The American Journal of Engineering and Technology
(ISSN – 2689-0984)
VOLUME 04 ISSUE 01 Pages: 1-9
SJIF IMPACT FACTOR (2020: 5. 32) (2021: 5. 705)
OCLC – 1121105677 METADATA IF – 7.856

Publisher: The USA Journals

Journal Website: https://theamericanjournals.com/index.php/tajet

Research Article

STUDY OF UNIFORMITY OF MOTION LAYERS OF RAW COTTON ON ROLLER CONVEYOR

Submission Date: December 25, 2021, Accepted Date: January 05, 2022,
Published Date: January 15, 2022 |
Crossref doi: https://doi.org/10.37547/tajet/Volume04Issue01-01

Djamolov R.K.
"Pakhtasanoat Ilmiy Markazi" JSC, Uzbekistan

Korabelnikova T.N.
"Pakhtasanoat Ilmiy Markazi" JSC, Uzbekistan

ABSTRACT

The article presents theoretical studies of the uniformity of movement of cotton layers on a roller conveyor, where an expression for finding the gaps between the rollers is determined, as well as the results of the experiments carried out on the main parameters of the receiving device, the optimal criteria for the values of the gaps between the rollers are determined - from 10 to 15 mm.

KEYWORDS

Raw cotton, receiving device, rollers, gaps, parameters, research, experiments.

INTRODUCTION

Currently, various mechanisms are used for handling raw cotton, but all of them have their own drawbacks, which can be fully eliminated. To solve the reliability of cotton handling, a new design of the raw cotton intake is proposed based on the improvement of the design of the HPP brand in the bottom, which instead of the

The American Journal of Engineering and Technology
(ISSN – 2689-0984)
VOLUME 04 ISSUE 01 Pages: 1-9
SJIF IMPACT FACTOR (2020: 5. 32) (2021: 5. 705)
OCLC – 1121105677 METADATA IF – 7.856
Publisher: The USA Journals

conveyor belt is installed a roller table with a longer service life (Fig. 1). In addition, this design allows you to separate some of the trash impurities from the cotton mass when overloading between the rollers of the roller table.

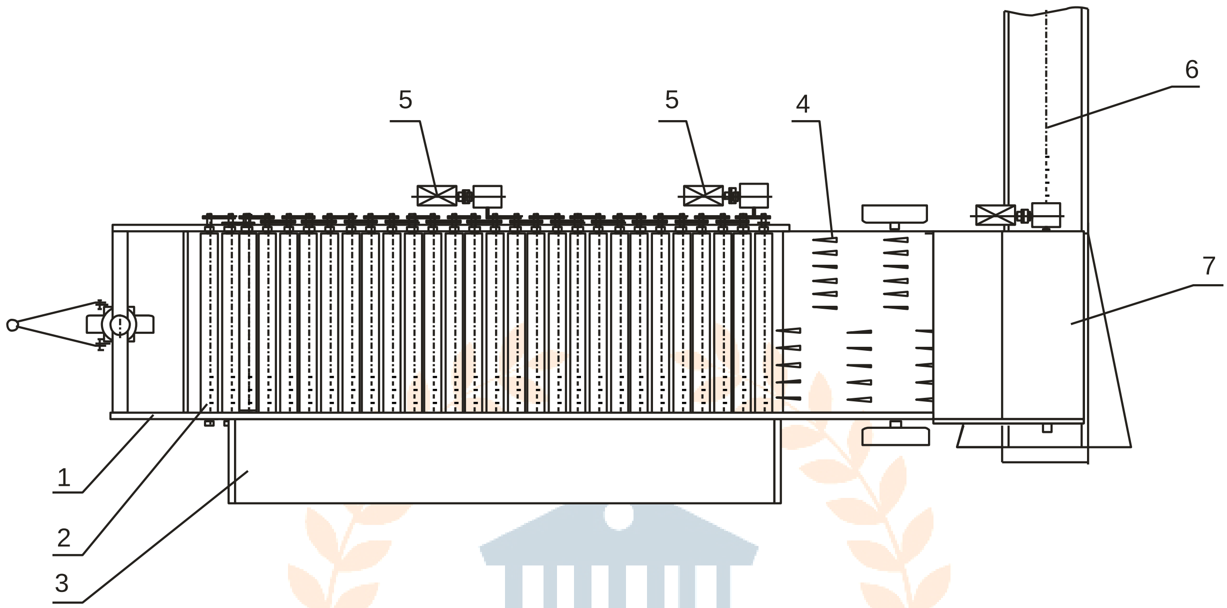

Fig. 1. Enhanced Receiver
1-frame, 2-rollers, 3-tailgate, 4-peg strips,
5-motor reducer, 6-portable belt conveyor, 7-apron.

EXPERIMENTAL AND THEORETICAL RESEARCH

To determine the geometric parameters of this device, we will use the theory of bulk cargo. First of all, we find the size of the gap between the rollers, and then their diameter. These two factors significantly affect the performance of the device, and they are closely interrelated. The third factor will be the speed of the rollers.

To find the parameters of the gaps between the rollers, we investigate the uniformity of movement of the layers of the transported material on the conveyor. The condition of movement at the very beginning can be noted the compaction of the load in the gaps between the rollers, in which the upper layers squeeze the lower ones, thus the formation of a lower substrate of high density occurs. And the movement will be in layers, as shown in Figure 2.

The American Journal of Engineering and Technology
(ISSN – 2689-0984)
VOLUME 04 ISSUE 01 Pages: 1-9
SJIF IMPACT FACTOR (2020: 5. 32) (2021: 5. 705)
OCLC – 1121105677 METADATA IF – 7.856
Publisher: The USA Journals

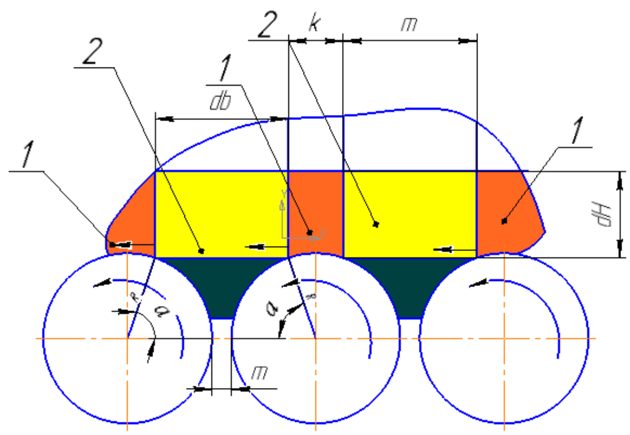

Fig. 2. The movement of the layer during the compaction of the substrate.

Layers 2 are considered moving, layers 1 can be considered static.

That is, the motion has a wave character, layers 2 push layers 1 and then take their place and become motionless, etc. higher layers of material may remain in place [1].

Let's select a section in layers 1 with a width k and a height dH, the force from the upper layers of gravity of the upper ones presses on it, and it is compacted to such an extent that the selected layer does not disintegrate during movement. Let's compose the equations for such a motion. Moreover, we will divide the problem into smaller ones and solve it later in a complex. In this case, the reaction of the support to the selected area is expressed by the following formula:

$$R = dH * k * l * \rho * g \qquad (1)$$

The force with which it will move is equal to:

$$F_{перем} = \frac{2M_{кр}}{D} \qquad (2)$$

The force with which the layer of cotton forces moves (Fig. 3) can be calculated using the following expression:

$$N = \mu_{xc}\sqrt{R^2 + F^2{}_{перем}} = \mu_{xc}\sqrt{(dH * k * l * \rho * g)^2 + \left(\frac{2M_{кр}}{d}\right)^2} \qquad (3)$$

The American Journal of Engineering and Technology
(ISSN – 2689-0984)
VOLUME 04 ISSUE 01 Pages: 1-9
SJIF IMPACT FACTOR (2020: 5. 32) (2021: 5. 705)
OCLC – 1121105677 METADATA IF – 7.856
Publisher: The USA Journals

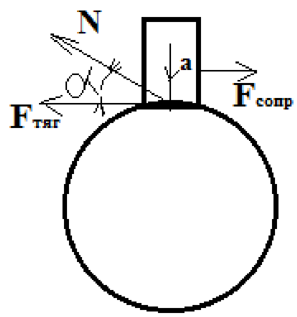

Fig. 3. Design diagram of the forces acting on the cotton layers from the rollers

But here the question of resistance in the idle zone is raised, and until we consolidate it, the movement cannot proceed.

Therefore, we introduce into the equation the resistance force of the movement of the cotton mass in the idle zone $F_{\text{сопрдвиж}}$, which will begin to move as it compresses, that is, at first it is not mobile, then when the driving layer is collected on it, it compresses and begins to move.

This force can be expressed in terms of mass, and it will depend on the diameter of the roller and the size of the gap between the rollers, since the width of the layer depends on this, knowing the angle of compaction, which we determined from the above calculations to simplify the calculation, we will take the angles equal to find the width of the layer (Fig. 2).

$$db = 2R\cos\alpha + m = D\cos\alpha + m \quad (4)$$

Moreover, then the reaction of the support from the fixed layer will be expressed as follows:

$$N_{нс} = dbh'l\rho g \quad (5)$$

The resistance force of movement of this layer will be equal to:

$$F_{\text{сопрдвиж}} = \mu_{x/c} dbh'l\rho g \quad (6)$$

In this case, the following condition takes place:

$$F_{\text{сопрдвиж}} < N \quad (7)$$

Substituting into expression (6) and (7), (3), (4) we get the following:

$$\mu_{x/c} dbh'l\rho g < \sqrt{(dH*k*l*\rho*g)^2 + \left(\frac{2M_{кр}}{d}\right)^2} \quad (8)$$

We transform (8) to the following form:

$$\mu_{x/c}(D\cos\alpha + m)h'l\rho g < \sqrt{(dH*k*l*\rho*g)^2 + \left(\frac{2M_{кр}}{D}\right)^2} \quad (9)$$

And then we transform expression (9) into the following form:

$$m < \frac{\mu_{xc}\sqrt{(dH*k*l*\rho*g)^2 + \left(\frac{2M_{кр}}{D}\right)^2}}{h'l\rho g\,\mu_{x/c}} - D\cos\alpha \quad (10)$$

From expression (10), you can find the permissible gap between the rollers for a given diameter.

The American Journal of Engineering and Technology
(ISSN – 2689-0984)
VOLUME 04 ISSUE 01 Pages: 1-9
SJIF IMPACT FACTOR (2020: 5. 32) (2021: 5. 705)
OCLC – 1121105677 METADATA IF – 7.856
Publisher: The USA Journals

The height of the layer, which will be moving, can be determined from the stability conditions of the latter from the bulk density of the load, which will affect this factor. Moreover, it will depend on the internal forces of adhesion between the cotton. Let's consider this case (Fig. 4).

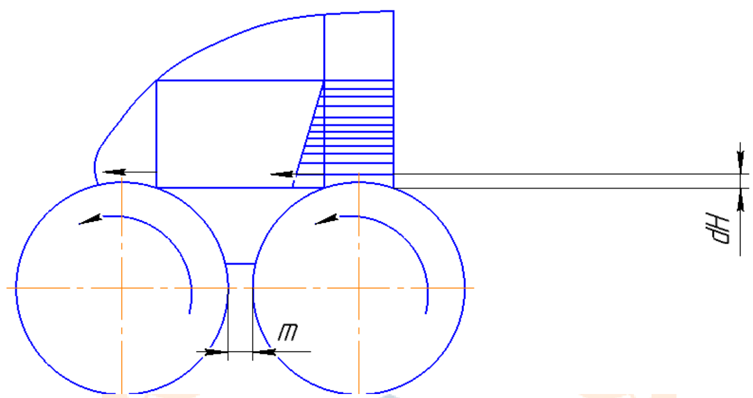

Fig. 4. Movement of the cotton layers.

For which we accept the condition

$$p_1 * s_1 * \mu_{x/x} < p_2 * s_2 * \mu_{x/c} \quad (11)$$

Where, p_1, p_2 - is the pressure on the blank layer and the driving layer, respectively, Pa; s_1, s_2 - is the area of the idle layer and the moving layer, respectively, m^2;

- $\mu_{x/x}, \mu_{x/c}$ - coefficient of friction of the blank layer and the driving layer, respectively.

As for p_2, which will change with the height of the layer, since it is connected with the bulk density and will change with the height, as well as from the compaction during the rotation of the roller, and it can be written as:

$$p_2 = \sqrt{(mgh)^2 + (U)^2} \quad (12)$$

Where U is the pressure from the roller compaction, Pa.

After substituting the area values and transformations into (11), we obtain the following formula:

$$p_1 * \mathrm{db} * \mu_{x/x} < p_2 * k * \mu_{x/c}$$

and then we obtain the following condition

$$\frac{p_1}{p_2} < \frac{k\mu_{x/c}}{\mathrm{db}\,\mu_{x/x}} = A \quad (13)$$

Let us introduce the coefficient A, which characterizes the stability of the displacement process, when A is equal to one, the process is stable, the movement is carried out in uniform layers, when A tends to 0, the movement is oblique (as shown in Figure 2.), with more units the process may stop altogether. As can be seen from the formula, the coefficient A will be characterized by the wiring between the rollers, since

The American Journal of Engineering and Technology
(ISSN – 2689-0984)
VOLUME 04 ISSUE 01 Pages: 1-9
SJIF IMPACT FACTOR (2020: 5. 32) (2021: 5. 705)
OCLC – 1121105677 METADATA IF – 7.856
Publisher: The USA Journals

in any case the gap between the rollers will always be greater than the length of contact with the rollers.

Further, an experimental study of the change in the gaps between the rollers of the roller table, depending on the fallout of trash impurities, with the simultaneous minimization of the fallout of slices of raw cotton was carried out.

Many scientists [2, 3, 4] studied the fractional composition of trash impurities in cotton raw materials. In this case, it is customary to subdivide trash impurities in accordance with their linear dimensions into large (more than 10 mm) and small (less than 10 mm).

Considering the above, in particular, there is a significant amount of small trash impurities in cotton, the following gaps between the rollers are determined: 5, 10, 15 and 20 mm. Experimental studies were carried out by changing the distance between the rollers from 5 to 20 mm in the indicated ranges with the passage of raw cotton of high - I-st and low-III industrial varieties, while the initial cotton weediness of the I-th industrial grade was 4.6%, moisture content 8 ,5 %; III grade, weediness 13.8% and humidity 12.8%.

When studying the composition of small litter of the 1st industrial grade, organic impurities such as: fragments of leaves, stems and fluffy waste took place.

Due to the fact that in practice in production, cotton raw materials are often taken with a large amount of soil, sand and dust-containing waste, an additional study of the deposition of inorganic impurities was carried out.
Each experiment was carried out in triplicate, where in each case cotton was passed in a uniform layer weighing 50 kg on the stand of the roller table. If for the 1st industrial grade the weediness is 4,6%, then for 50 kg of cotton there corresponds 2,3 kg (from 100%) of weeds.

In an experimental study with a change in the gaps between the rollers, we collected the trash impurities that fell under the roller table rollers (Fig. 5),

Fig. 5. Weed impurities and volatiles of raw cotton, fallen out under the roller table rollers
1 - cotton wedges, 2 - weeds.

The American Journal of Engineering and Technology
(ISSN – 2689-0984)
VOLUME 04 ISSUE 01 Pages: 1-9
SJIF IMPACT FACTOR (2020: 5. 32) (2021: 5. 705)
OCLC – 1121105677 METADATA IF – 7.856
Publisher: The USA Journals

Weighed and determined the proportion of trash that fell out under the rollers, calculated as a percentage of the total trash impurity in the raw cotton.

At the same time, the fallen wedges 1 of raw cotton were taken into account in weed impurities 2, the share of which was also determined as a percentage of the total weediness in raw cotton.

The results of this study are presented by graphs of the dependences of the influence of the change in the gap between the rollers of the roller table on the fallout of trash impurities and cotton slices of I and III industrial grades, which are presented in Figures 6 and 7, respectively.

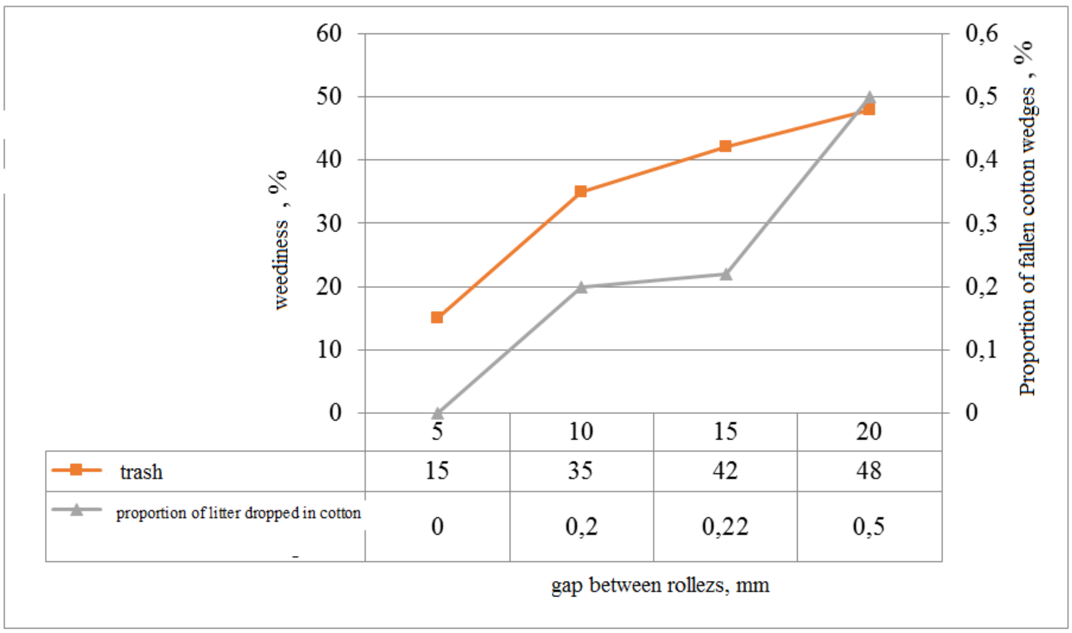

Fig. 6. Influence of the change in the gap between the rollers of the roller table on the fallout of trash impurities and slices of raw cotton of the I-st industrial grade.

Figure 6 shows that in the process of testing on raw cotton of the first industrial grade, with an increase in the gaps between the rollers, the loss of trash in the range of 15.1-48.3% increases, while the share of dropped out lobes from raw cotton also increases as a percentage from weeds from 0-0.5%.

The American Journal of Engineering and Technology
(ISSN – 2689-0984)
VOLUME 04 ISSUE 01 Pages: 1-9
SJIF IMPACT FACTOR (2020: 5. 32) (2021: 5. 705)
OCLC – 1121105677 METADATA IF – 7.856
Publisher: The USA Journals

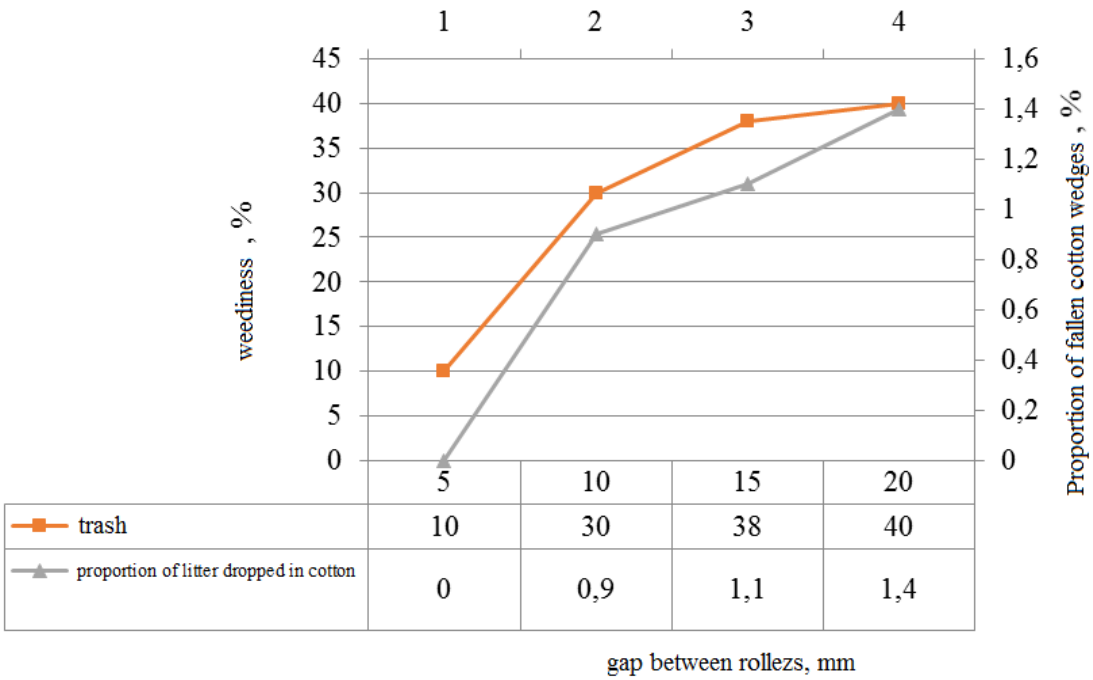

Fig. 7. Influence of the change in the gap between the rollers on the fallout of trash impurities and slices of raw cotton III industrial grade

Figure 7 shows that when testing raw cotton of the third industrial grade, with an increase in the gaps between the rollers, the dropout of trash impurities increases within 10,1% to 39,8%, while the share of dropped lobes from raw cotton also increases as a percentage of trash impurities - in the range of 0,0-1,4%.

It was observed that with an increase in the gap between the rollers to 10 mm, some cotton wedges fall out due to their clamping and pulling between the rollers of the roller table, and with an increase in the gap to 15 mm, there is a slight drop - out of the raw cotton wedges into the litter and with a further increase in the gaps, the wedges fall out cotton grows.

In the process of testing raw cotton of the first industrial grade, there was less loss of cloves, and more trash impurities in comparison with the low grade, which occurred in both cases with a gap between the rollers from 10 to 15 mm. The loss of weeds is due to the physical and mechanical properties of raw cotton. The observations of the experiment established that raw cotton of a high industrial grade has larger slices with mature fiber, the volatiles in which are located tightly, and at low moisture content of raw cotton, the separation of weeds from the cotton fiber increases through mechanical action.

Earlier studies in the study of the morphological properties of selection varieties of cotton [5] came to the conclusion that the property of low industrial varieties of cotton is a low density of lobules in a cotton boll, in connection with this, in cotton raw materials, the number of separated cotton lobes increases into bats with a deeper introduction of weeds impurities in the fiber.

CONCLUSIONS

1. By a theoretical study of the uniformity of movement of cotton layers on a conveyor, an expression for finding the gaps between the rollers has been determined.
2. Based on the results of the conducted experiments of the main parameters of the receiving-feeding device, the optimal criteria for the values of the gaps between the rollers were determined - from 10 to 15 mm.

REFERENCES

1. Ilyin, Kolesnikov, Saratov: Theory of Oscillations N.E.Bauman, 2003.
2. Salimov A. M., Akhmatov M. A. Pakhtaga dastlabki ishlov berish. "Bilim", Toshkent, 2005.
3. Ismatova M.M. Research of physical and mechanical properties of raw materials obtained under different conditions of primary processing of cotton / MM Ismatova, ZF Valieva, DE Kazakova. - Text: direct //Young scientist. - 2016. - No. 1 (105). - S. 154-158. - URL: https://moluch.ru/archive/105/24696/.
4. R.T. Kaldybaev, R.S. Tashmenov//Study of the quantitative and qualitative content of weeds in raw cotton for various cotton breeding, depending on the growing areas. No. 3 (363) textile industry technology 2016.
5. Khafizov I.K. and others. Improving the technology of processing seed cotton (review) - Tashkent, UzNIINTI, 1975. P.4.