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Theoretical Justification of Some Parameters of the Metering Device

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ABSTRACT: The article provides information about the device, principle of operation, design and operating parameters of the mobile draining device, as well as technological parameters of the process of draining pubescent cotton seeds to increase their flowability by various components.

KEYWORDS: draping, mobile draping device, Poppet drum, protective and nutritional component, flowability.

I. INTRODUCTION

It is known that the seeds of some agricultural crops, such as, for example, pubescent cotton seeds, because of the residual pubescence, have a very poor bulk. This does not allow them to be sown in an accurate way or with a small rate. In this regard, when they are sown, the rate of consumption per hectare is 1.5-2.0 times higher than the scientifically justified seeding rate. As a result, tens of thousands of tons of pubescent cotton seeds are thrown into the soil in vain, from which it would be possible to obtain consumer goods and animal feed. In addition, hundreds of tons of chemical preparations are released into the soil along with seeds, which were used to treat seeds against various diseases and soil pathogens that disrupt the ecological balance of the earth and the environment as a whole. To eliminate these disadvantages, it is necessary to increase the flowability of pubescent cotton seeds.

Analysis of literature sources and previously conducted research works on increasing the flowability of agricultural seeds has shown that one of the progressive ways to increase the flowability of pubescent cotton seeds is the way they are drained with various protective and nutritional components [1,2]. Taking into account the latter, we have developed and prepared an experimental sample of a mobile draining device to increase the yield of pubescent cotton seeds by draining various mineral resources or agricultural waste as a result of theoretical and experimental research, design and development work, as well as laboratory and field agricultural experiments.

Practice shows that one of the progressive ways to increase the bulk of low-loose seeds of agricultural crops is the method of draining them with various protective and nutritional components, i.e. mineral resources or agricultural waste. Taking into account the latter, we have developed a mobile draining device for farms and subsidiary farms.

II.RELATED WORK

Figure 1 shows a schematic diagram and a diagram of the movement of seeds on a Poppet drum of a mobile draining device. It consists of a Poppet drum 1, an insert element 2, a flange 3, a hollow shaft 4, an axis 5, bearings with housings 6, a sprocket 7, a position controller for the insert element 8, a regulator for the angle of inclination of the Poppet drum 9, an electric motor 10, pulleys 11, a frame 12, a gearbox 13, and a discharge window 14.

The Poppet drum 1 consists of one cylindrical and two truncated conical parts, and also has a bottom and an unloading window. Due to the fact that the axis of its rotation is located at a certain angle to the horizon, i.e. φ=35-45º

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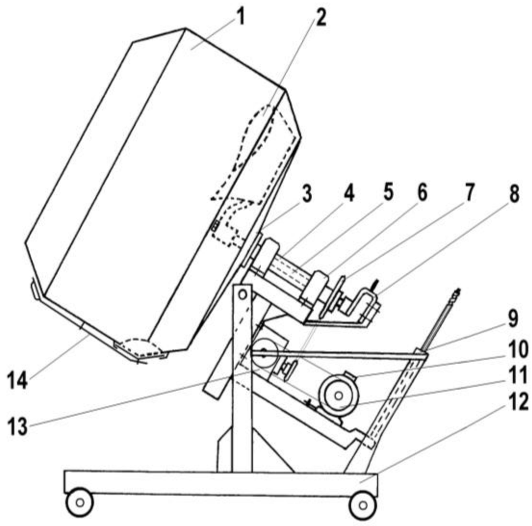
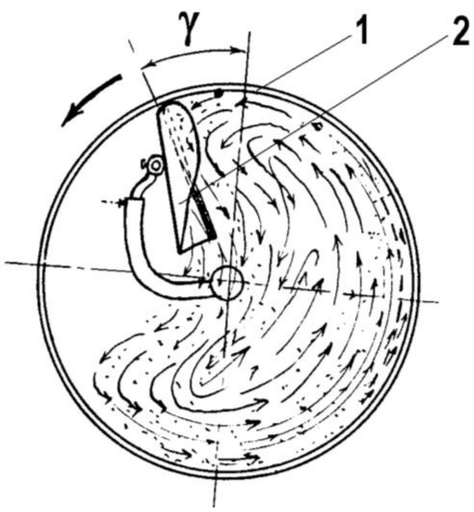
(Fig. 1,a), it includes the main elements of the working bodies of the Poppet and drum draggers.

The technological process of operation of the mobile draining device is as follows: seeds of agricultural crops of a certain quantity, i.e. 100-120 kg, are loaded into a Poppet drum 1 and with the help of an electric motor 10 and a gearbox 13, it is driven in rotational motion by means of a hollow shaft 4 through a V-belt and chain transmission. At this time, a solution of an adhesive liquid and a stimulating substance is applied to the surface of the seeds of agricultural crops that also perform a rotational movement.



a)



b)

Figure 1. Device (a) and flow diagram (b) of the mobile

Metering device operation

1−the disc-drum; 2−false item; 3−flange; 4−shaft; 5−axis; 6−bearings housings; 7−stars; 8−position controller plug-in element; 9−a regulator of the inclination angle of the disk-shaped drum; 10−electric motor; 11−a pulley; 12−frame; 13–reducer; 14–discharge window

To evenly cover the surface of the seeds with a solution of adhesive liquid and a stimulating substance, they are rolled for 8-10 minutes. The seeds of agricultural crops located in the rotating Poppet drum 1 are covered with a thin layer of adhesive liquid due to mutual movement and friction. After soaking with adhesives and stimulants, the seeds of agricultural crops are treated with chemicals against various diseases and soil pathogens. After a certain time, when the surface of seeds of agricultural crops is evenly treated with chemical preparations, they are covered with dry filling components, i.e. various mineral resources or agricultural waste, to increase flowability. When a smooth spherical shell is formed on the seed surface, i.e. when they acquire a rounded shape and become more uniform, the technological process of draining remains and the finished product from the Poppet drum 1 is loaded into bags with the help of the discharge window 14 and sent for sowing.

III. PROPOSED METHODOLOGIES

The insertion element 2, unfolding the drained flow of seeds of agricultural crops, continuously disrupts the ordered rotational movement of their longitudinal axes. As a result, the enveloping components are evenly distributed over the entire surface of the seeds, which increases their flowability and improves the quality of the resulting products.

The figure shows that the layering of components on the surface of seeds occurs when they move in a rotating inclined Poppet drum of a mobile draining device with an angle of inclination to the horizon φ=35-45°. We also take into account that in the process of layering other particles on the surface of seeds, a complex movement occurs:

- translational movement of the seed along the resulting rotating Poppet drum;

- rotational movement of seeds around their axes.

In addition, it should be noted that when the Poppet drum rotates, the seeds are dragged in the direction of its rotation, while creating a rotational movement of the seeds relative to their axes. As a result, depending on the centrifugal force, geometric dimensions and weight of the seeds, they roll down. And at the moment when the speed of movement of seeds is aligned with the circumferential speed of the Poppet drum, they are at absolute rest.

To justify some of the design and operating parameters of a mobile draining device, we consider the scheme of seed movement in a Poppet drum with an angle of inclination to the horizon.

From figure 1, a, it follows that the seeds of agricultural crops move up to a certain distance along the generatrix of the Poppet drum, and then the controlled flow of seeds unfolds with the help of an insert element, thereby violating their ordered rotational movement relative to the longitudinal axes. In the future, the seeds participate in a complex movement, which results in a fast and stable course of the technological process of draining and high quality of the resulting products.

IV. RESULT AND DISCUSSION

As noted above, in the technological process of draining, each seed performs translational and rotational movements. Let's also assume. that the components forming the film λ are layered on seeds of size x in one revolution around its own axis [1].

When the seed moves along the forming part of the Poppet drum along the path Δl, their size in diameter increases by an amount Δx equal to $2\pi n\lambda$, i.e.

$$\Delta x = 2\pi n\lambda \quad \text{или} \quad n = \Delta x / 2\pi\lambda, \tag{1}$$

where n is the frequency of rotation of seeds around its axis along the path Δl, min^{-1};

λ-thickness of the layered film on the seed surface, m.

The frequency of rotation of seeds around its axis along the path Δl is equal to

$$n = \Delta l / \pi x \tag{2}$$

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where Δl is the path taken by the seeds in translational and rotational motion, m;

x-seed size, m;

Since the film layering occurs when the seed rotates around its axis in the direction of rotation of the Poppet drum, the path traversed by it is equal to

$$\Delta l_1=\Delta l\cos\varphi, \tag{3}$$

where φ is the angle of inclination of the Poppet drum relative to the horizontal, degree.

With the latter in mind, expressions (2) can be written as

$$n=\Delta l/\pi x= \Delta l_1 / \pi x\cos\varphi. \tag{4}$$

On the other hand the linear speed of the Poppet drum is

$$V=\omega R, \tag{5}$$

where ω- is the angular velocity of the Poppet drum, rad / s;

R-is the radius of the disc-drum, m.

During time t, the rotating surface of the seed drum will travel a path equal to

$$\Delta l_1= \omega Rt. \tag{6}$$

Taking into account the expressions (1), (4) and (6) and differentiating them, we obtain the following equations

$$x\,dx=\frac{2\lambda\omega R}{\cos\varphi}dt. \tag{7}$$

Equation (7) is a mathematical model for determining the thickness of the layer of configurable components on the surface of agricultural crop seeds when they are drained.

By integrating equation (7) for $\lambda=const$, i.e. assuming that a film of the same thickness λ is layered on the seeds of agricultural crops during the entire time of cultivation on each plot Δl, we obtain the following expression

$$x_1=\sqrt{x_0^2+\frac{4R\omega\lambda t}{\cos\varphi}}, \tag{8}$$

x_0- where is the initial seed size, m;

x_1-seed size after layering components, m.

As follows from expression (8), the thickness of the layer of layered components on the surface of crop seeds at constant values of the initial seed size, the thickness of the layer of the layered film λ and the time of the technological cycle t depends on the radius R of the Poppet drum, its angular velocity (or rotation frequency n) and the angle of inclination φ of the Poppet drum relative to the horizontal. At the same time, the angle of inclination of the Poppet drum has a significant effect on the layering of components on the surface of seeds of agricultural crops, i.e. the greater the angle of inclination, the greater the layering of components, and Vice versa, the smaller the angle of inclination, the less layering of components.

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Figure 2 shows the curves of changes in the thickness of the layer of layered components on the seed surface, depending on the radius of the Poppet drum, the frequency of its rotation and the angle of inclination relative to the horizontal. Dependence curves are plotted on the example of pubescent cotton seeds for the following parameter values: 5.41×10-3 m; R=0,4 0,5; 0,6; 0,7; 0,8; 0,9 and 1.0 m; n=10; 15; 20; 25; 30; 35 and 40 min-1; t=1500 s; φ=10º; 20º; 30º; 40º; 50º; 60º and 70º.

It follows from the curves of dependencies that changes in the radius of the Poppet drum, the frequency of rotation and the angle of inclination relative to the horizontal lead to changes in the thickness of the layer of layered components on the surface of pubescent cotton seeds. For example, if at the radius of the Poppet drum R=0.4 m, the thickness of the layer of layered components on the surface of pubescent seeds was Δx=0.17 mm, then at R=1.0 m, it is Δx=0.42 mm.

The same pattern is observed when the rotation frequency and the angle of inclination of the Poppet drum relative to the horizontal increase. In particular, if at the rate of rotation of the Poppet drum n=10 min-1 the thickness of the layer of layered components on the surface of pubescent seeds was Δx=0.12 mm, then at n=40 min-1 it is Δx=47 mm, and if at the angle of inclination φ=10 ° it was Δx=0.23 mm, then at φ=70 ° it is Δx=0.65 mm. an increase in both the design parameters and the operating mode of the Poppet drum leads to an increase in the thickness of the layer of layered components on the surface of pubescent cotton seeds.

However, it should be borne in mind that when draining seeds of agricultural crops, the thickness of the layer of layered components on their surface should not exceed the maximum permissible value. For example, when draining pubescent cotton seeds, the thickness of the layer of layered components on their surface should not exceed 0.30 mm.

Analysis of the dependence curves in figure 2 shows that the maximum allowable value of the layer thickness of the layered components on the surface of pubescent cotton seeds is provided for a Poppet drum radius R=0.7 m, rotation speed n=25 min-1, and the angle of inclination to the horizon φ=40°. Further increase in the values of these parameters leads to an increase in the thickness of the layer of layered components on the seed surface more than the maximum permissible value. As the value of these parameters decreases, the thickness of the layer of layered components on the seed surface decreases. This not only reduces the thickness of the layer of layered components, but also worsens the quality of covering the seeds of agricultural crops with various protective and nutritional components [2].

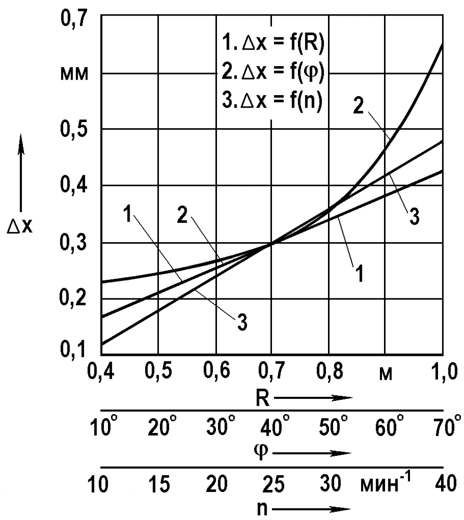

Figure 2. Change in the thickness of the layer of layered components (Δx), depending on the radius (R) of the Poppet drum, the speed (n), and the angle of inclination (φ)

V. CONCLUSION

Experimental studies on pre-sowing preparation of agricultural seeds for sowing on an improved draining

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device showed that the power consumption of the electric motor decreased by 17-20% compared to the previous ones. At the same time, the quality of the prepared seed material improved.

Thus, the improvement of the metering device allows, firstly, to increase the efficiency of the technological process of seed processing, secondly, to improve the quality of the prepared seed material, and thirdly, to reduce the power consumption of the electric motor. A conclusion section is not required. Although a conclusion may review the main points of the paper, do not replicate the abstract as the conclusion. A conclusion might elaborate on the importance of the work or suggest applications and extensions.

REFERENCES

[1] Calculation of equipment for granulating mineral fertilizers / M. S. Generalov, P. V. Klassen, A. P. Stepanov, I. P. Shomin. - Moscow: Mashinostroenie, 1984. - 192 p.
[2] Esirkepov B. Clarification of technologies and justification of parameters of the dragger of pubescent cotton seeds: autoref. Diss. ... candidate of technical Sciences. - Yangi-Yul, 1995. - 17 p.
[3] Mukhin V. D. Draining seeds of agricultural crops. - M.: "Kolos", 1971. -96 p.
[4] Esirkepov B. Clarification of the technology and justification of the parameters of the dragger of pubescent cotton seeds. - Yangiyul, 1995. - 17 p.
[5] GOST 21820.76-GOST 21820.4-76.The seed of the cotton plant. Methods of sampling and analysis. - M.: - ed. standards, 1980. - 47 p.
[6] Rosaboev A. T., Imamkulov U. B. Improved mobile replication device / / AGRO ILM. - Tashkent, 2016. - no. 2. - Pp. 80-81.
[7] Rosaboyev A.T., Imomqulov U.B. Substantiating theoretically the parameters of the blade in-built in the drum group of shelling installation // European Science Review. – Austria, Vienna, 2016. – № 5-6. – P. 193-195.