LINTER MASHINASINING TO'RLI YUZA SIRTIDAGI LINT OQIMINING HARAKATINI NAZARIY TAXLILI

Maqsudbek Shamshitdinov Elmurod o'g'li
Assistant of Namangan Institute of Engineering and Technology, Namangan, Uzbekistan
Phone.: (0894) 590-8868, E-mail. maqsud@gmail.com

Annotation:
This article presents a theoretical analysis of methods for effectively controlling lint flow and separating impurities using newly designed mesh surfaces with barrier plates installed in the lint discharge section of the linter machine. The study investigates the motion patterns of lint, air, and impurities, evaluating the efficiency of barrier plates at various angles and lengths.

Keywords: Linter machine, lint flow, barrier plates, motion equations, impurity separation, Maple software, air flow, axis-based analysis.

Newly designed mesh surfaces with barrier plates have been installed in the lint discharge section of the linter machine. These guides direct air and lint toward the discharge duct, preventing lint from passing through the mesh surface. A theoretical analysis examines the process of separating impurities from lint through the impact of air, lint, and impurities collectively striking a barrier installed at a 45° angle (Figure 1).

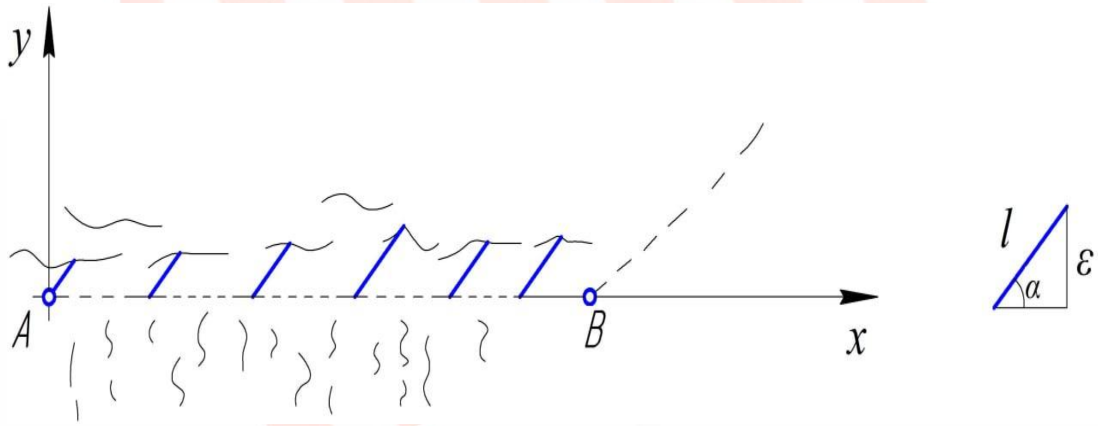

Figure 1. Diagram of lint movement on an improved mesh surface.

The movement of the lint flow resulting from the impact with the barriers, as well as the change in mass of impurities separated from it, is determined using motion equations [1].

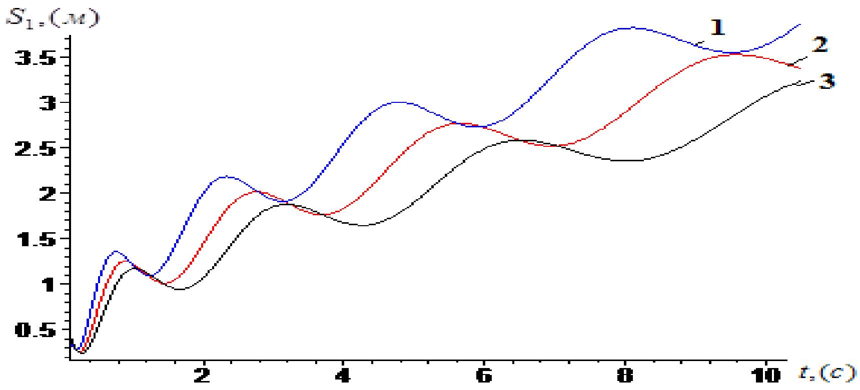

Figure 2. Graph of lint flow movement over time at various inclination angles of the barrier plate

Figure 2 illustrates the effects of airflow on lint movement across the mesh surface and the impact of the barrier plates' inclination angles and lengths on the lint flow. The graphs demonstrate that the greater the oscillation of the lint mass, the more effectively the impurities are separated and discharged. The oscillatory movement of the lint remains consistent in amplitude across the barrier plates with varying inclination angles and lengths. The motion of lint over a distance AV=LAV = L is expressed to represent the flow dynamics effectively.

$$\begin{cases} Y = \varepsilon \cdot \sin \pi \sqrt{\dfrac{g}{2 \cdot L}} \cdot t \\ X = \dfrac{g \cdot t^2}{2} \end{cases} \qquad (1)$$

The lint flow moves along the OXZ plane under the influence of air forces. The analysis demonstrates how the airflow interacts with the barrier plates, resulting in the separation and detachment of impurities. The projections of the airflow force along the axes are determined to understand the dynamics of the process.

$$P_x = P_y = 0 \, ; P_z = P \qquad (2)$$

We determine the motion equations resulting from the interaction of the lint flow with the barrier plates.

$$\begin{cases} X = \varepsilon \cdot \cos kz \\ Y = \varepsilon \cdot \sin kz \end{cases}$$

The laws of motion of the lines in the OXZ plane under the influence of air forces are expressed as follows.

$$\begin{cases} f_1 = x - \varepsilon \cdot \cos kz \\ f_2 = y - \varepsilon \cdot \sin kz \end{cases} \qquad (3)$$

By taking partial derivatives from equation (3), we determine the effect of the plates in separating impurities from the motion of the lines along the airflow.

$$\begin{cases} \frac{\partial f_1}{\partial x}=1 \quad \frac{\partial f_1}{\partial y}=0 \quad \frac{\partial f_1}{\partial z}=\varepsilon\cdot\sin kz \\ \frac{\partial f_2}{\partial x}=0 \quad \frac{\partial f_2}{\partial y}=1 \quad \frac{\partial f_1}{\partial z}=-\varepsilon\cdot\cos kz \end{cases} \qquad (4)$$

Using Lagrange's first equation [3], we derive the differential equation of motion for the line flow under the influence of air forces.

$$\begin{cases} m\cdot\ddot{x}=P_x+\lambda_1\cdot\frac{\partial f_1}{\partial x}+\lambda_2\cdot\frac{\partial f_2}{\partial x} \\ m\cdot\ddot{y}=P_y+\lambda_1\cdot\frac{\partial f_1}{\partial y}+\lambda_2\cdot\frac{\partial f_2}{\partial y} \\ m\cdot\ddot{z}=P_z+\lambda_1\cdot\frac{\partial f_1}{\partial z}+\lambda_2\cdot\frac{\partial f_2}{\partial z} \end{cases} \qquad (5)$$

We substitute expressions (3) and (4) into equation (5).

$$\begin{cases} m\cdot\ddot{x}=\lambda_1 \\ m\cdot\ddot{y}=\lambda_2 \\ m\cdot\ddot{z}=m\cdot g+\lambda_1\cdot\varepsilon\cdot k\cdot\sin kz-\lambda_2\cdot\varepsilon\cdot k\cdot\cos kz \end{cases} \qquad (6)$$

In the differential equation (6), we express the values of λ_1 and λ_2 in terms of the motion of the lines along the Ox, Oy, and Oz axes as follows.

$$m\cdot\ddot{z}=m\cdot g+m\cdot\varepsilon\cdot k\cdot\ddot{x}\cdot\sin kz-m\cdot\varepsilon\cdot k\cdot\ddot{y}\cdot\cos kz \qquad (7)$$

In the differential equation (7), we replace the velocity and acceleration of the lines along the Ox and Oy axes with the partial derivatives with respect to time from expression (3) and substitute them into equation (7).

$$\begin{cases} \dot{x}=-\varepsilon\cdot k\cdot\dot{z}\cdot\sin kz \qquad \ddot{x}=-\varepsilon\cdot k\cdot\ddot{z}\cdot\sin kz-\varepsilon\cdot k^2\cdot z^2\cdot\cos kz \\ \dot{y}=-\varepsilon\cdot k\cdot\dot{z}\cdot\cos kz \qquad \ddot{y}=-\varepsilon\cdot k\cdot\ddot{z}\cdot\cos kz-\varepsilon\cdot k^2\cdot z^2\cdot\sin kz \end{cases} \qquad (8)$$

By substituting the determined values of x′′x" and y′′y" from equation (7) into equation (8), we derive the following equation.

$$m\cdot\ddot{z}=m\cdot g+m\cdot\varepsilon\cdot k\cdot(-\varepsilon\cdot k\cdot\ddot{z}\cdot\sin kz-\varepsilon\cdot k^2\cdot z^2\cdot\cos kz)\cdot\sin kz-m\cdot\varepsilon\cdot k\cdot(-\varepsilon\cdot k\cdot\ddot{z}\cdot\cos kz-\varepsilon\cdot k^2\cdot z^2\cdot\sin kz)\cdot\cos kz$$

We simplify this differential equation to a more straightforward form.

$$m\cdot\ddot{z}=m\cdot g-m\cdot\varepsilon^2\cdot k^2\cdot\ddot{z} \qquad (9)$$

From the differential equation (7),

$$\ddot{z}=b \qquad (10)$$

We introduce the designation as follows.

$$m\cdot b=m\cdot g-m\cdot\varepsilon^2\cdot k^2\cdot b \quad\Rightarrow\quad b=\frac{g}{1+\varepsilon^2\cdot k^2}$$

We integrate using the initial conditions for the motion of the line flow on the surface, where t=0t = 0, z=0z = 0, and z′=0z' = 0.

$$\dot{z}=b\cdot t \qquad z=b\cdot\frac{t^2}{2} \qquad (11)$$

By substituting expression (11) into equation (3), we determine the motion of the line flow along the Ox and Oy axes.

$$\begin{cases} X = \varepsilon \cdot \cos\dfrac{k \cdot b \cdot t^2}{2} \\ Y = \varepsilon \cdot \sin\dfrac{k \cdot b \cdot t^2}{2} \end{cases} \tag{12}$$

Expressions (11) and (12) represent the equations of motion of the line flow along the Ox, Oy, and Oz axes on the surface of the tape. We determine the influences acting on the lines along the axes and, through this, examine the effect on impurity detection.

$$\begin{cases} R_x = \lambda_1 \cdot \dfrac{\partial f_1}{\partial x} + \lambda_2 \cdot \dfrac{\partial f_2}{\partial x} \\ R_y = \lambda_1 \cdot \dfrac{\partial f_1}{\partial y} + \lambda_2 \cdot \dfrac{\partial f_2}{\partial y} \\ R_z = \lambda_1 \cdot \dfrac{\partial f_1}{\partial z} + \lambda_2 \cdot \dfrac{\partial f_2}{\partial z} \end{cases}$$

Based on expression (4),

$$\begin{cases} R_x = \lambda_1 \\ R_y = \lambda_2 \\ R_z = \lambda_1 \cdot \varepsilon \cdot k \cdot \sin kz - \lambda_2 \cdot \varepsilon \cdot k \cdot \cos kz \end{cases} \tag{13}$$

Based on the three equations in expression (6),

$$\lambda_1 = m \cdot \ddot{x} \ \lambda_2 = m \cdot \ddot{y} \tag{14}$$

Now, the expression (13) will take the following form.

$$\begin{cases} R_x = m \cdot \ddot{x} \\ R_y = m \cdot \ddot{y} \\ R_z = m \cdot \ddot{x} \cdot \varepsilon \cdot k \cdot \sin kz - m \cdot \ddot{y} \cdot \varepsilon \cdot k \cdot \cos kz \end{cases}$$

We take the second-order partial derivatives with respect to time from the motion equations along the x, y, and z axes in equations (11) and (12) and substitute them into the respective expressions.

$$\begin{cases} R_x = -m \cdot \varepsilon \cdot k \cdot b \cdot (\sin\dfrac{k \cdot b \cdot t^2}{2} + k \cdot b \cdot t^2 \cdot \cos\dfrac{k \cdot b \cdot t^2}{2}) \\ R_y = m \cdot \varepsilon \cdot k \cdot b \cdot (\cos\dfrac{k \cdot b \cdot t^2}{2} - k \cdot b \cdot t^2 \cdot \sin\dfrac{k \cdot b \cdot t^2}{2}) \\ R_z = -m \cdot \varepsilon^2 \cdot k^2 \cdot b \end{cases} \tag{15}$$

As a result of the motion of the line flow on the surface, influenced by air forces and obstructed by the plates, the equations of the forces along the OX, OY, and OZ axes are determined. In this case, the forces along the axes play a significant role in the separation of mixed impurities [4]. The analysis of the effects of these forces is presented in graphical form using the Maple software.

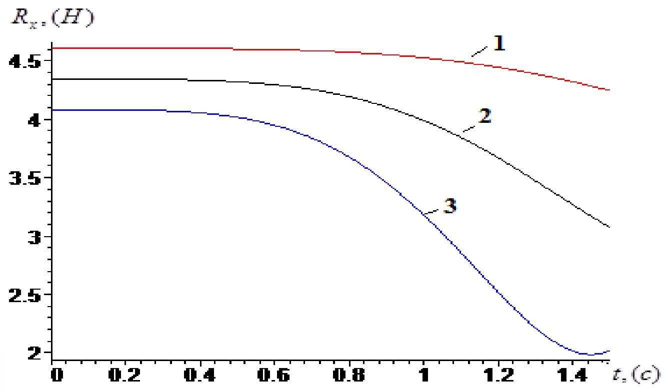

Figure 3. The graph of the change over time of the force acting on the line flow along the OX axis at different tilt angles of the obstructing plate.

From the analysis of the graphs in Figure 3, it should be emphasized that when expressing the motion of the line flow under the influence of air forces, the components of the forces along the axes play a significant role in effectively separating impurities from the lint. The effects of these forces on the trajectories of the flow are presented [8]. The values of the forces along the coordinate axes and their influence on both the line flow and the obstructing plate show that the force values do not significantly decrease as the tilt angle of the plate changes. This is illustrated in the graphs, which, in turn, leads to an increase in the impact of the line flow on the plates and an improvement in the efficiency of impurity separation [9].

References

1. Нуралиев Э.К. Повышение эффективности линтерования хлопковых семян путем совершенствования рабочей камеры линтера. Дисс.канд.техн.наук, ТИТЛП, Ташкент, 1990-138 с.
2. Сулаймонов Р.Ш., Расулов А., Бавабеков И.Т., Кодиров Х.О., Кулматов И.Т. Момиқ ажратиш машинасининг ишчи камераси ва асосий қисмларини такомиллаштириш. Илмий ҳисобот №040701, ОАЖ “Пахтасаноат ИИЧБ”, Тошкент, 2005-41 б.
3. Сулаймонов Р.Ш., Каримов У.К., Маруфханов Б.Х. Совершенствование базовых звеньев пильного линтера и его освоение в производстве, совершенствование работы линтера 5ЛП. Отчет НИР№1406, ОАЖ “Пахтасаноат ИИЧБ”, Тошкент, 2005-41 б., Ташкент, 2014, 51 с.
4. Умаров А.У. и другие. Исследование смешивания семян в рабочей камере линтера-РС. Хлопковая промышленность, №6, Ташкент, 1981.
5. Дьячков В.В. и другие. Создание модернизированного пильного линтера с элементами автоматического управления его работой. Отчет ЦНИИХпрома, Ташкент, 1990, 211 с.

6. Искандаров К.К. Повышение эффективности линтерования хлопковых семян путем совершенствования рабочих органов камеры линтера. Дисс.канд.техн.наук, ТИТЛП, Ташкент, 1998 – 125 с.
7. Сулаймонов Р.Ш. ва бошкалар. «Бектемир Чингин Линтерлаш» корхонасида ишлаётган Хитой линтер ва момик тозалаш дастгохларини маҳаллий линтер ва момиқ тозалаш дастгоҳларига қарагандаги самарадорлигини аниқлаш бўйича изанишлар. ИХ№091306, “Пахтасаноат илмий маркази” ОАЖ, Тошкент, 2010, 67 б.
8. “Reactive power compensation and start-up energy waste reduction of linter device electric motor” O.A. Azamatovich, MS Elmurod ugli [Google Scholar]
9. Tolalarni ajratish texnologik zavodida reaktiv quvvatni kompensatsiya qilish orqali energiya samaradorligiga erishish” O.A. Azamatovich, MS Elmurod ugli, MI Umid ugli- Ta’lim innovatsiyasi va integratsiyasi, 2023. [Google Scholar]
10. “Zamonaviy issiqlik elektr stansiyalarining gaz turbinali qurilmasiga kirish havosini sovutish tizimini ta’minlash” M. Shamshitdinov, I. Mashrabboyev – Sharh va tadqiqot, 2023. [Google Scholar]
11. “Zamonaviy kasb-hunar ta’limida kasbiy qiziqishlarning o‘ziga xos xususiyatlari” YO Yoqibovich, SM Elmurodugli - PEDAGOGS jurnali, 2022. [Google Scholar]
12. “Yuqori kuchlanishli o‘chirgichlarning podstansiyalarda joylashishi” S. Maqsudbek – Fan va ijod axborotnomasi, 2021. [Google Scholar]
13. “Paxta chiqindilari tarkibidan sanoat tolasini ajratuvchi qurilmani takomillashtirish” A.A.Obidov, S.D.Xamidov. Namangan 2022 [Google Scholar].
14. Omonov, T. M. (2018). Paxta tolasi va uning texnologik ishlov berish jarayonlari. T.: O'zbekiston Fanlar Akademiyasi nashriyoti.
15. Karimov, S. A. (2019). Sanoat texnologiyalarini modernizatsiyalash va iqtisodiy samaradorlikni oshirish yo'llari. "Iqtisodiyot va sanoat" jurnali, 12(3), 45-52.