Sorting of Sowing Seeds With Increased Fractionation Accuracy

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ANNOTATION

The paper considers the problem of sorting sowing seeds of agricultural crops. A theoretical and constructive device has been developed that allows increasing the accuracy of separating seeds into fractions. Seed density was taken as the sorting criterion. The work of the sorter is considered on the example of sorting cotton seeds. A design has been developed that allows increasing the criterion for sorting seeds by weight of individual seeds and accuracy up to 27 times.

KEYWORDS: Sowing seeds, seed fractions, seed density, seed weight, centrifugal force, sorter, conical working chamber.

Problem. It is an extremely important strategic task to fundamentally re-equip processing industries with equipment, provide them with modern equipment and technology, and establish technology chains.

An important direction of the food program is to improve the quality of sowing seeds of agricultural crops. The best results are achieved when sorting by seed density. It depends on the design of the machines for this process.

The densities of individual seeds in absolute values differ slightly from each other, which makes it difficult to accurately sort them into sowing and technical fractions.

Seeds can be sorted in different ways. Aerodynamic sorting is widespread because it is relatively easy and traditional. But sorting efficiency and accuracy are low. Feeble, light seeds pass into the composition of sowing seeds. This leads to a decrease in the planting stock. And the seed fund is prepared on the basis of great effort and expense.

Sorting is carried out by the electric method, but the efficiency of this method and the sorting parameters change dramatically with changes in air humidity and seed moisture.

Consider specifically the sorting conditions using the example of cotton seeds. These conditions can be easily adjusted to any other seeds.

To determine the efficiency of sorting cotton seeds, they are calculated by their germination, mechanical damage and weight of 1000 seeds. The weight of 1000 seeds indirectly characterizes the seed density parameter [1]. Currently, there are no methods that allow you to easily and quickly directly determine the density of seeds.

Seeds are classified by windage, that is, by the ability to fly [2]. Getting a good result in this method is made difficult by the following. The seed can stay in the air stream differently. But since the shape of the seed is "wrong", it is ovoid, so it can remain in the air along or across.

Rationale. The proposed method is aimed at creating a seed sorting machine by specific gravity. The specific gravity directly indicates the density of the seeds. The density of seeds determines their completeness, the main ingredients for growing seeds are carbohydrates, proteins, fats, trace elements. With good agricultural technology from full-fledged seeds, you can achieve rapid maturation and high yields.

Seed density grading has its own set of challenges. The weight of each individual seed is very small - 0.08÷0.11 g. It is necessary to increase the sorting and separation capabilities and the parametric difference between empty and full seeds. When the seed rotates in space, the centripetal force can exceed the weight of the seed by several times, and the difference in the sorting parameter will also increase. As the border of the sort field increases, so does the accuracy of the sort.

Centrifugal force acting on the seed in a rotary sorting chamber-

$$F_ц = m\,\omega^2 R,$$

here,

F_c - centrifugal force, N;

m - mass of seeds, we accept, **$m=0.1 \bullet 10^{-3}$ kg;**

R-the radius of rotation, m;

ω- the angular velocity of rotation, 1/sec.

Let's take the rotation speed "**n**" equal to **n**= 300 rpm .

Then, **$\omega = (\pi n)/30 = 31.4$ 1/sec.**

The radius of rotation in the sorting chamber is variable, on average R= 0.180 m, then the speed-

$$v = \omega R = 31.4 * 0.18 = 5.65 \text{ m/sec.}$$

$F_c = m\,\omega^2 R = 0.1 * 10^{-3} * 31.4^2 * 0.18 = 0.0177$N , or $F_c = 1.77$ g.

The ratio of the centrifugal force acting on the seed to the gravity force G of the seed is defined as the sorting factor k. Then, in our case, if the weight of the seed is **G = 0.1 g,** the sorting factor is -

$k = F_c/G = 1.77 / 0.1 = 17$

This means that the accuracy of sorting seeds can be increased by 17 times, other factors being equal sortin. Cone radius at the highest point of the sorting chamber **R = 0.280 m**. Here, **n= 300 rpm, ω = 31.4 1/sec**.

F_c= m ω2 R=0.1•10-3• 31.42 •0.28= 0.0276 N , or F_c=2.76g.

Sorting factor in this -

k = Fts/G =2.76 / 0.1 =27.6

Sorting accuracy is 27.6 times higher. The structure of the sorting device based on centrifugal forces follows from the above considerations. The seeds should be rotated to a certain degree in the sorting chamber. After the seeds begin to rotate, the amount of centrifugal force acting on the seeds begins to vary.

If the mass of a light seed is 0.06 g, then the centrifugal force acting on it is

$F_{c.\,l.}$ = 0.06 • 10-3 • 31.42 • 0.28 = 0.016 H, or $F_{c\,l.}$ = 1.6g

If the mass of the complete seed is 0.1 g, the centrifugal force acting on it is

$F_{c.c.}$ = 0.1•10-3•31.42•0.28 = 0.028 N, or $F_{c\,c.}$ = 2.8 g.

Hence the centrifugal force difference

ΔF = $F_{c.c}$ - $F_{c.\,l.}$ = 2.8 – 1.6 = 1.2 g.

For comparison, the difference in the strength of the weight of the light and sowing fractions of seeds

ΔG = $G_{c.}$ – $G_{l.}$ = 0.1-0.06 = 0.04 g.

The difference in the effect on seeds of light and seed fractions exceeds 30 times (1.2/0.04). Centrifugal forces sort the seeds layer by layer. At the edge of the chamber, seeds of the heavy seed fraction are collected, in the middle of the chamber, light seeds are collected.

But the case of this separation is special. In order for the seeds to change their relative positions in the sorting chamber, they are required to be in a pseudo-liquefied state. In the pseudo-liquefied state, the seed partially takes on the properties of liquid, including the properties of fluidity. When sorting everything, the heavy fraction is collected at the bottom and the light fraction is collected at the top. To create a pseudo-liquefied state, 16 mm high shelves were made on the walls of the cone chamber. These racks rotate with a conical drum, mixing the seeds and spreading microwaves. Fixed racks are installed in the central seed inlet pipe. They also mix the seed inside the chamber. As a result of both waves, the seed comes to a pseudo-liquefied state, and inside the chamber, heavy and light fractions are easily separated from each other.

This sorting method and theory allows for the development of constructions of efficient machines for sorting various seed materials.

Construction of the sorter. In order to increase the efficiency of cotton farming, scientific research was conducted and a machine design was developed to sort the bare seeds by density for the preparation of high-quality seed that meets the set requirements. A centrifugal seed sorter is shown in Figures 1, 2.

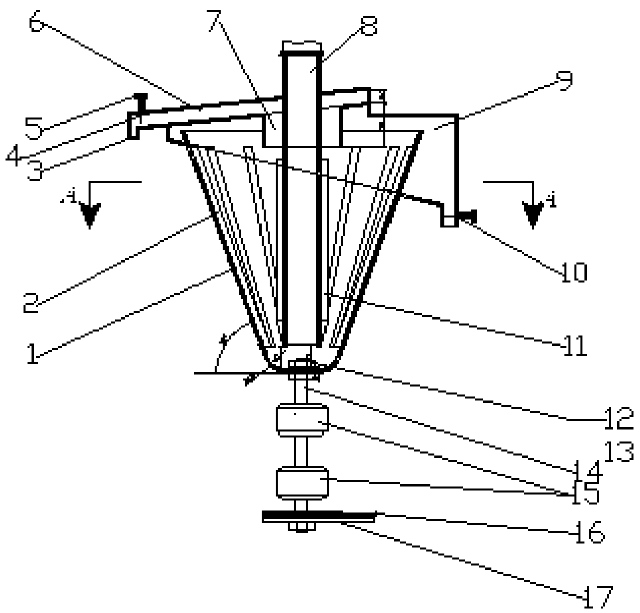

Fig. 1. Sorting device. 1- sorting cone, 2- partition (12 pcs.), 3- tray for the exit of technical seeds, 4- shutter, 5- lever, 6- tray for technical seeds, 7- pipe for the exit of technical seeds, 8- pipe for supplying seeds to chamber, 9 - seed fraction outlet unit, 10 - adjusting device, 11 - fixed rail (12 pcs.), 12 - nut (M 30), 13 - washer, 14 - shaft, 15 - bearing housing, 16 - belt, 17- pulley.

The sorting chamber is made in the form of a conical, hollow chamber 1. 12 shelves 2 are installed on the inner wall of the camera. A supply pipe 8 is installed in the middle of the chamber for the seed to enter the chamber. Above the camera is a tray that collects technical seeds. An additional pipe 7 is installed for light seeding.

Tray 9 is installed to isolate the seed fraction. Normalizing devices 10 are installed in the seed ejection zones. To rotate the conical cam, a drive 16.17 is installed. The housing 15 is mounted on the support bearings of the shaft of the conical drum 14.

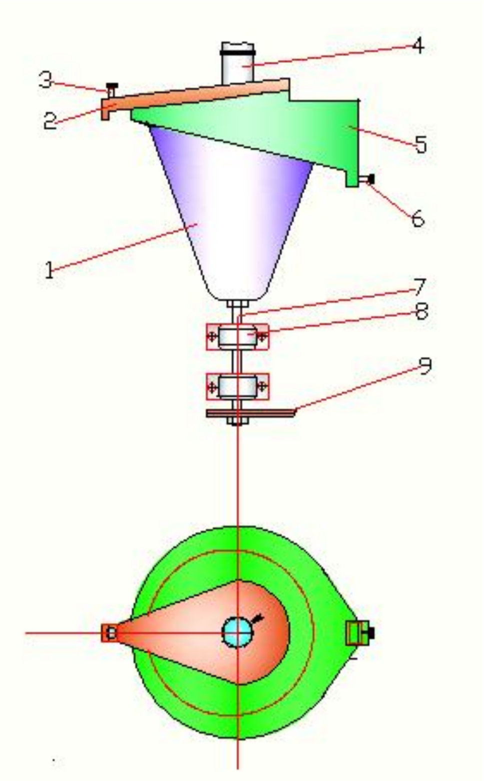

Fig.2. General View of the sorting device. 1- conical body of the sorting device, 2- tray for the output of technical seeds of low density, 3- lever for regulating the output of technical seeds, 4- pipe for introducing seeds into the device, 5- tray for outputting the sowing fraction of seeds from the device, 6- lever for regulating the output of seeds, 7 - shaft, 8 - bearing, 9 - pulley driving the shaft.

How the sorter works. The sorter works as follows. The seed enters the sorter through pipe 8 and goes down to the lower part of the chamber. Camera 1 will rotate. There, the seeds are thrown to the periphery of the drum under the influence of racks 2. The drum must be filled with seed, after it is filled, the sorting process begins. Light seeds are collected in the middle of the machine due to low centrifugal force. Heavy seeds are collected at the edge of the chamber due to the high centrifugal **force.**

For the machine to work well, the seeds must be in constant motion. Mutual movement is created by movable and fixed shelves.

Shelf sizes matter a lot. Shelves should not trap seeds in the grooves between them. Otherwise, the seeds will not mix. The height of the shelves is assumed to be 16 mm. At this size, the seed layers will be mixed relative to each other. When the seeds meet the racks, microwaves are generated that propagate inside the machine. The conical design of the drum allows it to rotate at high speeds without damaging the seeds.

Light seeds are collected around the inlet pipe in the middle of the conical drum and are in an upward motion. Tube 7 serves to separate seed fractions from each other. The light fraction of seeds enters the pipe and rises through pipe 7 to the system for extracting technical seeds. The tray is set at an angle and sends the seeds to the crane in the exit area. The output of seeds is regulated by the slot of the normalizer 4.

The seed fraction fills the conical drum, enters the receiving tray 9 and is removed from the machine through the device 10, which regulates the output of the seed fraction.

Currently, the requirements for the sorting process have increased, and according to industry guidelines, the yield of light technical fraction should not exceed 15 percent. The machine mode depends on the quality of the seed. If there is poor quality seed, the technical fraction should be increased. There is little technical fraction in high-quality seeds and the seed fund is preserved.

References:

1. Zikriyaev E.Z. and others. "Cotton primary processing", Tashkent, "Mekhnat", 2002.
2. Spravochnik on initial processing of cotton.Tashkent, "Voris - publishing house", 2008.
3. G. Jabborov and others. "Technology of processing of seeded cotton", Tashkent, "Ukitchich", 1987.
4. Mardonov, B; Usmanov, Kh. S.; and Sirojiddinov, F. N. (2019) "THE CLEANING SEED COTTON OF SMALL WEED IMPURITIES AND THEORETICAL RESEARCH TO IMPROVE ITS EFFICIENCY," *Scientific-technical journal*: Vol. 23 :
5. Ботирали Рахмонкулович Беккулов, К. А. (2022). ОПРЕДЕЛЕНИЕ КОЛИЧЕСТВА ШАЛЫ В СУШИЛЬНОМ БАРАБАНЕ. *Бюллетень науки и практики*, 377-381.
6. Рузиев, А. А. (12-3(93)). ЦЕНТРОБЕЖНОЕ СОРТИРОВАНИЕ СЕМЯН СЕЛЬСКОХОЗЯЙСТВЕННЫХ КУЛЬТУР ПО ПЛОТНОСТИ. *Universum: технические науки*, 82-86.