DETERMINATION OF RADIAL SPEED IN SCREW CONVEYOR SHAFTS BASED ON EXPERIMENTAL RESEARCH

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ABSTRACT

The article presents that as a result of experimental studies of the electrostrain method, the patterns of changes in angular velocities in the screw conveyor and the shaft of the screw conveyor drive sprocket for cleaning and transporting the down jacket in various productivity work are determined. Graphs of the dependence of the angular velocities of the angular performance of the screw conveyor shaft with a wavy surface of the rolling bearing and the longitudinal drive sprocket are plotted, and the optimal values of the parameters are recommended.

Key words: down jacket, screw, conveyor, angular velocities, shaft.

Purpose. Development of an efficient structure of a screw conveyor that transports and cleans fluff, and definition of its parameters based on complex experimental researches.

Methods. Experimental researches were conducted at the Tashkent Scientific-Research Institute of Agricultural Mechanization and Electrification using the tensometric test method. There, the radial speed of the screw shaft are determined with the help of tensor resistors.

Results. As a result of experimental researches, the radial speed change laws of the screw shaft and the leading star shaft of the fluff transportation and cleaning screw conveyor were determined in different working conditions. These laws were determined by the oscillograms presented in the article.

Conclusion. In this paper, radial speed changing laws on the screw and leading star shafts of the screw conveyor transportation and cleaning cotton fluff were determined experimentally. Graphs of dependence of radial speed and their vibration ranges on performance and wave height on the surface of the screw were constructed. Based on the analysis, the optimal values of the parameters were recommended.

Introduction. After sawing, the fluff is separated from the seed in linters. Screw conveyors are used to transfer the waste containing fluff to the pressing machine [1]. An existing screw-type fluff-carrying bladed shaft transports the fluff along the warp. In the screw cleaner that we offer, the screw blade is made in a wave shape, which increases the friction of the transported fluff, as a result, the debris contained in the fluff is separated and exits from the shell slits in the sieve. It should be noted that the improvement and effective cleaning of the wave on the fluff of the screw depends more on the change of the radial speed of the screw shaft [2]. Because a change in radial speed creates an angular acceleration, that is, an additional impulse force appears. This increases the cleaning effect. Therefore, in experimental studies, it is important to determine the laws of angular velocities in the screw shaft and the leading star shaft.

Experimental research methods.

An experimental copy of the proposed design of the fluff-carrying and cleaning screw conveyor was prepared and the existing methods of conducting experimental researches were used [3,4]. Figure 1 shows a prototype of a screw conveyor that has a new design. As we mentioned above, in order to increase the performance of the screw conveyor, a mechanism including a chain with belt elements was used in the transmission mechanism. Figure 2 shows a view of the recommended chain drive and the components of the chain roller and the molds for its manufacture [5].

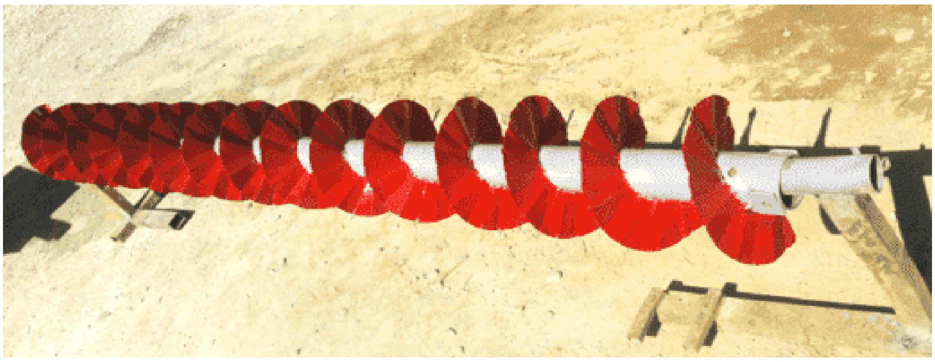
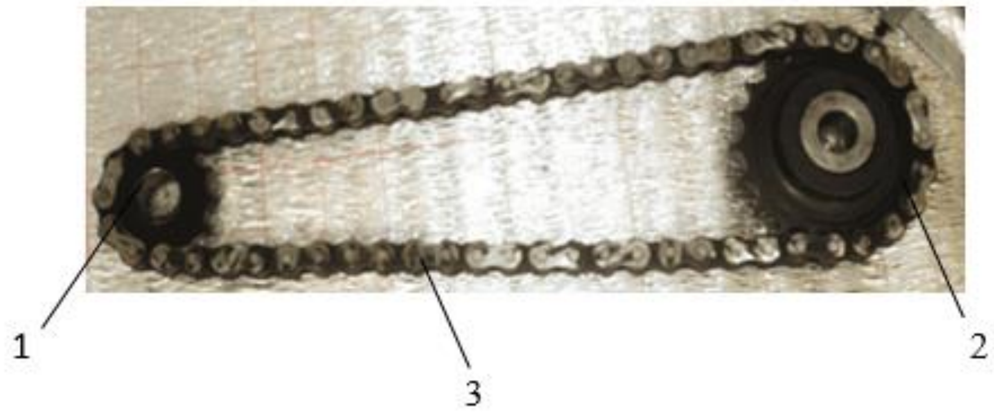


Figure 1. Overview of the screw shaft of the new design conveyor

The electrotensometric scheme of the experimental stand of the conveyor with a screw with a wavy surface of the fluff carrier and cleaner is presented in Fig. 3. When the test stand starts up, the electric motor 1 transmits the movement through the variator 2 to the reducer 4 through the clutch 3. Then it transmits the motion to the screw shaft of the screw conveyor through the recommended chain drive. Through the Arduino (ATP) microcontroller 13, data is transferred to the computer 14 [6].



where, 1 – leading star, 2 – following star; 3 – chain.
a – an overview of the chain drive

1 – axial base, 2 – cylinder in chain drive, 3 – pressing bushing.
Fig. 2. Recommended chain drive overview and chain roller components.

Based on the scheme above, an experimental stand of a conveyor with a chain drive was prepared. At first, the 2.0 kW 710 rpm engine was connected to the T2N-450 cylindrical gear reducer that has 20 gears and it is fixed to the frame. During the experiment, the speed of the shaft was changed with the help of variator 2, that is, the number of revolutions of the screw shaft fixed to the leading star was obtained at 28, 32 and 36 rpm. In order to increase the accuracy of the obtained results, the tests were repeated 3 times in the same mode.

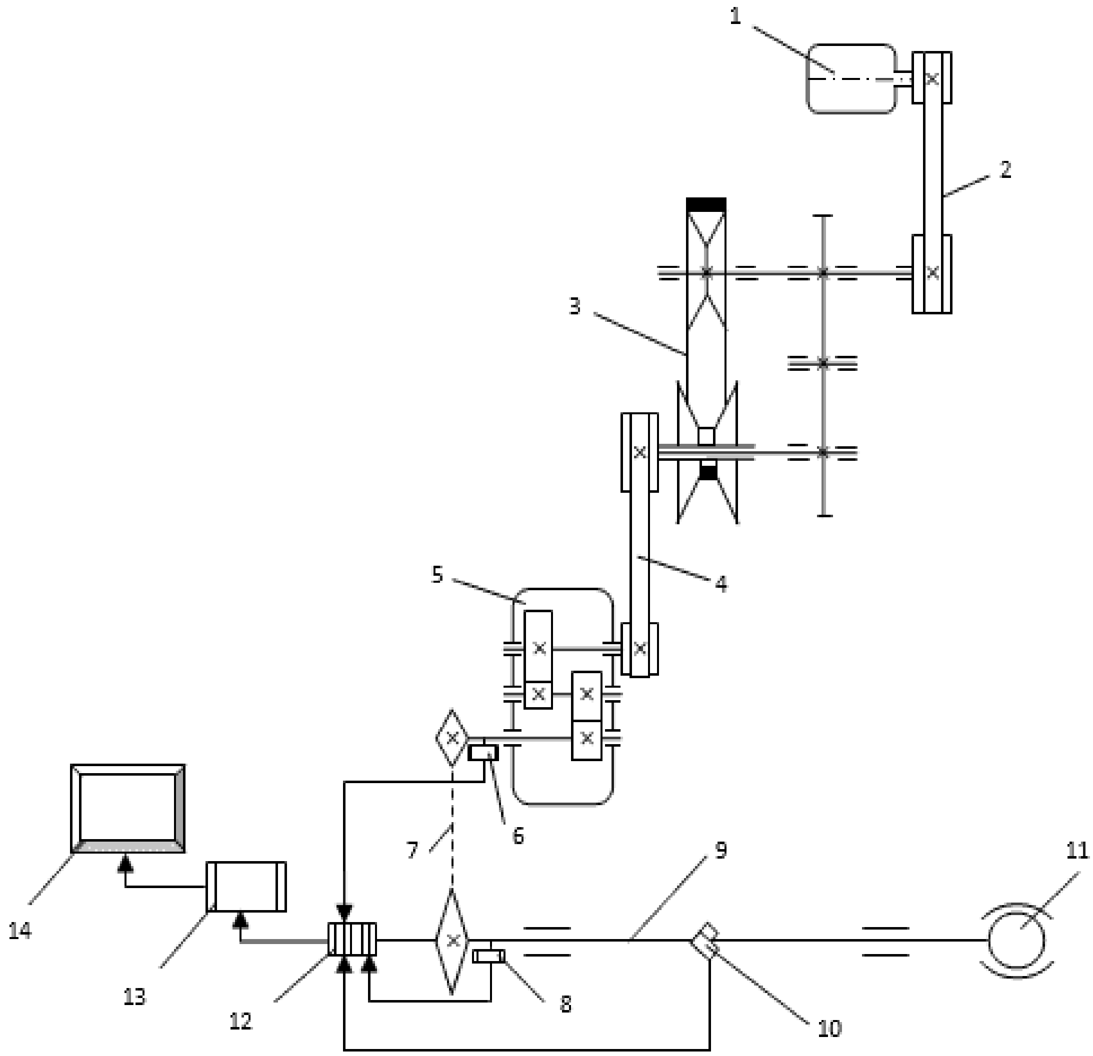
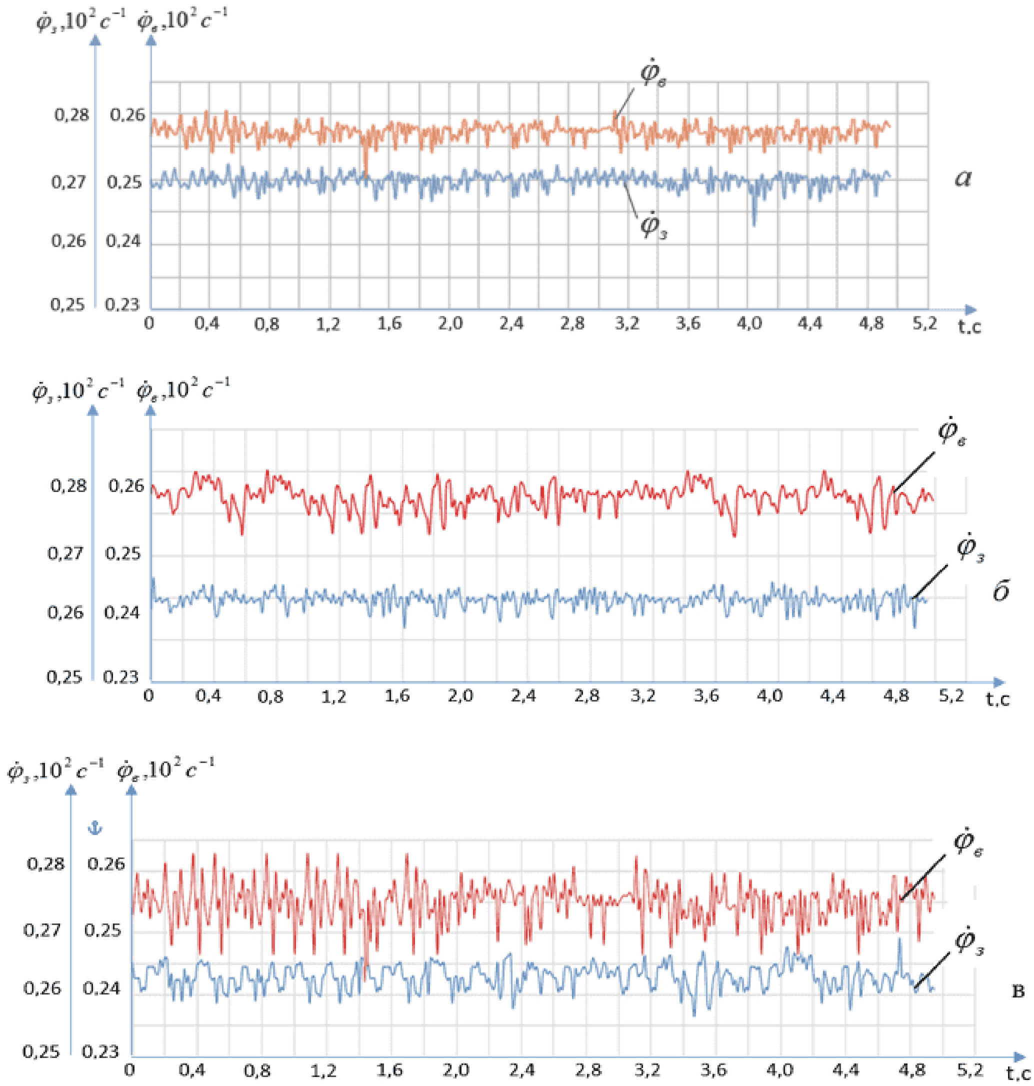


Fig. 3. Experimental setup of the electro-tensometric scheme of the screw conveyor.

Where, 1 – electric motor; 2,4 – belt drive; 3 – variator; 5 – reducer; 6 – high-impact ky-037 branded sound module; 7 –chain drive; 8 – optical tachometer; 9- screw shaft; 10 – tensor resistor glued in the half-bridge method; 11 - stopping device; 12 – current collector; 13 - Arduino (ATP) microcontroller; 14 – computer.

Experimental results and analysis of measurement of radial speed on propeller shaft and drive star shaft.

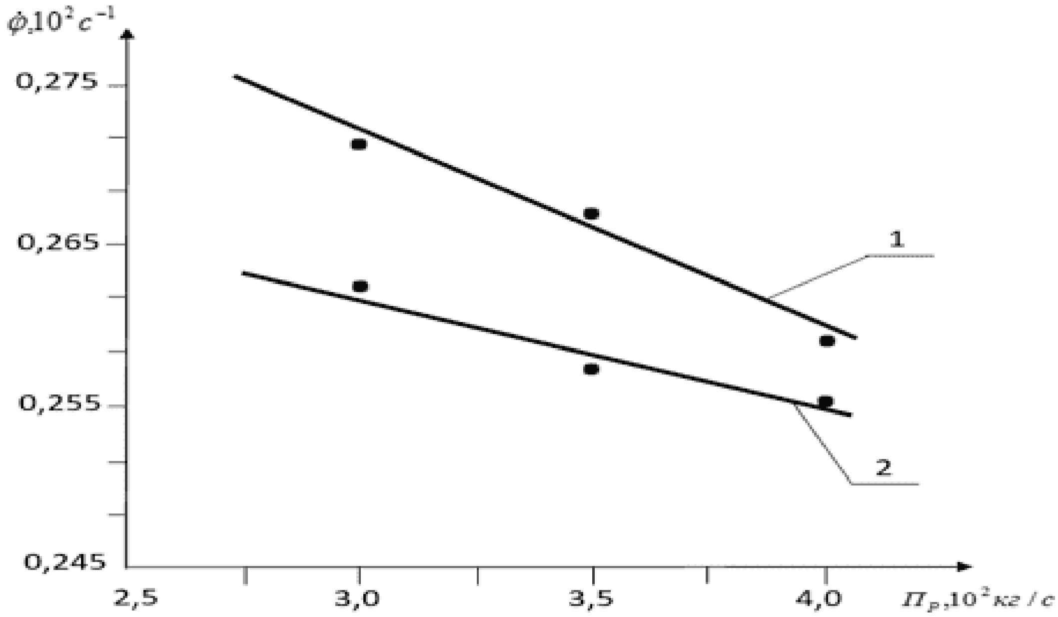
As a result of the experimental researches, the laws of change of radial speed of the screw shaft and the leading star shaft of the screw conveyor of fluff transportation and cleaning were determined in different working conditions. These patterns were determined by the oscillograms presented in Figure 4. Based on the analysis of the oscillograms, it can be noted that the average values of the angular velocities on the screw shaft and the leading star shaft are almost close to each other, but it can be seen that the amplitudes of the angular speed oscillations on the screw shaft are significantly larger than the angular speed on the leading star shaft. Here, with the increase in productivity, the values of the radial speed $\Delta\dot{\phi}_v$ and $\Delta\dot{\phi}_z$ decrease, and the vibration amplitudes increase accordingly (Fig. 4 v). As a result of the processing of the received oscillograms, parameter connection graphs were constructed. Fig. 5 shows the graphs of the dependence of the radial speed on the performance of the screw shaft of the screw conveyor with a wavy surface of the fluff carrier and cleaner and the transmission leading star shaft [7].



Where, a $- P_r = 300 kg/c$; $b - P_r = 350 kg/c$; $v - P_r = 400 kg/c$.

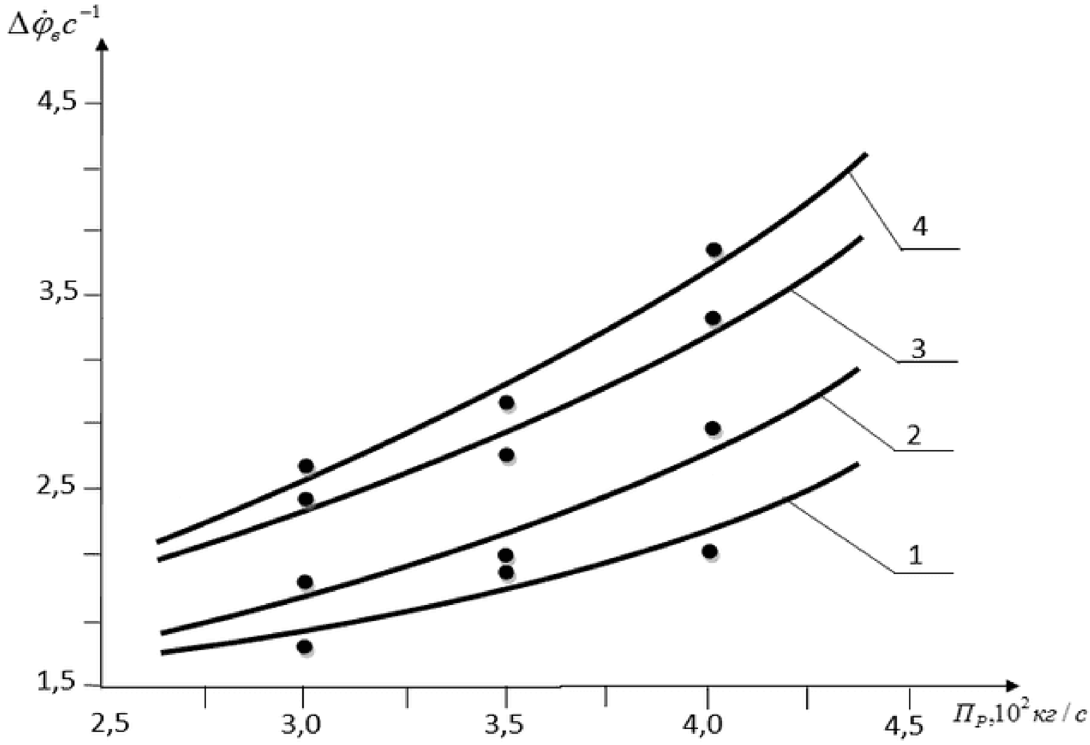
Figure 4. Laws of change of radial speed in the screw conveyor shaft of the lint carrier and cleaning screw and the star shaft of the chain drive.

According to the analysis of the graphs, it should be said that when the productivity increases from $2.25\cdot10^2$ kg/s to 4.0·102 kg/s, the average value of $\dot{\varphi}_в$ changes from 0.623·102 s^{-1} kg/s to 0.255·102 s^{-1} kg/s decreases in an almost non-linear manner. It should be noted separately that the uneven rotation of the screw shaft is more due to the wavy surface of the screw, that is, the effect of the wave amplitude is the main one. Fig. 6 shows the graphs of dependence of the radial speed of the conveyor screw shaft and the transmission drive star shaft on the performance of the vibration coverage and the change in the amplitude of the waves. With increasing productivity, the values of $\Delta\dot{\phi}_v$ and $\Delta\dot{\phi}_z$, respectively, increase in a non-linear pattern. In particular, when the screw conveyor productivity is $4.0\cdot10^2$ kg/s, and when h=$9.0\cdot10^{-3}$ m, the range of angular velocity oscillations on the lint-cleaning conveyor screw increases to 3.81 s^{-1}, correspondingly, on the leading star shaft The values of $\Delta\dot{\varphi}_з$ reach 3.14 s^{-1}. This is because angular speed fluctuations are sufficiently absorbed in the chain drive. Also, the rubber bushing of the roller in the chain has a significant effect on the absorption of vibrations (Fig. 6, graphs 1, 2 and 3, 4). It should be noted that these vibrations cause the fluff to become more dense and increase the effectiveness of its cleaning at the expense of the final result. But $\Delta\dot{\varphi}_в$ and $\Delta\dot{\varphi}_з$ greater than $(3.5\div4.0)s^{-1}$ increases the damage to the fluff, reduces the machine resource. Therefore, the recommended values of the parameters are desirable to be in the range of $n_p \le (4,2\div4,5)$ kg/s and $h \le (1,2\div1,4)\cdot10^{-3}$ m [8].



Where, $1-\dot{\phi}_z = f(P_r)$; $2-\dot{\phi}_v = f(P_r)$.

Figure 5. Graphs of the performance of the fluff conveyor and cleaning wave surface screw conveyor screw shaft and gear drive star shaft angular speed.



Where, 1,3 $- \Delta\dot{\phi}_z$; 2,4 $- \Delta\dot{\phi}_v$; 1,2 $- h = 6{,}0 \cdot 10^{-3}m$; 3,4 $- h = 9{,}0 \cdot 10^{-3}m$.

Figure 6. Graphs of the dependence of the radial speed of the fluff carrier and cleaning wave surface screw conveyor screw shaft and the gear drive star shaft on the performance of the vibration coverage and the change in the amplitude of the waves.

Conclusion. As a result of the experimental researches, using the electrotensometric method, the laws of change of the radial speed of the screw shaft and the leading star shaft of the screw conveyor for fluff transportation and cleaning were determined in different working conditions. Graphs of the angular speed of the screw conveyor with the fluff carrying and cleaning wavy surface and the angular speed of the transmission drive star shaft were constructed. Recommended parameter values.

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