

STUDY OF SEED MOVEMENT IN A TWO-CHAMBER SORTING MACHINE

A.A. Abdullaev, M.A.Salomova
Namangan State Technical University.

Annotation. *The paper presents theoretical studies on the study of the movement of seeds in the separator in the working chamber of the seed sorting device in the seed processing technology. To improve the process of reliable seed sorting and fractionation, a horizontal two-chamber seed sorting device is proposed depending on the mass and other properties of cotton seeds.*

Key words: *cotton, fiber, seeds, lint, sorter, working chamber, pipe.*

ENTRANCE

In world production, the creation of cotton varieties with high consumer properties, the preparation of high-quality seeds, the development of regulatory techniques and technologies that positively influence the production process, and the improvement of existing technologies at enterprises are of particular importance. In this regard, one of the important tasks is the implementation of scientific research in the direction of production of seeds with a radical change in quality indicators, high germination, uniform and uniform treatment with chemical preparations. High quality indicators of cotton seeds are ensured by technological systems for their sorting and high-quality treatment. In order to improve the quality of sorting, in addition to the improvement of equipment, uniform feeding of seeds to sorting units is of great importance. To achieve an increase in the quality indicators of the prepared seeds by increasing the productivity of the sorting devices introduced in the seed preparation workshops, it is important to improve the working bodies of the units and create new equipment.

One of the main requirements for the technological processes of seed sorting is the reliable sorting of seeds and increasing their efficiency in fractions. For the preparation of selected seeds while preserving the natural properties of cotton seeds, it is necessary to correctly use the technological process and fully utilize technical capabilities. In the technological process of sorting cotton seeds, it is observed that a certain amount of various impurities, immature, and empty seeds are present in the seeds. The removal of these foreign impurities from the sorted seeds undoubtedly reduces the quality indicators of seed preparation.

In this study, a new two-chamber sorting device was proposed, which has the ability to sort cotton seeds with high productivity. The method of operation of the new device is sorting under the influence of a horizontal air flow. Due to the change in the air velocity of the seed carrier in the sorting chamber, the possibility of sorting by aerodynamic parameters is created. High-quality sorting of seeds in the sorting device is important for obtaining seed varieties from them. Therefore, in production, horizontal and vertical aerodynamic sorting devices that perform resource-saving and high-quality work processes in seed processing shops are widely used. In the study, in order to improve the process of reliable sorting and

fractionation of seeds, a horizontal two-chamber seed sorting device was proposed, depending on the mass and other properties of cotton seeds.

The law of motion of seeds under the influence of a horizontal air flow is somewhat more complex than vertical motion. Because particles of granular material mixed with air (cotton seeds) are in oscillatory translational motion, and the air flow is not laminar, but in a turbulent state. This, in turn, indicates the complexity of the movement of seeds in a horizontal airflow. The purpose of the developed two-chamber separator is to create the possibility of separating seeds into fractions, i.e., seeds and technical seeds, due to the volumetric expansion of the working chamber.

Let us consider cotton seeds as a spherical body with a mass m . Although the movement of seed air in the working chamber is turbulent, we do not take into account its rotational movement relative to its center of gravity. We assume that seeds move mainly under the influence of air currents and gravity.

Seeds enter the working chamber through the 0-0 section. The air velocity, is deflected by an angle when passing through the guide and relative to the XOY coordinate system

$$v_{ox} = v_o \cos \varphi, v_{oy} = v_o \sin \varphi$$

is decomposed into components.

The XOY Cartesian coordinate system is arranged as shown in Figure 1. The velocity of the air and seed flow passing through the 0-0 cross-section of the working chamber changes at the cross-sectional area according to the opposite law. The numerical values of the main dimensions of the sorting device are taken as follows:

$$h_0=0,25 \text{ m}, h_1= 0,5 \text{ m}, h_2= 0,6 \text{ m}, h=1,2 \text{ m}, a_0=0,4 \text{ m}, b_0=1 \text{ m},$$

$$l_1 = l_2 = 1,2, 0 \leq \varphi \leq \pi/4, g=10 \text{ m/s}^2, v_o = 16 \div 20 \text{ m/s}.$$

The values of the coefficients of aerodynamic air resistance to seed movement in the OX and OY directions are as follows: k_x 0.1 0.6, k_y .

We calculate the cross-sectional area of the working chamber. Cross-sectional area 0-0: $S_{ox}= b_o \cdot h_o, S_{oy}= b_o \cdot a_o$. Matching air velocity $v_{ox} = v_o, v_{oy} = 0$;

0-1 cross-sectional area of the intermediate working chamber.

$$S_{1x} = b_o y, S_{1y} = b_o x, v_{1x} = \frac{S_{ox}}{S_{1x}} v_o \cos \varphi, v_{1y} = \frac{S_{oy}}{S_{1y}} v_o \sin \varphi, h_o \leq y \leq (h_o + h_1),$$

$$0 \leq \varphi \leq \pi/4, 0 \leq x \leq l_1$$

1-2 cross-sectional area of the working chamber in the span.

$$S_{2x} = b_o y, S_{2y} = b_o x, v_{2x} = \frac{S_{ox}}{S_{2x}} v_o \cos \varphi, v_{2y} = \frac{S_{oy}}{S_{2y}} v_o \sin \varphi, (h_o + h_1) \leq y \leq h, ,$$

$$0 \leq \varphi \leq \pi/4, l_1 \leq x \leq (l_1 + l_2)$$

In the working chamber, the system of external forces driving the seeds is:

$G=mg$ - gravity:

$$\begin{cases} P_x = k_x(v_{ox} - \dot{x}(t))^2 \\ P_y = k_y(v_{oy} - \dot{y}(t))^2 \end{cases} \quad (2.3)$$

(2.3) at: v_{ox}, v_{oy} - air flow velocities

$\dot{x}(t), \dot{y}(t)$ OX, OY- absolute velocities of seeds in directions.

In this work, we assume that cotton seeds differ from each other in mass and degree of pubescence and do not have a correlation. According to the second law of dynamics,

according to D'Alembert's principle, differential equations of the movement of seeds through the chambers after entering the working chamber are compiled. Let's create a system of differential equations describing the laws of seed movement:

$$\begin{cases} \ddot{x}(t) = k_x(v_{1x} - \dot{x}(t))^2 \\ \ddot{y}(t) = k_y(v_{1y} - \dot{y}(t))^2 \end{cases} \quad (2.4)$$

Initial conditions

$$\begin{cases} x(t)=0, \dot{x}(t) = 0 \\ y(t)=0, \dot{y}(t) = 0 \end{cases} \quad (2.5)$$

$$k_x = 0.2; 0.35; 0.45; 0.50; 0.55; 0.6 ; k_y=0.2; 0 \leq \varphi \leq \pi/4;$$

The system of differential equations describing the laws of seed movement in the interval 1-2 is as follows:

$$\begin{cases} \ddot{x}(t) = k_x(v_{2x} - \dot{x}(t))^2 \\ \ddot{y}(t) = k_y(v_{2y} - \dot{y}(t))^2 \end{cases} \quad (2.6)$$

Initial conditions

$$\begin{cases} x(t_0) = l_1, \dot{x}(t_0) = v_x(t_0), \\ y(t_0) = (h_0 + h_1), \dot{y}(t_0) = v_y(t_0) \end{cases} \quad (2.7)$$

$$k_x = 0.55; 0.6 ; 0.75; k_y=0.2; 0.3; 0.4; 0 \leq \varphi \leq \pi/4;$$

Since the equation of the differential systems developed in this study is nonlinear, it was solved numerically based on a special program. Corresponding graphs of the regularities of changes in the relative and absolute velocities of seeds in the horizontal and vertical directions depending on time were obtained (Figures 1.2-3.4).

Figure 1 shows the regularity of movement of seeds by fractions in the part of the sorting chamber intended for seeds. The graphs in this figure reflect the coefficient of aerodynamic resistance of seeds in the horizontal direction in the sorting chamber.

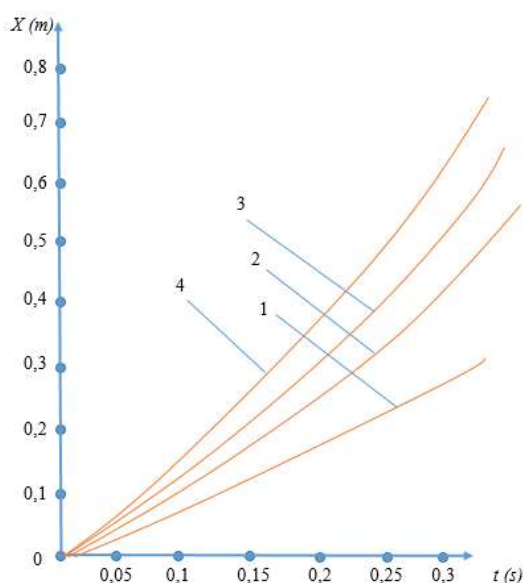


Figure 1. Law of change over time of the horizontal movement of cotton seeds

curve 1 at $k_x=0.25$ and $k_y=0.2$, $m_1=0.8$, curve 2 at $k_x=0.35$ and $k_y=0.2$, $m_2=0.26$, curve 3 at $k_x=0.45$ and $k_y=0.2$, $m_3=0.20$, curve 4 at $k_x=0.50$ and $k_y=0.2$, $m_4=0.18$.

Fig. 3 shows the regularity of the dependence of the displacement of seeds in the vertical direction on the values of $k_x=0.2, 0.35, 0.45, 0.50$ and $k_y=0.2$ Y (m) and time t (s). 3-rasm. Paxta chigitlarining vertikal yunalishdagi harakatini vaqt bo'yicha o'zgarish qonuniyati

4-rasmda paxta chigitlarini birinchi kamera bo'yicha uchib tushishi $y(x)$ ni $k_x=0.4, 0.65, 1.0, 1.2$ va $k_y=0.2$ (1-4 egri chiziqlar) larga bog'liqlik qonuniyati keltirilgan.

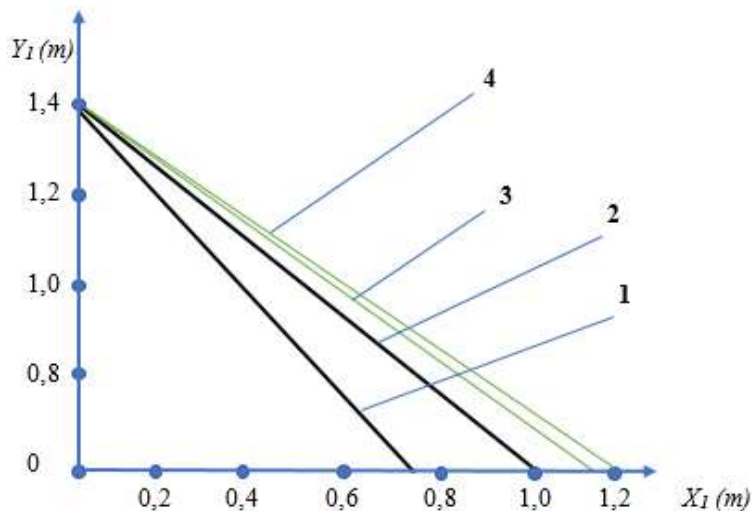


Figure 4. Law of seed fall through the first chamber

An increase in the resistance coefficient k_x , which determines the degree of delinted cotton seeds, leads to an increase in the flight distance along the length of the sorting chamber. That is, seeds with resistance coefficients $k_x=0.4, 0.65, 0.85$ are distributed in the first chamber and fall at distances $x(0.66)=0.46$ m; $x(0.85)=0.6$ m; $x(0.85)=0.65$ m. Seeds with a resistance coefficient of $k_x 0.8$ mainly fly towards the second chamber. That is, $x(k_x 0.8)=1.2$ m.

The patterns of seed movement through the chamber with a value of 0.8 are shown in Figure 5, from Figure 3 we can see that the time of seed fall through the first chamber is 0.3 seconds. From 0.3 seconds, we observe the movement of seeds with a resistance coefficient $k_x = 0.8$ along the second chamber towards the base of the chamber. Seeds mainly fall into the final parts of the second chamber. That is, light seeds with a high degree of pubescence fall into the second chamber, and seeds with a high pubescence mass fall into the first chamber. Graphs show the velocities of the airflow entering the sorting chamber:

$$v_0 = 16 - 26 \text{ m/s}$$

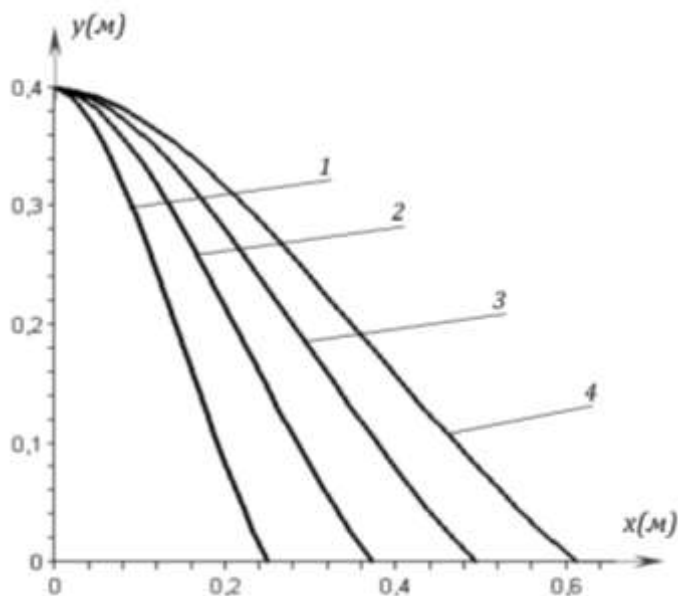


Figure 5. Law of falling seeds through chambers at different speeds

(curves 1-4) the distribution of seeds by chambers 1 and 2 and the patterns of their descent are presented. From the graphs, it can be seen that at a speed of 16-18 m/s, seeds fly into the first chamber, and at a speed of 18 m/s, they fall to the bottom of the second sorting chamber. Foydalanilgan adabiyotlar.

REFERENCES:

1. Ахмедходжаев Х.Т., Турсунов А. «Пневматический сортировщик хлопковых семян» Хлопководство и зерноводство. Республиканский научно технический журнал, 2000, №2. стр.30-32.
2. Obidov A.A., Abudllaev A.A. Urug'lik chigitlarni saralash qurilmasi. Foydali modelgan patent, FAP 2022 0328.
3. Paxtani dastlabki ishlash bo'yicha qo'llanma. "Paxtasanoat ilmiy markazi" AJ, T-2019 y. -114 b.
4. Obidov A., Abudullayev A. Theoretical justification of the efficient operation of the seed sorting device. Engineering, Scientific Research Publishing. 2023, 15, 720-728
5. Obidov A., Abdullaev A. Chigitlarni saralash qurilmasining samarali ishlashini nazariy asoslash. Namangan to'qimachilik sanoati instituti "To'qimachilik va moda sanoatida ilm-fan va innovatsiyalar" ilmiy texnika jurnali, № 1.
6. Dilfuza N., Sardorbek M., Mo'minjon E. PAXTA-XOMMOTNING BILAN O'ZBAR TA'SIRINI O'RGANISH.
Dilfuza, N., Sardorbek, M., & Mo'minjon, E. PAXTA-XOM-MODY BILAN O'RGANISH.

7. Мелибаев, М., Нишонов, Ф. А., & Содиков, М. А. У. (2021). Показатели надежности пропашных тракторных шин. *Universum: технические науки*, (2-1 (83)), 91-94.
8. Нишонов, Ф. А. (2022). Кидиров Атхамжон Рустамович, Салохиддинов Нурмухаммад Сатимбоевич, & Хожиев Бахромхон Рахматуллаевич (2022). ПРОБЛЕМЫ И РЕШЕНИЯ СБОРА УРОЖАЯ АРАХИСА. *Вестник Науки и Творчества*, (1 (73)), 22-27.
9. Tohirjonovich, M. M., Akhmatkhanovich, N. F., & Rakhmatullaevich, X. V. (2022). Combination machine for harvesting nuts. In *Conference Zone* (pp. 19-21).
10. Рустамов, Р., Халимов, Ш., Отаханов, Б. С., Нишонов, Ф., & Хожиев, Б. (2020). Ерөнгоқ хосилини ййғиштириш машинасини такомиллаштириш—Илмий ишлар тўплами|| Халқаро илмий ва илмий-техник анжумани.
11. Мелибаев, М., Нишонов, Ф., & Кидиров, А. (2017). Требования к эксплуатационным качествам шин. *SCIENCE TIME. Общество Науки и творчества. Международный научный журнал. Казань Выпуск*, (1), 287-291.
12. Негматуллаев, С. Э., Рахманова, В. К., & Нишонов, Ф. А. (2024). ОСОБЕННОСТИ МЕТРОЛОГИЧЕСКОГО ОБЕСПЕЧЕНИЯ ТЕХНОЛОГИЧЕСКИХ ПРОЦЕССОВ В МАШИНОСТРОЕНИИ. *Научный Импульс*, 3(28), 464-476.
13. Мелибаев, М., Нишонов, Ф., & Норбоева, Д. (2017). Етакловчи ғилдирак шинасининг тупроқ билан тўқнашувини шина ички босими ва тортиш кучига боғлиқликда аниқлаш. *Фарғона политехника институти илмий-техника журналы,— Фарғона*, 21(4), 39-43.
14. Нишонов, Ф. А., & Рустамович, Қ. А. (2022). ТИШЛИ ҒИЛДИРАКЛАРНИНГ ЕЙИЛИШИГА МОЙНИНГ ТАЪСИРИНИ ЎРГАНИШ ВА ТАҲЛИЛИ. ТАЪЛИМ ВА РИВОЖЛАНИШ ТАҲЛИЛИ ОНЛАЙН ИЛМИЙ ЖУРНАЛИ, 113-117.
15. Мелибаев, М., Нишонов, Ф., & Норбоева, Д. (2017). Плавность хода трактора. *Наманган муҳандислик технология институти. НМТИ. Наманган*.
16. Melibaev, M., Negmatullaev, S., Farkhodkhon, N., & Behzod, A. (2022, June). Technology of Repair of Parts of Agricultural Machines, Equipment with Composite Materials. In *Proceedings of the Conference Zone, Berlin, Germany* (pp. 204-209).
17. Мелибаев, М., Нишонов, Ф., Мирзаумидов, А., & Норбоева, Д. (2017). Влияние вертикальной нагрузки на удельное давление пневматического шины./“Замонавий ишлаб чиқариш шароитида техника ва технологияларни такомиллаштириш ва уларнинг иқтисодий самарадорлигини ошириш” анжуман маъруза материаллари тўплами. 24-25 май.
18. Нишонов, Ф. А., Кидиров, А. Р., Салохиддинов, Н. С., & Хожиев, Б. Р. (2022). ПРОБЛЕМЫ И РЕШЕНИЯ СБОРА УРОЖАЯ АРАХИСА. *Вестник науки и творчества*, (1 (73)), 22-27.
19. Melibaev, M., Negmatullaev, S., Farkhodkhon, N., & Behzod, A. (2022, June). Technology of Repair of Parts of Agricultural Machines, Equipment with Composite Materials. In *Proceedings of the Conference Zone, Berlin, Germany* (pp. 204-209).

