The influence of the location of the cells on the allocation of weed impurities for cleaning raw cotton from fine waste

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Abstract. The article considers the influence of the movement of raw cotton in the cleaning zone with various options for the location of the grid holes. The article also provides a theoretical study of the movement of cotton on the surface of the grid. The location of the grid holes for cotton movement is recommended. The ratios of the reaction forces at impact are presented, as well as the method for calculating the angle of flight particle of cotton before hitting a multifaceted grid surface.

1. Introduction
The main working bodies of the cleaning machines for small waste are the annular cylinder and the grid surface. The intensity of the cleaning of raw cotton from fine litter depends not only on the rational design of the cylinder, but also on the correct choice of cleaning grid surfaces, removing weed impurities from the cleaning zone.

Earlier, in TITLP [1], studies were conducted to identify the effectiveness of the grid surfaces used in fine litter cleaners, which found that the most effective, from the point of view of the separation of weed impurities, is a grate with round grates.

However, it did not find wide application in industry, since the gaps between the grates in the lower part of the grate were clogged with weed impurities and stones, which removed the cleaning effect.

High rates of cotton cleaning were achieved when using woven wire grid in cleaners. However, they did not find application in cleaners, because of the complexity of manufacture.

Perforated nets with grid sizes of 6 and 50 mm are installed in pecking and cylinder cleaners for fine litter of type 1XK (SCh-02), but nets of 4.5 x 50 mm are also found (taking into account the size of specks up to 5 mm). In this case, the large axis of the grid cells is perpendicular to the direction of movement of the raw cotton.

2. Literature review
Bobomatov A.Kh. in the thesis [1] recommends installing the grid with the larger axis parallel to the movement of the raw cotton. This increased the cleaning effect, however, with a grid size of 6x50 mm, cotton flies fell into the waste, and when cleaning raw cotton with increased (up to 12%) moisture, the netting jumpers (between two adjacent cells along the way) were clogged with raw cotton. Therefore, this arrangement of grid cells is not widely used.

The intermediate arrangement of grid cells has not been investigated. As will be shown below, we experimentally studied the influence of the intermediate arrangement of grid cells (their location with
the major axis at an angle of 45° in the direction of the cotton movement) on the cleaning performance of raw cotton, such as the cleaning effect, seed damage, free fiber formation and loss of volatiles [2,3].

For a greater cleansing effect of fine litter, it is desirable to increase the space for litter separation. This can be done by increasing the size of the grid cells or their different locations along the path of the raw cotton.

However, increasing the size of the cells causes the loss of volatiles in the waste, which is unacceptable. By arranging the cells of the grid adopted for installation for these cleaners at a certain angle, it is possible to increase their size, without, however, causing raw cotton to fall out [4].

**Figure 1.** Cell layout grid.

As can be seen from Fig. 1, the size of the grid cells when their major axis is located at an angle of 45° to the direction of movement of the raw cotton, as it were, increases by 2.5 mm and is 8.5 mm against 6 mm when the cells are positioned at an angle of 90°.

The greatest increase in “free space” or, equivalently, an increase in the size of the cells is achieved due to the location of the grid cells with a larger axis along the direction of the raw cotton.

The influence of the grid size on the allocation of fine litter can be analyzed. When the rotary cylinders rotate in the zone between them and the net, vortex air movements occur. However, the laws of their formation have not been established [5,6].

3. Theoretical research

In our analysis, their influence is not taken into account, but it is shown only as first approximations how the different arrangement of grid cells can affect the selection of weed impurities. Consider the movement of one speck (figure 2), assuming that it is affected by the force of air resistance \( K_c v_c^2 \) and the force of weight \( P_c \). The raw cotton moves along the net at a speed lower than the speed of the annular cylinder \( \left(v_\theta \right) \), i.e. as stated above \( v_c = \left(0.6 \div 0.7\right)v_\theta \).

Moreover, since the cell size is small, we assume that the vector of the air resistance does not change its direction. We compose differential equations in projections on the X and Y axis (figure 2).

\[
m_c \omega_{c_x} = K_c v_c^2, \quad m_c \omega_{c_y} = -P_c \]

But
\[ \omega_{c_x} = \frac{dv_{c_x}}{dt} \quad \text{And} \quad \omega_{c_y} = \frac{dv_{c_y}}{dt} \]

And then
\[ m_c \frac{dv_{c_x}}{dt} = K_c v_{c_x}^2, \quad m_c \frac{dv_{c_y}}{dt} = -P_c \]

We take the integrals of these equations
\[ \frac{m_c}{K_c} \int \frac{dv_{c_x}}{v_{c_x}^2} = \int dt \quad \text{And} \quad \int dv_{c_y} = -g \int dt \]

Figure 2. The forces acting on the mote when moving in the cell area.

We find the integration constants \( c_1 \) and \( c_2 \) from the initial conditions.

At, \( t = 0 \); \( v_{c_x} = (0,6 \div 0,7)\nu_\phi \), \( a \) \( v_{c_y} = 0 \) \( c_1 = -\frac{m_c}{K_c} \frac{1}{(0,6 \div 0,7)\nu_\phi} \)

\( c_2 = 0 \)

Then the general solution would be:
\[ -\frac{m}{K} \left( \frac{1}{V_{c_x}} - \frac{1}{(0,6 \div 0,7)\nu_\phi} \right) = t \]
\[ v_{c_y} = -gt \]

We find from the equations (1) \( v_{c_x} \)
\[ \frac{K_c t}{m_c} (0,6 \div 0,7)\nu_\phi v_{c_x} + v_{c_y} = (0,6 \div 0,7)\nu_\phi ; \quad v_{c_x} = \frac{(0,6 \div 0,7)\nu_\phi}{-\frac{K_c t}{m_c} (0,6 \div 0,7)\nu_\phi + 1} \]

We integrate the last equation and the equation \( v_{c_y} = -gt \)

Separating the variables we get:
\[ \int dx_c = (0,6 \div 0,7)\nu_\phi \int \frac{dt}{1 - \frac{K_c}{m_c} (0,6 \div 0,7)\nu_\phi t} ; \quad \int dV_c = -g \int t dt \]
After integration, we find:

\[ x_c = -\frac{m_c}{K_c} l_n \left( \frac{0.6 \div 0.7 V_\theta K_c t}{m_c} + 1 \right) + c_3 \]  \hspace{1cm} (3)

\[ V_c = -gt^2 + c_4 \]  \hspace{1cm} (4)

Find the integration constant \( c_3 \) with \( c_4 \) from the initial conditions \( t = 0, \ X_c = 0 \ \ Y_c = 0 \)

then \( c_3 = 0, \ c_4 = 0 \).

Consequently

\[ x_c = -\frac{m_c}{K_c} l_n \left( \frac{0.6 \div 0.7 V_\theta K_c t}{m_c} + 1 \right) \quad \text{And} \quad Y_c = -gt^2 \]

To find the trajectory of the mote flight, it is necessary to exclude time \( t \) from these equations; find \( t \) from the first equation.

\[ e^{\frac{x_c K_c}{m_c}} = -\left( \frac{0.6 \div 0.7 V_\theta K_c t}{m_c} + 1 \right) \]

Where from

\[ t = \frac{m_c}{(0.6 \div 0.7 V_\theta K_c)} \left( e^{\frac{x_c K_c}{m_c}} + 1 \right) \]

Substituting the value \( t \) in the second equation, we obtain the path of the mote.

\[ Y_c = -g \left( \frac{m_c^2}{(0.6 \div 0.7 V_\theta K_c)^2 V_c^2 - e^{\frac{x_c K_c}{m_c}} + 1} \right)^2 \]  \hspace{1cm} (5)

From this equation it can be seen that the greater the abscissa \( X_c \) i.e. the size of the grid cell, the greater the ordinate of \( U_s \) and when it is larger than the thickness of the grid (\( b = 3 \text{ mm} \)) then the speck will stand out through. To calculate the \( Y_c \) using this formula for known values of \( X_c \), it is necessary to know the values of \( m_c, K_c \) and \( V_\theta \).

4. Results and discussion

From the work of TITLP [7,8] and also from our experimental measurements, it is known that the average weight of small weed impurities (fragments of leaves, bracts) of raw cotton of the first varieties 108-f and C-4727 is on average \( P_c = 0.003 \text{ g} \), and the area of the mote is \( F_c = 1.2 \times 10^{-5} \text{ m}^2 \).

Therefore, for calculations, we can accept: \( m_c \approx 3 \times 10^{-7} \text{ kgs.m}^2 \).

The specific gravity of air can be taken \( \gamma = 1.22 \text{ kgs/m}^3 \) and \( g = 9.81 \text{ m/s}^2 \), \( F_c \) it is known, and \( V_\theta = 10 \text{ m/s} \). To find the value of the coefficient \( K_c \), you need to know the coefficient of frontal Resistance of the speck \( C_R \). The air resistance \( KV_c^2 \) during the movement of the speck in the cell zone cannot be greater than its weight force, if it was greater, and then there would be no litter. For the extreme case, you can write [9,10]:

\[ P_c \geq KV_c^2 \geq F_c C_R \frac{\gamma V_c^2}{2g} \]

where from \( C_R \leq \frac{P_c 2g}{F_c \gamma V_c^2} \).
it is found (according to measurements) \( C_R \approx 0.1 \alpha \quad K_r \approx 7.5 \cdot 10^{-8} \frac{kgS \cdot sek^2}{m^2} \).

Given the size of \( X \) cells (4.5; 6; 8.5; 50 mm) with known average values \( m_c \approx 3 \cdot 10^{-7} \frac{kg \cdot s^2}{m} \),

\[
\nu_c = 10 \frac{m}{sek} , \quad F_c \approx 1.2 \cdot 10^{-3} m^2 , \quad \frac{\gamma}{2g} = 6.25 \cdot 10^{-2} kGcG^4 sek^2 ;
\]

We find:

\[
\begin{align*}
X = 4.5mm & \quad \nu = 3.5 mm \\
X = 6mm & \quad \nu = 4.7 mm \\
X = 8.5mm & \quad \nu = 6.65 mm \\
X = 50mm & \quad \nu = 39 mm
\end{align*}
\]

By a value of \( \nu \), one can judge how the arrangement of grid cells affects the selection of weed impurities. Obviously, the higher the value, \( \nu \) the better the allocation of litter.

5. Conclusion
The calculated data show that a grid with a cell with a larger axis in the direction of movement of the raw cotton should better isolate weedy impurities. The smaller the grid cell size in this direction, the weeder impurities should be released worse.

References
[1] Bobomatov A Kh 2017 Creation of an effective design and improvement on a scientific basis of calculation methods for a cotton cleaner - raw from fine litter (Tashkent Uzbekistan) p 126
[2] Murodov O 2019 Perfection of designs and rationale of parameters of plastic Koloski cleaning cleaners International Journal of Innovative Technology and Exploring Engineering 8(12)
[3] Khojiev M T, Juraev A D, Murodov O D and Rakhimov A K 2019 Development of design and substantiation of the parameters of the separator for fibrous materials International Journal of Recent Technology and Engineering 8(2)
[4] Muksin K, Ilkhom A and Javlon K 2019 A new technology for dust removal from cotton processing International Journal of Recent Technology and Engineering 8(3)
[5] Ilkhom A, Muksin X, Orof A and Ruxsora K 2019 The composition of releasing passion of dusty in the process of pat International Journal of Engineering and Advanced Technology 8(3)
[6] Abbazov I, Sarimsakov O, Khodjiev M and Mardonov B 2018 Waste Produced at Cotton Waste Factories American Journal of ASCIT Communications 5 22-8
[7] Urinov N, Saidova M, Abrorov A and Kalandarov N 2020 Technology of ionic-plasmic nitriding of teeths of disc saw of the knot of saw cylinder IOP Conference Series: Materials Science and Engineering 734(1)
[8] Rajabov O and Shodiyev Z 2019 Analysis of Small Fluctuations of a Multifaceted Mesh under the Influence of Technological Load from the Cleaned Cotton - Raw International Journal of Advanced Research in Science, Engineering and Technology 6(10)
[9] Anvar J and Ozod R 2019 Analysis of the Interaction of Fibrous Material with a Multifaceted Grid of the Cleaner International Journal of Recent Technology and Engineering 8(1)
[10] Rajabov O, Fazliddin K, and Salimov Sh 2020 Substantiation of Parameters of the Fibrous Material Cleaning Zone International Journal of Engineering and Advanced Technology 9(3)