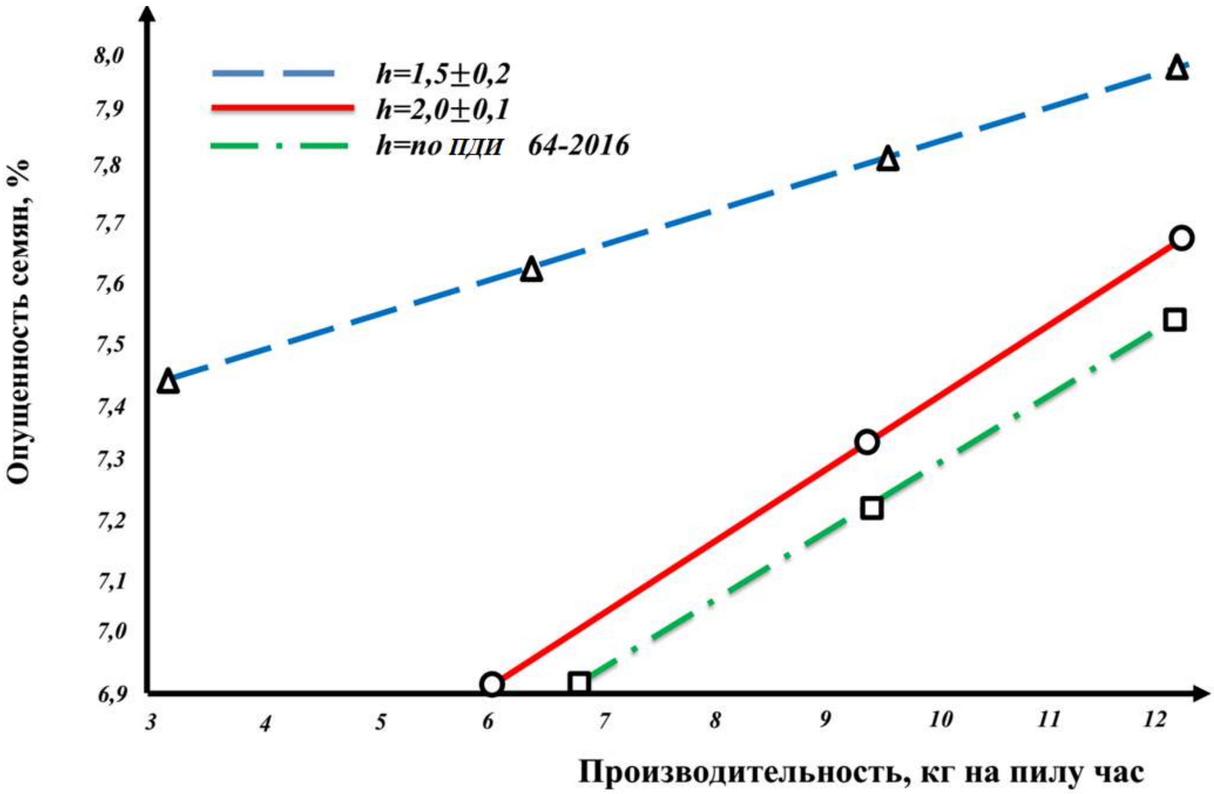
In contrast to the general pattern, the sum of fiber defects on the V variant of saws had an overestimated value.

This can be explained by the fact that the saw blades of the V variant after the tooth crossing did not undergo chamfering, only the teeth were ground in a sand bath under different conditions with other options for preparing saws. Apparently, such an identical condition for processing teeth for all variants is insufficient for the V variant and the teeth of the V variant, obviously, have not been freed from invisible burrs. Thus, the number of burrs on the teeth of the V variant was greater than on the teeth of the I, IV variants. And in the industry, it has long been known that the presence of burrs leads to a deterioration in the quality of products.



Graph 2: The dependence of mechanical damage to seeds on the effectiveness of gin

Graph 2 shows that the change in the crushing of seeds is inversely proportional to the change in thickness at the vertices of the tooth. The reasons for this can also be found in the change in the specific pressure on the seeds from the edge of the tooth.



Graph 3: Dependence of seed pubescence on the effectiveness of gin

It can be seen from Graph 3 that the change in the total omission of seeds occurs in the opposite proportion to the change in the thickness of the top of the tooth.

IV. CONCLUSION

It is possible that partial linterization processes also occur during the ginning process. If we assume this, then in our case, an increase in the thickness at the top of the tooth also caused an intensification of the linterization process during ginning. Therefore, an increase in the thickness at the top of the tooth caused a decrease in the complete omission of seeds.

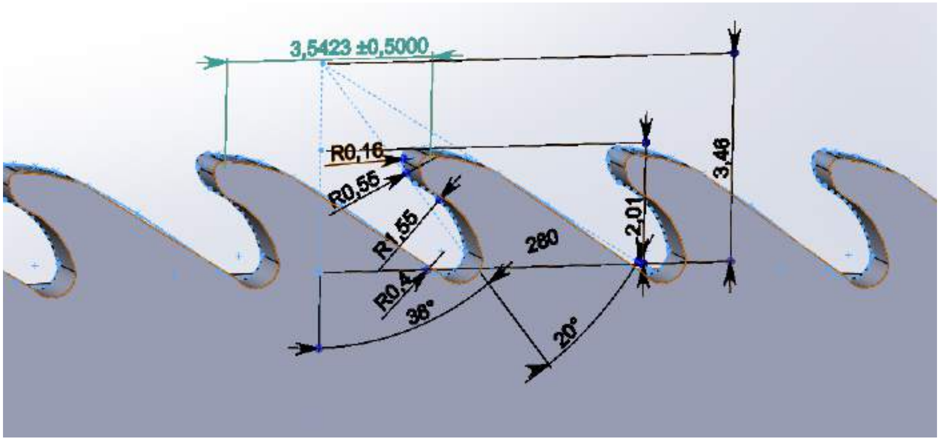


Fig. 2: The developed profile of the tooth of the genie saw

It can be seen from Graph 4 that the residual fiber content of the seeds changes in inverse proportion to the change in the thickness of the tooth tip. The explanation for this is the same as in Graph 3.

And, finally, it can be seen from Graph 5 that the law of changing the load on the electric motor of the gin saw cylinder with respect to the change in tooth thickness proceeds according to the law of direct proportion.

The explanation of the latter is that with an increase in the thickness at the top of the tooth, the degree of its contact with the mass of the raw roller increases and this causes an increase in the load on the gin shaft.

Thus, according to the results of the test, we come to the conclusion that the rational thickness at the top of the saw tooth is equal to e = 0.8 ± 0.1 mm, at which it is possible to obtain products of the proper quality.

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