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Experimental Studies of the Screw Conveyor to Transport the Cotton Seeds

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ABSTRACT: The article presents the results of experimental studies of the screw conveyor to transport the cotton seeds from gin to Lintern machine having a cleaning unit of seeds from trash. It is shown that the rotation speed and propeller pitch has a significant impact on the cleaning effect of the installation. Analysis of the results of experimental studies indicates that an increase in the speed of rotation of the rotor and the reduction of its step cleansing effect increases.

KEYWORDS: connection, mechanization, equipment, transporting, improving, screw conveyor, transport the cotton seeds

I.INTRODUCTION

In connection with the growing requirements for the quality of raw cotton, a broad program of technical re-equipment and further development of the cotton-ginning industry is being launched in the country. It is proposed to equip cotton-cleaning plants with modern equipment, to improve the technological processes of cotton processing.
Along with improving the quality of products, one of the main and urgent tasks facing the cotton gin industry is the complete mechanization of laborious and hard work, as well as the automation of process control. Currently, mechanisms and devices for complex mechanization of labor-intensive and hard work with raw cotton, seeds and waste have been created and are successfully operating in the cotton-cleaning industry.
In the technological process of transporting raw cotton and seeds, screw conveyors are widely used, which are highly efficient and economical means of distributing cotton through production line batteries, feeding for cleaning in drying and cleaning and cleaning workshops, as well as for seed through linters and removal of seeds from the linters to the place of storage and shipment. As is known, in the process of primary processing of raw cotton, a screw conveyor, among other places, is used to transport ginned cotton seeds from the saw filament separator to batteries of letter machines [1].In [2], in order to improve the quality of the obtained lint in the process of lining cotton seeds and reduce the content of weed impurities in them, a screw conveyor equipped with a screening surface in the semi-cylindrical part of its trough was proposed.

II. LITERATURE REVIEW.

Currently, ginning factories are widely used, as a means of transporting the processed material, screw conveyors. They are, for example, used to transport advanced seeds from gin to linters. Operation of screw conveyors in a production environment shows that when transporting cotton seeds, with their continuous and continuous wooing, there is an intense release of trash, however, due to the lack of removal of such trash in existing screw conveyor designs, they again move with the total weight of cotton seeds transported , get into the linters and negatively affect the quality of the resulting lint.In addition, the increased maintenance of weed impurities in cotton seeds leads, when processed in the oil and fat industry, to a decrease in the yield of oil and a decrease in its quality. Application, according to our research in the laboratory, a modernized screw conveyor with a cleaning unit for cotton seeds from weed impurities can effectively remove weed impurities released during the cotton seed transportation and thereby reduce their content in cotton seeds [1].

III. EXPERIMENTAL PART

Consequently, under production conditions, we can expect an increase in the cleaning effect of a modernized screw conveyor, a decrease in the content of weed impurities in cotton seeds, which allows obtaining lint of the required quality and an increase in the yield of oil in the oil industry. In order to verify the results of laboratory research on the use of an upgraded screw conveyor with a cleaning unit for transported cotton seeds from weed impurities, production tests of the proposed screw conveyor design were performed at the Mustakillik cotton-cleaning plant in the Tashkent

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region. For the production tests, a screw conveyor of the ShS brand installed at the cotton-cleaning plant “Mustakillik” was used, between the saw-type DP-130 gin saw and the batteries of the liner machines of the 5LP brand.Screening surfaces with aperture sizes in ahb = 3x20mm, installed in the semi-cylindrical part of the screw conveyor chute, were manufactured in a production environment of RIM-COLOSS Ltd. using a computer-controlled YAWEI-NISSHNBO machine made by the People's Republic of China. The made sifting surfaces were mounted in a screw conveyor installed between the gin and the linter for transporting cotton seeds (Fig. 1). During the tests, the screw conveyor worked with constant performance. In places where cotton seeds enter the screw conveyor and when they exit the conveyor, special windows are provided for sampling cotton seeds. Before the start of the experiments, all the technological parameters of the screw conveyor were brought to the established values. In continuation of that work, we carried out experimental studies of the process of transporting cotton seeds with a screw conveyor of the proposed design in order to create an efficient and reliable design. Existing well-known methods of research of screw apparatus do not take into account some features of the movement of material in the chute, for example, the difference in the flow behavior in the channel of the screw apparatus at small and large filling ratios and rotational frequencies. Calculated dependencies are proposed for a single constant mode of motion, with no attention being paid to the fact that a change in one parameter (for example, the filling ratio of the channel from 0.2 to 0.8) drastically changes the nature of the flow in the channel. Calculations performed using radiation formulas for low-speed conveyors give 1.3–1.5 times overestimated performance values and 1.5–3 times underestimated power values compared to experimental values [2].

In studies of the process of transporting cotton seeds to substantiate the structural-kinematic and regime parameters of the screw conveyor with a node for cleaning seeds from weed impurities, an experimental modeling method was chosen as the most effective for understanding the patterns that determine the functional parameters of the object in question. In accordance with the goal, the following main tasks of experimental research were identified: Establishment of the regularities of the process of transporting cotton seeds by a screw conveyor for various modes of its operation. Justification of the effectiveness and determination of characteristics of the mode of vibration excitation of the screw conveyor. Determination of the optimal design and operating parameters for transportation with minimal energy consumption. To perform experimental studies, a special laboratory stand of a screw conveyor with interchangeable screws was manufactured [Fig. 1].

The experimental stand consists of a screw conveyor with corresponding components similar in design and size to the screw conveyor used in the cotton-cleaning industry for transporting cotton seeds. The screw of the conveyor receives movement from the electric motor with a power of N = 5.5 kW through a reducer and a belt drive.

Figure 1. General view of the experimental stand.

As the main indicator of the studied screw conveyor with a cleaning unit, the effectiveness of cleaning the transported seeds from weed impurities (cleaning effect) was adopted. The implementation of a screw conveyor with a

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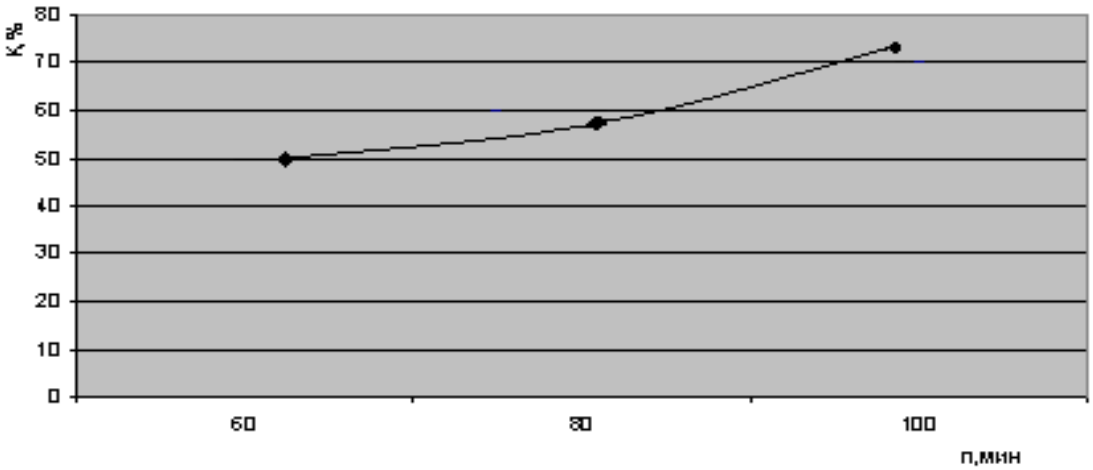
seed cleaning unit from weed impurities during their transportation requires additional study of the screw speed parameters on the cleaning effect and therefore, at the first stage of research, experiments were conducted to study the effect of the screw rotation speed on the cleaning effect.



In the existing constructions of the seed screw conveyor, the screw speed is equal to n = 60 min-1 and this speed value is set solely for the consideration of the need to ensure the removal of seeds from the gin constantly and on time.

Each series of experiments consisted of a series of experiments performed under strictly identical conditions. To determine the number of experiments in each series, necessary to obtain the measured parameters with a given accuracy and confidence and interval, a preliminary series of ten experiments was carried out, the results of which were processed according to the standard method of determining the arithmetic mean and standard deviations. It was found that the required number of experiments to obtain a confidence level = 0.95 and a measurement accuracy of a parameter of 5% is three.

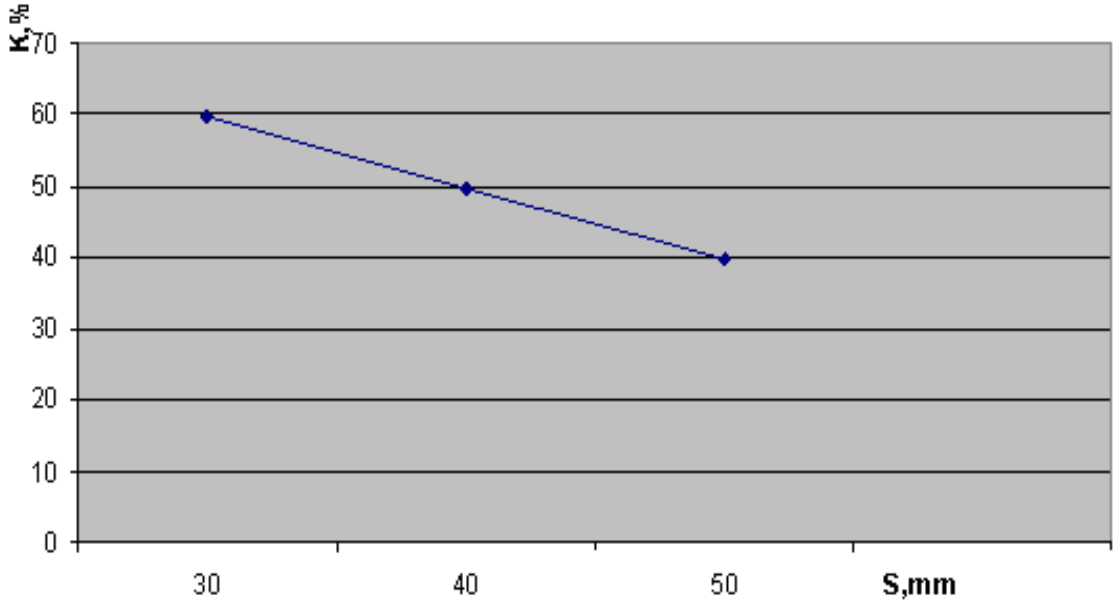


Fig.2. The dependence of the cleaning effect on the pitch of the screw.

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This can be explained by the fact that with a small screw pitch, the time that cotton seeds stay in the screw conveyor increases, as a result of which their more intense conversion occurs, enhanced release of trash. At the same time, visual observations of the transportation process, as well as video filming, showed that an increase in the screw filling factor of more than 0.5 does not lead to a noticeable increase in the cleaning effect of the screw conveyor due to a strong transfer of material through the screw shaft. Circular rotation was observed at a screw rotation frequency n of more than 80-100 min-1 and a slope angle of the loader more than 100. Moreover, a particularly strong transfer occurs during transportation by the screw, which has a big step. The injection of the individual "labeled" particles into the bulk of the charging material clearly demonstrates how the circulation of the material arises and develops with increasing technological parameters. A significant part of it is involved in a circular motion, and the axial speed of movement decreases. Studies of the effect of vibration excitation of the elements of the screw conveyor on the efficiency of transportation are carried out. It is known that the use of vibration, as a rule, leads to a significant intensification of processes and an increase in the quality indicators of various devices. Vibration machines and processes are currently used in almost all industries. In our case, to create vibration during operation of the screw conveyor with a cleaning unit, the conveyor chute was attached to the stand through an elastic rubber element, so that the chute had a certain oscillation frequency when transporting cotton seeds. Experiments with vibration excitation of the screw conveyor revealed in all cases the intensification of the process of separation from the transported material, which increases the cleaning effect of the screw conveyor. This effect is especially noticeable at increased screw speeds. As an example in fig. 5 is a diagram of the dependence of the cleaning effect on the rotational speed n with the chute vibration (dotted lines 1) and without vibration (solid lines 2).

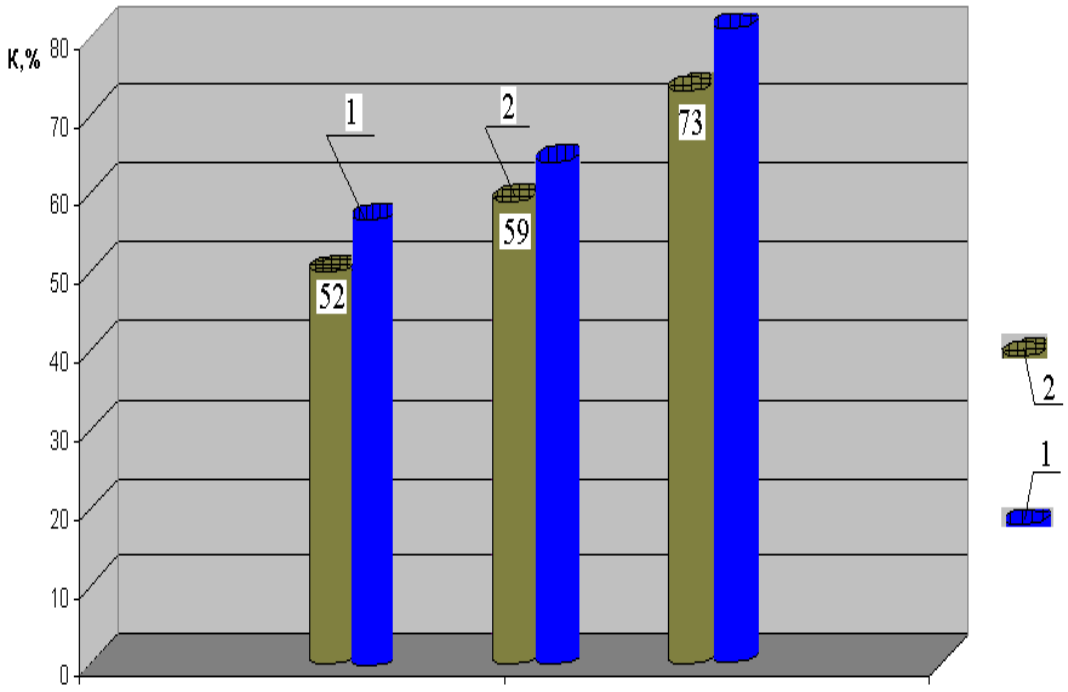

Fig.3. Comparative chart

As can be seen from the graph, vibro-excitation allows you to increase the cleaning effect by an average of 10-13% at auger rotation frequency of more than 60min-1. Currently, studies are underway to determine the rational values of the amplitude and frequency of vibration of the installation.

IV. CONCLUSION

The cleaning effect of the screw conveyor increases with an increase in the number of revolutions of the screw of the conveyor and a decrease in the pitch, as well as when the screening surface vibrates.

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