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Development of innovative technological bases of sorting and granulation processes of fibrous raw materials

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Abstract. *The paper considers the development of an innovative technological process for the production of fibrous cotton raw material as seed, as well as the theoretical basis of the operations performed on the mechanised unit used in the granulation and sorting of raw materials.*

Keywords. fibre raw material · mechanised plant · pellet system · sorting · innovative technology

Mathematics Subject Classification (2010): 7605

1 Introduction

Analysis of numerous studies shows that one of the main problems of agriculture is the issues of sorting of high yielding seeds [1 - 3]. Studies carried out in the direction of solving this problem have shown that here it is advisable to ensure the effective use of systems of greater importance in the production of granulated cotton seeds, including technological equipment for improving the spraying process. The plants used for the production of seed sprinkling from seeds are mainly characterised by complexity of construction, low technological efficiency, considerable labour intensity, high consumption of energy and resources, and environmental pollution [4, 5]. Taking into account these discrepancies, the theoretical and practical basis for the development of a new mechanised plant was developed (Fig.1).

2 Methodology

The device consists of a liquid-filled vessel, the working surface of which is covered with a rubber layer, rotating around its axis, and a disc 1, which is in contact with paralon 2 on top. It consists of a hollow vessel - 9 connected to the disc, a flask - 8, a chain transmission - 5, an auxiliary shaft - 6 and a disc 7 mounted on this shaft. By means of this disc, movement is provided from the electric motor - 4, chain transmission - 11 through shaft 10, from shaft

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12 through shaft 13 in the hopper, from the sorting arm - 14. The device also comprises a tank for the working solution - 16, a pump - 17, a rotating liquid dispenser with two radial openings - 22, a housing with 23 openings - 21, radial openings - 18, a plug - 20. In order to adjust the flow rate of liquid entering through the distributor into the hole along the axis - 19, a holder - 28, a nut-screw pair - 27, a screw - 26 and a fitting - 20 connecting the rod 28 with the screw 25 are used. During the technological process, the fibres wrapped around their outer surface are ejected to different distances depending on their mass, as they fly out of the unit under the action of 15 equal forces. The principle of operation of the unit for processing fibrous cotton raw material is carried out in the following sequence: the consumption of raw material and solution according to the requirements Q_1 is regulated by Q_2 before putting the unit into operation. The raw material flow rate Q_1 is carried out by changing the angle of inclination of the shaft of the hopper of the plant supplying the sorter with fibrous raw material by changing the chain transmission, and the solution flow rate Q_2 is carried out by changing the position of the rotating plug of the liquid separator 20 on its housing 21. At this time, a screw 26, which changes position when viewed from a fixed tripod by means of a nut-screw pair, by means of a hinge-kinematic contact 25, wherein it is in hinge-kinematic contact, causes the stems 20 of the rigidly connected plug to rotate 21 on the housing 24, respectively, increasing the radial openings in the plug and the housing (18; 22 and 23) the live shear area resulting from its meeting changes accordingly. Here, as the plug moves clockwise, the flow rate of solution that passes through the opening and enters the gap in the plug 19 causes a decrease in the flow rate of solution that returns back to the reservoir, or vice versa. Before putting the device into operation, the 1 angle copy of the disk with rubber coating on the working surface is adjusted according to the consumption of fiber raw materials for processing in ω_2. Then, with the Engine 4 and the pump 17 turned on – the processing is left to work. The liquid entering the central channel of the flyance 8 by passing through the divider, as well as the fibrous dewides corresponding to the consumption of the liquid entering the channel from the fibrous dewide Hopper, moving along the Archimedes spiral curve during the rotation of the disk 1 in contact with the surface of the paralon 3 in the container with liquid (R1.-.R3). During the operation of the proposed device, throwing at different distances and creating additional resistance, disrupting the sorting process of raw materials-chaotic situation, fibers located on the outer surface of the raw material eliminate the violation of the effect created by the mass (sorting by mass).

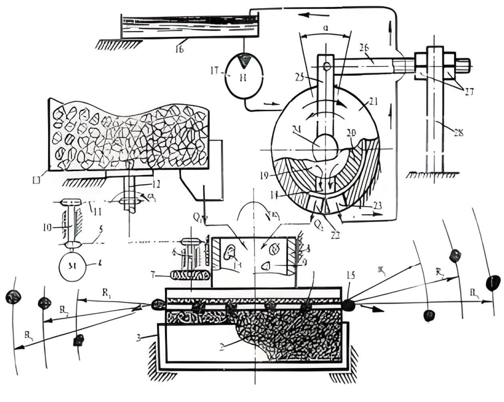

Fig. 1. Centrifugal type universal design for sorting and processing fibrous cotton seeds: 1 – disk; 2 – paralon; 3 – container with fungicide; 4 – electric motor; 5 – chain drive; 6 - shaft; 7 – rubber disk; 8 – flange; 9 — central hole of the flange; 10 – shaft; 11 - chain transmission; 12 – bunkers shaft; 13 - juice hopper; 14 - juice; 15 - moistened juice; 16 – fungicide tank; 17 – pump; 18 – radial hole plug; 19 — axial hole of the plug; 20 – plug; 21 – cover; 22; 23 - radial barrel hole; 24 – rod; 25 – paragraph; 26 – pin; 27 – nut – screw thread; 28 – support

Using the mentioned possibility of the proposed device, it is possible to select large masses of high-quality processed seeds and provide agricultural production with seed material with high quality indicators. During operation of the device, sorting of fibrous cotton seeds makes it possible to obtain biologically mature seed material, which is the basis of the future product. Theoretical study is of particular importance. Since solutions with low percentage density are usually obtained by adding ordinary water from solutions with high percentage density in various industries, we calculate the amount of water added for this purpose using known expressions. For preparing a solution with a desired viscosity from a solution with a given viscosity, we can calculate how much regular water is required in this process to produce a solution with μ_1 per cent hardness by mass m_1, dosed per unit time, from it in a μ_2 per cent $(\mu_1 > \mu_2)$ solution

$$m_1 \,.\, \mu_1 = (m_2 + m_{su}) \cdot m_2 \tag{2.1}$$

Hence the mass of a solution of μ_2 percent to obtain a solution of the required consistency

$$m_2 = \frac{m_1}{\mu_2} \cdot {}_1 - m_1 \tag{2.2}$$

Taking into account the masses of solutions, their solids and other indicators that affect the process of dosing the solution, we will get the well-known following statement.

$$\frac{m_{su}}{m_1} = \frac{\frac{m_1 \cdot \mu_1}{\mu_2} - m_1}{m_1} = \frac{\frac{m_1 \cdot \mu_1 - m_1 \cdot \mu_2}{\mu_2}}{m_1} = \frac{m_1\,(\mu_1 - \mu_2)}{m_1 \cdot \mu_2} = \frac{\mu_1 - \mu_2}{\mu_2} \tag{2.3}$$

According to the results of research it can be noted that to provide the technological process with the solution with the required viscosity the mass of the dosed low $\frac{\mu_1 - \mu_2}{\mu_2} \cdot m_1$ solution will be different from the mass of the dosed solution. In this case $\mu_1 > \mu_2$, the mass of the low-alkaline liquid to be dosed will be many times the mass of the solution $\frac{\mu_1 - \mu_2}{\mu_2}$, or $\mu_1 < \mu_2$, by analogy, will less by $\frac{\mu - \mu_2}{\mu_2}$.

3 Conclusions

By estimating the masses in the solutions and using the potential capabilities possessed by the dispenser, it is possible to obtain the mass of any flow rate of the solution with the proposed consistency in a short period of time.

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