Analysis of research results dedicated to the process of purification and sorting of cotton seeds

Sohibjon Tojimirzayevich Rejabboev
Namangan State Technical University

Abstract: This article analyzes the process of sorting and cleaning cotton seeds, as well as the research work carried out by researchers to eliminate the observed shortcomings. As a result of the analysis, the importance of cotton seed sorting, the achievements obtained as a result of the research work carried out by researchers, are presented.

Keywords: cotton, fiber, seeds, lint, sorter, gin machine, linter, fine mixture

Introduction

The main raw material for global textile production is cotton fiber. According to the International Cotton Advisory Committee (ICAC), 23.07 million tons of cotton fiber have been produced worldwide in recent years, and its consumption is 24.55 million tons. Cotton fiber consumption and demand for it are expected to continue to grow in the future due to the intensive population growth. The increase in demand for cotton fiber, in turn, requires continuous improvement of its quality and production efficiency. In this regard, much attention is paid to increasing the competitiveness of cotton fiber in the global market, new technologies and their modernization to produce modern, technologically reliable, and high-quality products. In the world, special attention is paid to the use of highly efficient technological machines in the field of primary cotton processing and the development of their resource-saving technologies [1].

In particular, preserving the initial quality indicators of fiber and seeds and reducing energy consumption of technological processes, creating compact, simple, material- and energy-saving equipment designs, modern, automated technologies capable of managing product quality, as well as improving product quality and reducing its cost by accelerating the introduction of the created advanced equipment and technologies into the production process are the main factors in the development of this industry.

The technological properties of seeds are mainly determined by their physical-mechanical and biological properties, i.e., the degree of maturity, and influence the technological process in varying amounts. Based on this, they can be conditionally divided into physical-mechanical and mechanical-technological parts. At the same

time, the physical and mechanical properties of seeds and seed mass in many cases differ from each other.

The physical and mechanical properties of seeds include their shape and geometric dimensions, seed mass density, and gravity [1]. Externally, straight and normal-shaped seeds have a pear-shaped shape, with a large and rounded tip that decreases towards the tip and consists of a pointed tip. The widest part is about a quarter of the length of the blunt side of the seed, in many studies the shape of the seed is taken as spherical[5]. The conducted averaging results in the loss of specific characteristics of the seeds, especially in the difficulty of understanding the clear separation of seeds after ginning. When observing the separated fractions in the regenerator, the fiber length of many fibrous seeds going for linting is 25-33 mm. Calling them flakes is incorrect, but calling them seeds is also not true [7].

In the research conducted by Kh.T.Akhmedkhodzhaev [2], a device was proposed for sorting seeds by passing them through the openings of the inclined grate of the vibrating sorter. First and foremost, the shape and size of the seeds are of great importance in this process. A special device and methodology have been created to determine the size of seeds with varying hairiness. Measurements were carried out by repeating 200 medium and fine-fiber cotton seeds (Table 1).

Table 1.

Seed sizes of common cotton varieties

Selection variety	Seed size after ginning			
	Length (D_1), mm	Diameter (D), mm	Mass of 1000 seeds, g	Hairiness, %
P-6524	8.0-12.25	5.5-8.75	138.2	14.2
Namangan-77	7.25-12.3	5.6-9.0	125.8	14.9
Andijan-35	8.1-12.2	5.8-9.8	128.3	13.8

In the studies conducted in the dissertation work, based on the size and shape of the seeds, studies were conducted on the position of the centers of gravity for both seeds with fiber at the end or tip and for seeds without fiber. For calculations, two figures were proposed - two semicircles with a side and a rectangle with a central part. Using the laws of mechanics, the centers of seed weight were determined based on their components.

The degree of seed damage also significantly affects the seed sorting process. Studies of seed damage during ginning and linting revealed the following. For example, if for the C-6524 1st grade 50 g. cotton seeds, damage in the troika is 2-3%, in the middle 9-22%, and at the end 3-6%, then for the C-6530 2nd grade cotton seeds, this value is 1-3% in the troika, 8-19% in the middle, and 2-5% at the end. This "distribution" by shell damage can also be characterized by the natural physical properties of cotton seeds.

Based on the above, it can be noted that in modern conditions, it is necessary to produce devices that operate with high reliability, reducing the negative impact of devices operating during the seed cleaning process on seed quality [5-6].

Cotton seeds are divided into technical seeds intended for processing at oil and fat processing plants and seeds used for sowing. Technical seeds are divided into various production grades. Cotton seeds are divided into technical and seed, processed at oil extraction enterprises. Cotton seeds are used in agriculture, mainly for sowing, and for this purpose, they are processed and prepared for sowing based on a special technology. Technical seeds are mainly used in the oil and fat industry to obtain cottonseed oil and are divided into four industrial grades based on their production from cotton [4].

In fully ripened cotton, the share of seeds is about 55.0-63.9% of the total cotton weight.

The degree of contamination, moisture content, and pubescence of cotton seeds submitted to oil extraction enterprises must meet the standard requirements (2 and 3 tables).

Table 2.

Composition and main indicators of cotton seeds

Cotton variety	Share of unsuitable seeds by weight, %	Seed class	Humidity mass fraction %, not more than	Mass fraction of pubescence, %	
				Medium-staple cotton varieties	Long-fiber cotton varieties
And	1,5	1. 2. 3.	8.0 10.0 10.0	Maximum 7.0 Maximum 9.0 Maximum 10.5	2.0 - 6.5 - -
II.	3.0.	1. 2. 3.	9.0 11.0 11.0	Maximum 8.0 Maximum 9.0 Maximum 10.5	3.0 - 7.5 - -
III.	11.0	-	12.0	7.0-11.0	4.0 - 8.5
IV.	33.0	-	13.0	8.0-13.0	4.5 - 9.0

When processing cotton seeds, the degree of their complete separation from fiber and residual fuzziness are determined and analyzed. Using cotton seeds for both oil production and planting material requires minimal pubescence: the less pubescence of the seeds, the higher the degree of oil extraction and the better seed germination [8].

Table 3.

Color of the seed kernel in the cotton variety section

Cotton seeds grade	Kernel color in seed section
And	White-yellow with a light green or other shade depending on the selection variety of cotton
II.	Depending on the selection variety of cotton, it is white-yellow with a mixture of slightly different colors.
III.	From gray, white-yellow to light yellow with various light shades
IV.	Yellow to light brown

In addition, the fiber content of seeds is of great importance in the rational use of fibrous raw materials in industry. The less fuzzed the processed seeds are, the more lint and delint are obtained from the fiber coating of the seeds.

The design of the device designed for experiments is shown in Figure 1 and consists of the following working parts: feeding hopper 1, eccentric 2, belt drive 3, electric motor 4, bearings 5, trays for receiving seed fractions 6, mesh drum 7, separating drum 8, and screw for foreign impurities 9.

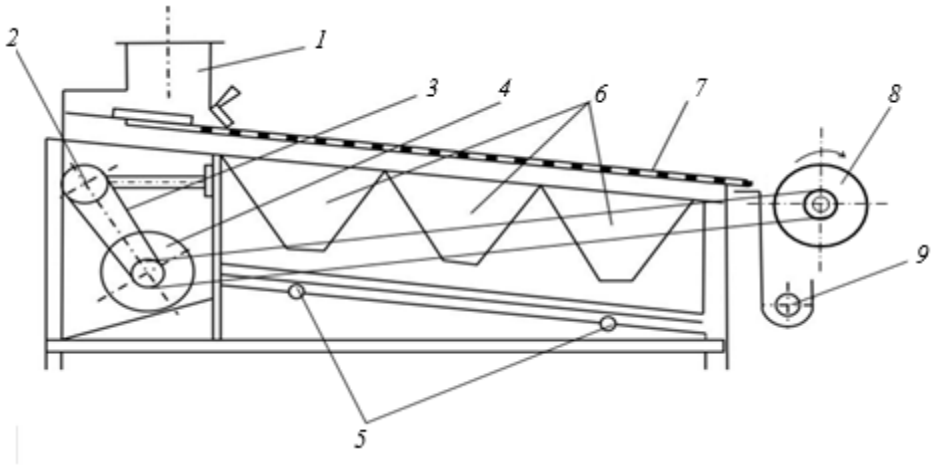

Figure 1. Diagram of the experimental design of a device for sorting ginned seeds
1-feed hopper; 2 - eccentric; 3 - belt drive;
4 - electric motor; 5 - bearings; 6 - trays for receiving seed fractions; 7-grid surface;
8-separating drum; 9-screw of foreign impurities

Eccentric 2 is fixed on the surface 7 of the ginned seed sorting by fractions. Fraction Sorting Machine The wire forming the mesh drum parts has a diameter of 4 mm. The seed delivery hopper 1 is made of steel, with a thickness of 1, a width of 1000, a height of 500, and a width of 50 mm.

Grooves 6 for separating seed fractions (small impurities, clean ginned seeds, seeds subject to linting) are made of three thicknesses of 1 mm for each. Length 1500 mm, width 150 mm, and they are installed in a free position on the device frame. Each tray is tilted to the opposite side so that the seeds can fall. To ensure the movement of the ginned seeds, the sorting surface carriage is located on bearings 5 in special nests.

The electric motor 4, which sets the device in motion, transmits the oscillatory motion to the carriage through the belt drive 3 and the eccentric 2, and the separating drum 8 transmits the motion to the drum through the belt.

The main work in the device for sorting ginned seeds is performed by the mesh drum 7, which is made with mesh holes. The parts of the sorting surface intended for fractions are made in the form of surface gaps (sections), the surface gaps are increased to the last section according to the size of the seeds in the fibrous mass. Surface spaces are separated by plates. During operation of this seed sorting device, the seed mass in the required layer is fed through the plate regulator of the feed hopper from the outlet

to the sorting surface carriage. The resulting seed mass with a sorting mesh on the fraction begins to move along the surface based on the angle of inclination and the oscillatory motion. In the initial section, small impurities in the seed mass pass through the corresponding openings and enter the tray designated for them. As a result of the oscillatory motion supplied to the carriage, the seed mass is loosened, and the cleaning process from impurities is carried out more efficiently. Seeds separated from impurities are transferred to the next section, where, since the gaps are specially prepared for clean ginned seeds, well-distilled seeds from the mass pass through the gaps and enter the groove intended for them. This is because the gap size in this section is 10% larger than in the previous section.

In the last section, there are wire gaps intended for seeds containing up to 12%, where lintering seeds are separated. After the seed mass passes through all sections, it enters the separating drum 8, where high-temperature seeds and free fibers are captured. This drum (Fig. 2) is designed to obtain long fiber pieces and feed them to the next process - the gin machine. From all studies, it is known that when sorting seeds mechanically, an error of 10-15% is observed (in other types of sorters, it is even greater). Therefore, in the new sorting device, the function of the separating drum is to separate the mass from foreign impurities that have reached the sorting surface. A screw (9) for foreign impurities is installed at the bottom of the drum, which feeds the incoming impurities to the start of the process with an error of 10-15%.

Conclusion

Literature analysis has shown that the work carried out at cotton ginning enterprises to extract fibrous seeds from the gin is insufficient. To date, it has been established that the technological process does not yield the expected results due to the fact that it is carried out using the saw drums of the regenerator, which retain seeds with fiber, installed in the technological process. Based on the identified urgent problem, it is necessary to determine the optimal dimensions of the mesh surface of the screw regenerator for separating fibrous seeds. Considering that no in-depth theoretical research has been conducted on the isolation of fibrous seeds, it is necessary to conduct theoretical research in the theoretical work.

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