SOI: 1.1/TAS DOI: 10.15863/TAS
International Scientific Journal
Theoretical & Applied Science
p-ISSN: 2308-4944 (print) e-ISSN: 2409-0085 (online)
Year: 2021 Issue: 11 Volume: 103
Published: 08.11.2021 http://T-Science.org

QR – Issue QR – Article

Sh. Khusanova
Fergana Polytechnic Institute
Lecturer, Fergana, Uzbekistan

Sh. Imomqulov
Namangan Engineering Technological Institute
Assistant, Namangan, Uzbekistan
shuhrat19801221@mail.ru

Yu. Ergashov
Fergana Polytechnic Institute
Associate Professors, Fergana, Uzbekistan

O. Sarimsakov
Namangan Engineering Technological Institute
Dr. Tech. sciences, prof., Namangan, Uzbekistan

INTERACTION OF COTTON FIELD WITH SAW TEETH IN THE GINNING PROCESS

***Abstract**: Increase in fiber yield due to the improvement of machines for separating raw cotton from seeds, on which the technology of primary processing of cotton is currently being developed.*

***Key words**: Saw gin, Saw tooth geometry, working chamber, Gin process, Fiber, cylinder, construction.*

***Language**: English*

Citation: Khusanova, Sh., Imomqulov, Sh., Ergashov, Yu., & Sarimsakov, O. (2021). Interaction of Cotton Field with Saw teeth in the Ginning Process. *ISJ Theoretical & Applied Science, 11 (103),* 337-343.

Soi: http://s-o-i.org/1.1/TAS-11-103-24 ***Doi***: crossref https://dx.doi.org/10.15863/TAS.2021.11.103.24

***Scopus ASCC**: 2200.*

Introduction

In recent years, changes in the field of primary processing of cotton, the introduction of new techniques and technologies, the reduction of costs through the production of more and better quality fiber in the initial processing of cotton.

The following requirements must be met when ginning cotton: separation of all fibers capable of spinning from seeds, the absence of defects in the fiber and seeds as a result of the action of gin working bodies on the fiber; that the pieces of cotton do not join the fiber or seed that comes out of the demon; it should be possible to adjust the hairiness of the seed and the amount of fiber in the stalk. In the process of ginning, along with partial cleaning of the fiber from impurities and separation of the fiber from the fiber, the following defects can occur: a piece of seed coat sticky fibers, broken and damaged fibers, knots, twisted fibers, cracks, loose seeds [1,2].

In order not to cause demonic defects, demons and other previous machines must be used in accordance with the technological requirements and they must always be kept in good condition. The main working part of the saw gin consists of a metal saw (with sharp teeth) and a ribbed grille [3,4,5]. As a result of the interaction of these two working parts (organs) with each other, the fiber is separated from the seed, that is, the saw picks up the fiber with its teeth and then forcibly cuts it from the seed, thus separating the fiber from the seed. There will definitely be very rough and negative effects. For this reason, sawdust is not used in the separation of I-III grade long-fiber cotton fiber. During the ginning process, cotton and fiber are cleaned of some fine impurities, and a supplier for cotton is used. For fiber, when the fiber is separated from the saw, it is separated from the fiber by the weight of the waste, using the air in it [4-7].

Materials and methods

Let's look at the process of tearing cotton fiber by the teeth of a gin machine saw. In the process, the mass of fiber attached to one saw is mo (gr). If the number of saw teeth is z and the number of saw turns is n (rpm), the efficiency of the fiber separator per 1 min is as follows:

$$P_m = m_o \, z \, n, \qquad (1)$$

If there are N saws in a single-saw cylinder and the output is expressed in hours:

$$P_m = 60 \, m_o \, z \, n \, N, \qquad (2)$$

Typically, medium-capacity ginneries are equipped with 2 fiber separation machines and the average productivity is 10 tons (10,000 kg) per hour, and 5 tons (5,000 kg) per machine. Accordingly, taking into account that DP saws have 130 saws, 1 saw has 280 teeth, the number of saw turns is 730 rpm.

$m_o = P_m /(60 \; z \; n \; N) = 5000/(60 \cdot 280 \cdot 730 \cdot 130) = 3.14 \cdot 10^{-6}$ kg

Accordingly, it can be said that when the working capacity of a gin machine is 5 tons per hour, one tooth of it corresponds to 3.14 010-6 kg or 3.14 010-3 g of cotton fiber [6-10].

Figure 1 shows a graph of the mass of fiber per tooth depending on the productivity of the gin machine and the number of rotations of the saw cylinder.

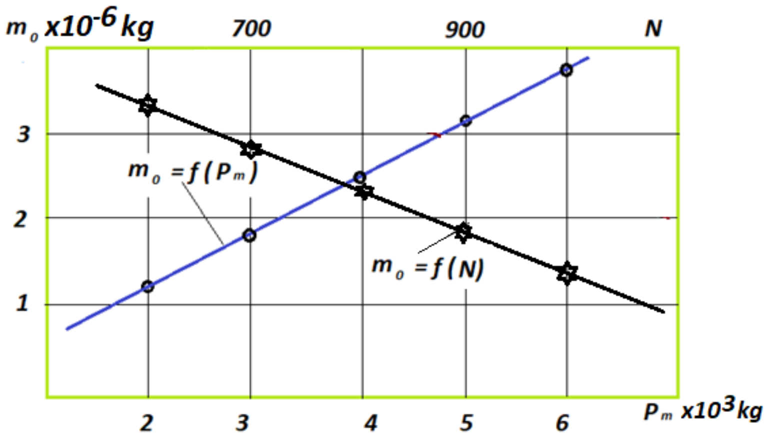

Figure 1. Dependence of the mass of fiber per tooth on the productivity of the gin machine and the number of saw cylinders

According to him, as the productivity of the gin machine increases and the number of saw cylinders decreases, the amount of fiber per saw increases, and conversely, as the gin machine decreases and the number of saw cylinders increases, the amount of fiber per saw increases. the amount of incoming fiber decreases. This is logically correct. Therefore, the ultimate goal in production is not to increase the amount of fiber per tooth, but to increase the overall productivity of the gin machine.

Now, let's see how much of the space between the saw teeth is occupied by the fibers attached to one saw tooth. According to the references, 1 fiber of medium fiber cotton is mt = (0.5 - 0.6) 010^{-5} grams. In this case, the number of fibers per saw tooth is equal to:

$N_t = m_o / m_t = 3.14 \cdot 10^{-3} / (0.5 - 0.6) \cdot 10^{-5} = 628 - 523$ pcs.

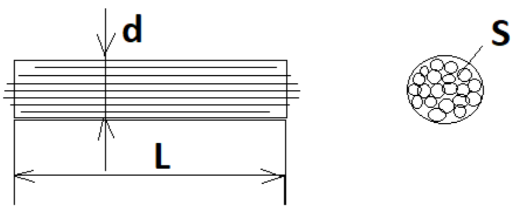

Figure 2. Scheme for determining the cross-sectional area of a fiber tuft.

The fibers attached to the saw are in the form of tufts (Fig. 2). We try to determine the total cross section and the volume it occupies.

If the tutam has diameter d and length L, its size is:

V = S L

The diameter of one fiber

dt = 15-25 μm ≈ $2x10^{-2}$ mm, the cross-sectional area is as follows:

S_t = 0.25 π d^2 = 0.25 x 3.14 x 4 x $(10^{-2})^2$ = $3.14x10^{-4}$ mm^2;

When the number of fibers in the tuft is N, the surface occupied by the tuft is equal to:

$$S = k\,N\,S_t \tag{3}$$

Here k is the coefficient of filling the cross-sectional area of the fibers. Its value is higher than 1.

Let k = 1.25. According to it,

S_t = k N S_t = 1.25x (628 ÷ 523) x $3.14x10^{-4}$ = 0.25 – 0.21 mm^2;

We assume S_t = 0.25 mm^2.

We assume that the average fiber length is L = 32 mm for medium fiber cotton. In that case

V = (0,25 ÷ 0,21) x32 = (6.72 ÷ 3.3) mm^3. We will try to determine how much of the surface area of the fiber bundle occupies the space between the saw teeth. The space between the saw teeth is triangular. We define its surface. To do this, we find the sides of a triangle in Figure 3:

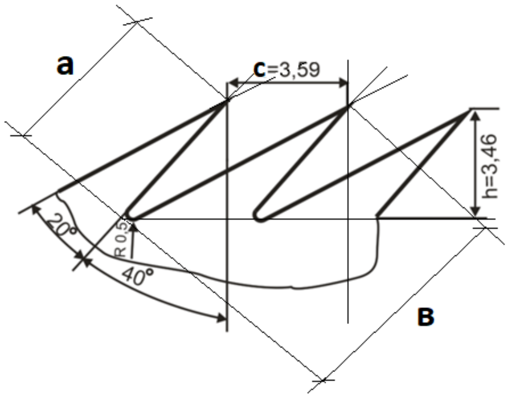

Figure 3. Scheme for determining the area between the saw teeth

$$B = h/\cos 60 = 3.46/\,0.5 = 0.5 = 6.92mm$$
$$a = h/\cos 40 = 3.46/0.77 = 4.49mm$$

We determine the face of a triangle with 3 sides by Geron's equation:

$$S = \sqrt{p(p-a)(p-b)(p-c)}$$
$$= \sqrt{7.5(7.5-3.59)(7.5-6.92)(7.5-4.49}$$
$$= \sqrt{7.5\cdot 3.91\cdot 0.58\cdot 3.01} = 7.2mm^2$$

Here *r* is the half perimeter, r = 0.5(a+b+c) = 0.5(4.49 + 6.92 + 3.59) =7.5 mm.

Let *e* be the coefficient indicating how much of the area between the saw blades occupies.

It can be defined as follows:

e = (S_t /S)x100% = (0.25/7.2) x100% = 3.47%

this value is very small and indicates that the cotton tuft is only 1/29 of the area between the saw teeth. This means that very little of the useful area between the saw teeth is working and most of the area is left empty.

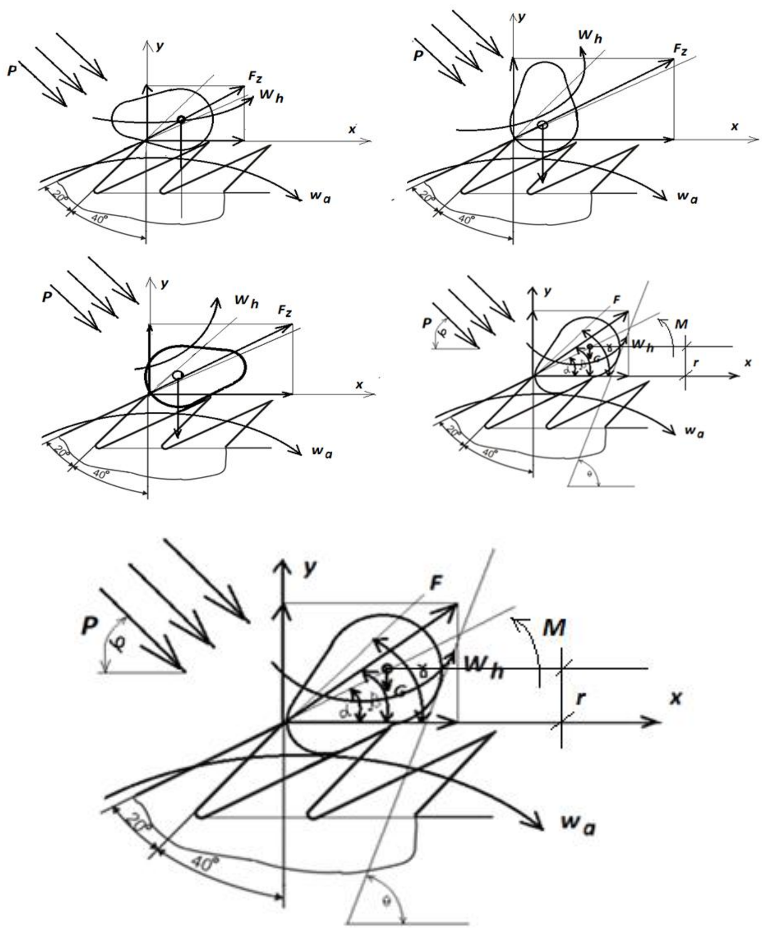

Figure 4. The scheme of the most dangerous situation in the interaction of sawdust with cotton seeds

Accordingly, it can be said that the size of the saw teeth is obtained with a very large reserve, ie for the current workload (for example, 5 t/machine hour) the area between the teeth is large and logically reduce it to a certain extent. does not reduce the efficiency of the sawing process. 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 material roller consists of newly inserted pieces of cotton into the chamber and partially ginned, as well as seeds that have been completely torn off. May hit the spherical part. Here, what the teeth collide with is a probable event. However, observations show that in 60-70% of cases, the teeth come in contact with the newly introduced cotton, ie 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 on the inner wall and meets the saw cylinder.

However, in 30-40% of cases, the saw teeth may encounter a half-cleaned or completely cleaned seed coat. The possible scenarios are shown in Figure 3. If we observe these cases, we can see that the strength of the wall of the large spherical part of the seed is higher than on other sides, the depth of immersion between the saw teeth is low, and when the seed hits the surface of the grate, it has a high chance of falling out. In these cases, it should be noted that the probability of damage is relatively low, although there is no guarantee that the seed wall will not be damaged at all. The most dangerous situation is the situation where the cotton seed is caught between the three sides and the saw teeth and thus hits the surface of the grate (Fig. 4).

First, we consider the process of impact of the saw teeth with a free-standing cotton seed with the raw roller attached. Let the mass of the saw tooth be m1, speed v_1, mass of cotton seed m2, speed v_2. The shock process can be described as follows:

$$\left.\begin{aligned} m_1\frac{dv_1}{dt} &= -F, \\ m_2\frac{dv_2}{dt} &= -F. \end{aligned}\right\} \qquad (4)$$

Here the impact force is not complete, but its projection on the axis passing through the center of gravity of the seed deforms the seed. And with its projection on the axis perpendicular to the said axis, the distance M to the center of gravity of the seed creates a moment of force M. He tries to turn the seed (Fig. 4). When the value of the force does not change, an increase in its projection on one axis, for example on an axis perpendicular to the radius, leads to a decrease in its projection on the axis along the radius. That is, the force of impact is completely transformed by the force that turns the seed. This situation is important for us. This is because if the seed rotates around the point of contact with the saw tooth, the fibers on the back of it 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 chance of unraveling its fibers will increase. It is possible to raise the shoulder of power for this, but it is an objective phenomenon and we cannot influence it. Way 2 is to increase the value of the force projection F_x. To do this, reduce the slope of the front corner of the saw teeth to a certain extent. This projection is found as follows:

$$F_x = F\ cos\frac{\gamma + \alpha}{2} \tag{5}$$

Here is the angle of inclination of the saw blade relative to the plane perpendicular to the plane at the point of contact of the front of the saw tooth, α 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 indicates the thickness of the tooth, ie its strength. Therefore, it is advisable to keep it at a level 20 degrees higher than the front angle. Because this angle does not serve to hang the fiber.

The cosine function is 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 equal to 0 at 90 degrees, then the projection of the force on the plane perpendicular to the radius is zero, and the tooth loses the ability to hold the fiber. The actual value of the tooth slope is 400 with respect to the radius and 500 with respect to the plane perpendicular to it. This value provides a tooth height of 3.46 mm. To determine the rational angle of inclination, we need to know to what value we need to reduce 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.

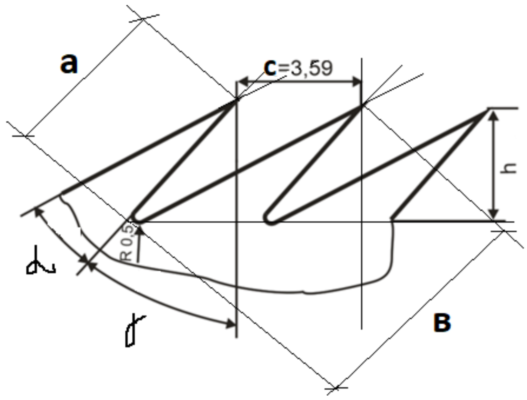

Figure 5. The scheme of finding the slope of the tooth by its height

Figure 4 shows the following:

$$Cos = h / a\ ; cos(= h / B, \tag{6}$$

According to the sine theorem:

$$Sin(90+\gamma) / B = sin(90-\gamma-\alpha) / a\ = sin\alpha / c; \tag{7}$$

According to the reduction equations: Sin(90+ γ) = cos γ.

Let $a\ =\ 200.$ Tooth pitch does not change: S = 3.59 mm; Assuming the tooth height h = 2mm,

Cosγ =2/a ; cos(γ + 20) =2/B ; cos γ /B = *cos*(γ + 20)/3.59 = *sin*20/*c* =>

cos γ /B = sin20/3.59 => cos γ = 0.095B = 2/a ; 2/B = 3.59x0.34/3.59 =>

2/B = 0.34 => B = 2/0.34 = 5.89 mm => a = 2/(0.095x5.89) = 3.57 mm

=> γ = arccos (0.56) = 0.98 = 56.2^0 or when taken relative to a plane perpendicular to the radius 90-56.2 = 33.9^0 . The inclination of the back of the tooth is 39.9+20 = 59.9^0.

The area between the teeth, according to Geron's equation:

S=$\sqrt{p(p-a)(p-B)(p-c)}$ =

=

$\sqrt{6.525\ (6.525\ - 3.57)(6.525\ - 5.89)(6.525\ - 3.59)}$ = 5.99 mm^2

Half perimeter p = 0.5(3.57+5.89+3.59) = 6.525 mm

The coefficient e, which indicates the area of the fiber bundle between the saw teeth, can be determined as follows:

e = (S_t /S)x100% = (0.25/5.99) x100% = 4.17%

This was 3.5% in the current option. In our option it increased by 4.2%. However, it should be noted that there is a large reserve. Now, let's take a closer look at the shock. The rate of convergence of the centers of gravity of the affected objects during the impact is as follows:

$$\alpha = v_1 - v_2 \tag{8}$$

According to Hertz's law, the force of impact can be expressed as follows:

$$F_z = n\sqrt{a^3} \tag{9}$$

The value of n taken for static cases also works for the shock process. Accordingly:

$$n = 4\frac{\sqrt{R_1}}{3\pi(k_1 + k_2)} \tag{10}$$

Where R_1 is the radius of the impact body, the coefficients

$$k_1 = (1 - v_1^2)\pi E_1$$
$$k_2 = (1 - v_2^2)\pi E_2 \tag{11}$$

In this case, E and *n* are the Yung modulus and the Poisson's ratio, respectively. Indices 1 and 2 indicate the affiliation of the blower (saw tooth) and the receiver (cotton seed). Differentiating (8) and substituting (9) for (4), we obtain:

$$\ddot{a} = nM\sqrt{a^3}, \tag{12}$$

bu yerda

$$M = \frac{1}{m_1} + \frac{1}{m_2}, \tag{13}$$

Now, if we integrate each of the 2 sides of equation (12) by $\dot{a}$, we get:

$$\dot{a}^2 - v^2 = -\frac{4}{5} Mn\sqrt{a^5} \tag{14}$$

Where v is the velocity of the objects approaching each other at the onset of the stroke (t = 0), m / s.

The maximum value of deformation a_1 occurs when the body stops moving, ie $\dot{a}$ = 0.

$$a_1 = \sqrt{(5\, v^2/4Mn)^5} \tag{15}$$

Now, on the basis of the obtained equations, it is possible to determine all the necessary parameters. The speed of convergence of objects: the speed of the saw teeth is 12 m / s, the speed of the seed is 2 m / s and the velocities are one-way, so their difference is: v = 12-2 = 10 m / s.

(13) ga ko`ra $M = \frac{1}{m_1} + \frac{1}{m_2} = \frac{1}{5} + \frac{1}{6.1x10^{-2}} = 3.83$ g^{-1}.

From (11) we can find k_1, k_2, from (10) n, from (15) a, from (9) F_z impact force. In this case, E and n are the Jung modulus and Poisson's ratio for steel, respectively, $E = 200x10^9\ Pa$; v= 0.24-0.28, $E = 12x10^9\ Pa$; $v = 0.25$ for cotton seeds (for flexible material); When the radius of the tooth tip R_1=0.1mm, it is possible to obtain graphs of the change in the impact force F.

The impact force creates a voltage G in the seed coat. In order not to break the seed, this voltage should not exceed the G_r strength limit of the seed coat. Its value can be determined as follows:

$$G = \frac{F_z}{s_k} \leq G_r\ , \tag{16}$$

Here, s_k is the impact area (the size of the surface in contact of the seed coat with the saw, m2), G_r is the critical stress breaking the seed coat, Pa. A voltage of 100-130 MPa is sufficient to break 1 fiber. Since the seed coat material is close to the fiber material, we take this stress as the critical stress that breaks the seed: By determining the impact stress for different values of $G_r = 120$ MPa and $s_k$force area, we can determine the rational radius of rotation R_1 for the saw tooth.

References:

1. Sarimsaqov, A.U., Karimov, A.I., & Muradov, R.M. (2012). Arrali jin ishchi kamerasidagi jarayonlarni amaliy va nazariy statik hisobi. *Mexanika muammolari*, Toshkent, № 2, pp. 60-63.
2. Ergashev, Yu., Xusanova, A.Sh., & Babayeva, M. (2020). Arrali jinlash selektiv texnologiyasining dinamik xarakteristikasini tahlili. *FarPI Ilmiy-texnika jurnali-Farg'ona*, №1, pp.252-2555
3. Sarimsaqov, O.Sh., Sattoriv, N.M., Siddiqov, Z.A., & Xusanova, Sh.A. (2020). Improvement of the Process in Disassembling of Cotton Stack and Transfering the Cotton into Pneumotransport. *International Journal of Advanced Science and Technology*, 29(7), pp. 10849-10857.
4. Khusanova, S., Esonzoda, S., Mirzayev, B., & Khakimov, I. (2021). Methods of control of air pressure in the working chamber of arrali demon machine. *International Engineering Journal For Research & Development*, *6*(3), 5-5.
5. Alisher, S., Otabek, S., Shohida, K., & Khakimov, I. (2021). Study of constructive and technological parameters of sawing machines jins and linters. *International Engineering*

Journal For Research & Development, *6*(3), 11-11.

6. Ochilov, M. M., Husanova, Sh. A., & Hakimov, I. Sh. (2021). Equipment improved except the saw. *Jekonomika i socium*, (2-2), 113-116.
7. Alibekovna, X. S., & Shavkatbekovich, K. I. (2020). Increasing Work Efficiency by Improving the Working Camera and Construction of Saw and Roller Mechanism. *JournalNX*, *6*(06), 740-742.
8. Makhmudovna, N. M., & Mukhammadkarim, M. (2021). The importance of improving technological processes for storage and processing of dry cocoons grown in different seasons. *International Engineering Journal for Research & Development*, *6*(3), 3-3.
9. Nabiev, K. K., Jakubov, N. Zh., & Nijazalieva, M. M. (2019). Puti povyshenija nadjozhnosti niti pri stachivanii shvejnyh izdelij. *Vestnik nauki i obrazovanija*, 20-3 (74).
10. Zikirov, M. C., Qosimova, S. F., & Qosimov, L. M. (2021). Direction of modern design activities. *Asian Journal of Multidimensional Research (AJMR)*, *10*(2), 11-18.