Mathematical Model of the Process of Hiding Cotton Fiber From Saw Teeth

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ABSTRACT

It is known that the issue of maintaining the initial quality of cotton products in the process of sawing is relevant. The main reason for this is that the ginning process is carried out with strong impact effects on the raw material.

Keywords: Break, break, cut, result, crush, seed, quality, degree, forgetfulness, contamination, length.

In cotton seeds, there are cases of mechanical damage, including crushing, breaking, cutting, crushing, and in the fiber, there are cases of shortening as a result of breaking, breaking and shearing.

As a result of such effects, the quality of cotton fiber and seeds deteriorates: its total amount decreases as a result of seed crushing, its degree of contamination increases, its germination decreases due to seed breakage, oil yield decreases in technical seeds, fiber content increased by seed husk, average fiber length decreases, the index of short fibers in it increases, the mass fraction of impurities and defective compounds in the fiber increases.

Numerous studies have found that reducing the size of saw teeth has a positive effect on fiber quality. From this point of view, the reduction of the saw teeth also improves the quality of the obtained fiber.

However, while some studies have concluded that the reduction of saw teeth should theoretically have a positive effect, this has not been proven in the industry, in particular, the sawing process has seen a sharp decline in productivity. What is the reason for this?

When we studied the process of attaching cotton fibers to our saw teeth, the saw once encountered the raw material roller and showed that once it had pulled out a certain amount of fiber, it could no longer fit with the other fiber. This is because, in our view, 2: the length of the fiber is several times larger than the size of the saw teeth, firstly, the fiber sticks to the top of the saw teeth and blocks between the saw teeth, and secondly, the fiber attached to one tooth, the working teeth of the teeth the surface is blocked by the side. To get a clearer picture of the situation, we cite Figure 1.1. To distinguish the position of the fibers from each other, the fibers are drawn in different colors, and it is possible to

observe their irregular arrangement around the saw teeth

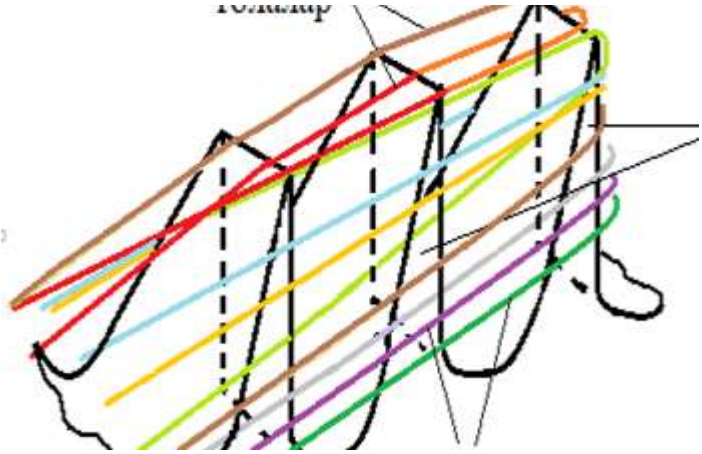

Figure 1.1. The scheme of attachment of fibers to the saw teeth

Both the distance between the saw teeth and the tooth height will be around 3.5 mm. The fiber length is 30-35 mm. If the saw teeth are hanging from the fiber near the seed shell, when the saw is 1 mm thick, the length of one end protruding from the side of the saw will be more than 30 mm and it will block around at least 5-6 teeth. As a result of the occlusion of the tooth space with fibers from the side and top, the teeth lose their ability to hold the fiber, and the teeth cannot actually pick up anything other than the fibers that actually hang on the tooth, even though they move inside the raw roller. According to our above calculations, the average number of fibers attached to a single tooth does not exceed 500-600, and they can occupy only 4% of the area between the saw teeth.

Mathematical model analysis of the process of removing cotton fiber from saw teeth

We know that the raw material roller formed in the working chamber of the gin machine rotates at a linear speed of 2-2.2 m / s. During operation, the teeth of the saw cylinder are driven into the raw material shaft at a speed of 12.0 m / s. The raw roller consists of pieces of cotton that have just entered the chamber and are partially ginned, as well as seeds that have been completely torn off. Here, what the teeth collide with is a probable event. However, observations show that in 60-70% of cases, the teeth encounter a newly introduced cotton, i.e. a fibrous mass. This is because the cotton falling from the top of the raw roller forms a fibrous layer around the roller, and the front apron of the working chamber slides into the inner wall and encounters the saw cylinder. However, in 30-40% of cases, the saw teeth may encounter a partially cleaned or completely cleaned seed coat.

Substantiate the parameters of the process of removing cotton fiber from the saw teeth

As mentioned above, the projection of the force on the axis passing through the center of gravity of the seed during the impact deforms the seed. With the projection of the force on the said axis perpendicular to the axis, the product of the force M with the distance (shoulder) to the center of gravity of the seed produces a moment of force, and it tries to rotate the seed. When the value of the force does not change, an increase in its projection on a single axis, such as an axis perpendicular to the radius, leads to a decrease in its projection on the axis directed along the radius. That is, the impact force is completely converted into the force that rotates the seed. This situation is important for us. This is because if the seed rotates around the point of contact with the saw tooth, there is a chance that the fibers on its back will meet the saw teeth and the seed fiber will be completely removed. If we increase the value of this force moment, the seed will spin faster and the chances of unraveling its fibers will increase. It is possible to raise the power shoulder for this, but it is an objective phenomenon that we cannot influence. Way 2 is to increase the value of the power projection Fx. To do this, you need to reduce the slope of the front corner of the saw teeth to a certain extent. This projection is found as follows:

$$F_x = F \cos\frac{\gamma+\alpha}{2}, \qquad (5)$$

Where g is the angle of inclination of the saw tooth relative to the plane perpendicular to the plane at the point of contact, a is the angle of inclination of the saw tooth relative to

the plane perpendicular to the plane at the point of contact.

The back angle of the saw tooth represents the thickness of the tooth, i.e. its strength. It is therefore advisable to keep it at a level that is more than 20 degrees in force relative to the front corner. Because this angle does not serve to hang the fiber.

The cosine function is equal to 1 when the angle is 0. In this case, the force of impact and its projection are equal, but in this case there is no tooth and no fiber. If it is 0 at 90 degrees, then the projection of the impact force on the plane perpendicular to the radius is zero, and the tooth's ability to hold the fiber is lost. The actual value of the tooth slope is 400 relative to the radius and 500 relative to the plane perpendicular to it. This value provides a tooth height of 3.46 mm.

To determine the rational deflection angle, we need to know how much we need to lower the height of the tooth. Earlier, when we analyzed the thickness of the fibers attached to the tooth, we said that it is possible to reduce the tooth height to 2 mm by ensuring its fiber-holding properties and toughness. In this regard, we assume a tooth height of 2 mm and find its slope. The study of ginning processes in sawdust through the literature has shown that increasing ginning efficiency leads to an increase in the density of the raw material roller, which in turn worsens the quality of the product. It can be seen that the density of the raw roller affects the saw disc teeth, and the saw teeth affect the seed, resulting in increased fiber and seed damage. In this case, the mass of compaction directly doubles in the firing zone, which leads to an increase in defects in the firing process (Table 1.1.)

Table (1.1.)

Condition of raw material roller	Density, kg / m3	Mechanically damaged fibers,%
The first	72,8	2,0
After passing the raw material test:		
Zich	94,2	25,5
Average	82,4	18,5
Empty	70,7	9,0

An increase in fiber damage in the ginning zone is associated with an increase in the density of the raw material roller.

When measuring the force in the velocity direction at the tip of the tooth, its value showed that as the density of the raw material roller increased, the force value was 25 N at the minimum density of the raw material roller, 42 N at the average density of the raw material roller and 67 N at the high density of the raw material roller.

This is of course due to large loads (relative to the relative strength of the individual fiber) and deterioration of the saw tooth and crankshaft surface quality can lead to serious damage to the fiber quality and, in some cases, surface erosion.

Some researchers believe that the main reason for the formation of defects in the form of broken fibers is insufficient distance between the plane of the saw surface and the cross section of the column, ie the gap between the saw disk and the column is not centered.

However, the number of fibers pulled between the saw teeth and the chisels may not be appropriate, as there may be fibers pulled by several teeth at the same time into the hole. With this in mind, choosing a rational value of the saw tooth thickness will significantly reduce the impact of the force on the fiber while minimizing its damage.

The aim of the research was to improve the profile of the saw tooth, along with the quality of the working surface of the saw saw, the cleanliness of the side surfaces of the tooth depends on the quality of the cotton fiber in the range of 6-7 classes. The best performance of the wetted fibrous material was observed on surfaces coated with chromium or polymer.

During the test, it was found that the intensity of adaptation of the sides of the working surface of the gin saw depends on the

size of the gap (gap) between the chisel and the saw. The drill, in turn, depends on the vibration of the saw itself, the uncertainty of installation, the vibration of the saw shaft, and other causes.

In this case, if the friction takes place only on the sides of the saw tooth with a fibrous mass, then the erosion will take place over a long period of time. However, if the saw blade with the side of the tooth touches the coil because it is not centered, rapid erosion will occur.

An increase in the gap between the gin saw and the chisel work zones as a result of their collapse will not ensure the operation of the gin device as specified in the instructions.

The creation of a new modern ginning machine and the improvement of the existing one cannot be done without theoretical and practical tests. There are a number of problems that cannot be solved at this stage in a purely theoretical way. Therefore, conducting experiments using modern methods plays an important role.

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