BRITISH VIEW

MULTIDISCIPLINARY JOURNAL

www.britishview.co.uk

Anthropologie, Applied Linguistics, Applied Physics, Architecture, Artificial Intelligence, Astronomy, Biological Sciences, Botany, Chemistry, Communication studies, Computer Sciences, Computing technology, Cultural studies, Design, Earth Sciences, Ecology, Education, Electronics, Energy, Engineering Sciences, Environmental Sciences, Ethics, Ethnicity and Racism Studies, Fisheries, Forestry, Gender Studies, Geography, Health Sciences, History, Interdisciplinary Social Sciences, Labour studies, Languages and Linguistics, Law, Library Studies, Life sciences, Literature, Logic, Marine Sciences, Materials Engineering, Mathematics, Media Studies, Medical Sciences, Museum Studies, Music, Nanotechnology, Nuclear Physics, Optics, Philosophy, Physics, Political Science, Psychology, Publishing and editing, Religious Studies, Social Work, Sociology, Space Sciences, Statistics, Transportation, Visual and Performing Arts, Zoology and all other subject areas.

Manuscripts typed on our article template can be submitted through our website here. Alternatively, authors can send papers as an email attachment to editor@britishview.co.uk

Editor Multidisciplinary Journals
Website: http://britishview.co.uk
Email: editor@britishview.co.uk

British View ISSN 2041-3963 Volume 8 Issue 2 2023
Universal impact factor 8.528
SJIF 2022: 4.629

ANALYSIS OF THE VERTICAL VIBRATION OF ROLLER MECHANISMS WITH BELT ELEMENTS WITH BELT CONVEYOR AS A DEPENDENCE ON ITS PARAMETERS

Jumaev Akbarjon Sayfullaevich
Almalyk branch of Tashkent State Technical University named after Islam Karimov
Doctor of Philosophy in Technical Sciences (PhD), Associate Professor
E.mail: akbarjon.jumayev@mail.ru

Raximjonov Navodir Axmadjon o'g'li
Almalyk branch of Tashkent State Technical University named after Islam Karimov
student
E.mail: rakhimjonovnavodir4044@gmail.com

Akbaraliev Asliddin Akmal o'g'li
Almalyk branch of Tashkent State Technical University named after Islam Karimov
student
E.mail: asliddinakbaraliyev24@gmail.com

ABSTRACT: In the article, the determination of the laws of motion of the belt conveyor roller mechanisms was considered mainly in the case of being placed at an oblique angle. In this case, it is observed that during the transportation of the transported product, the rolling bearings of the roller mechanism with belt elements move as a result of high loading. For the analysis of these technological processes, the solutions of vertical vibrations of the belt conveyor with a roller mechanism consisting of a belt bushing of the bearing support of the new construction, the analysis of its parameters, and the general vibration laws and graphs are presented.

Keywords: deformation, construction, dynamics, kinematics, eccentricity, angular velocity, amplitude, frequency, bearing, belt element, roller, belt, conveyor.

INTRODUCTION

It is difficult to imagine the work of modern industrial enterprises, especially mining enterprises, without the use of belt conveyors. This vehicle allows you to automate the production process and make the work process more efficient. The belt conveyor is the most common type of transportation machines, and it is important because it ensures continuous transportation of products (minerals). It ensures the continuity of the processes of transportation of various types of goods and materials in almost all industries. The advantage of belt conveyors over other means of transport is that due to the significant speed of the belt, high efficiency and productivity of technological processes, low energy consumption, simplicity of the device design, reliability and durability are ensured. In addition, reliability in product transportation, ease of use and maintenance, long-distance delivery, automatic operation and transportation in combination with technological equipment ensure high productivity due to the continuity of the process. It is possible to carry out certain technological operations simultaneously with the transportation of goods on belt conveyors.

LITERATURE REVIEW

The main reason for the low-frequency vibration of the roller mechanism, including the vibration of rolling bearings, is caused by various vibration components. In a detailed analysis of the spectrum of low-frequency vibrations of the roller mechanism with a guide element, it was found that there are other components that differ in the quality of assembly of working elements and the quality of installation of rolling bearings, as well as the influence of various operating factors on rolling bearings.

The mechanical vibration of belt conveyor roller mechanisms is caused by the oscillating motion of the conveyor belt. It is recommended to consider the vibration phenomenon from low frequency to ultrasonic frequency. Imbalance of the eccentricity rotating masses, incorrect adjustment of the working elements of the guide roller mechanism, including incorrect centering of the rolling bearings in the installation, cause frequent occurrence of low-frequency vibrations (from 0 to 300 *Hz*). The appearance of medium-frequency vibrations (from 200 to 2000 *Hz*) is observed as a result of the interaction of the rotating and stationary elements of the rolling bearing, as well as due to high vibrations that occur during the transportation of loads [1].

With lubricant products, due to quality lubrication of the sliding parts of the mechanism, with low radial loading, it smoothest its non-symmetrical edges, which leads to a decrease in the medium-frequency vibration of the bearing. At the same time, in details that act as a loaded sliding support, medium-frequency vibration may increase [2].

DISCUSSION

It should be noted that the vertical vibration law of the mechanism is based on the law when the supports are taken the same, when it is considered that the center of gravity is located in the middle of the load on the roller mechanisms that carry out the rotational movement of the support on the belt conveyor. Based on this, we determine the oscillations of the roller mechanism from the following equation [3]:

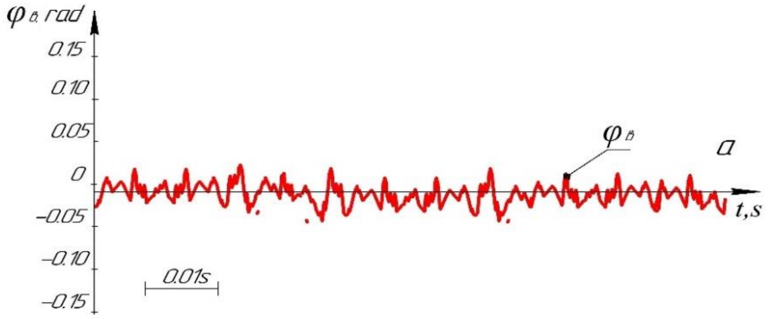
$$J\frac{d^2\varphi}{dt^2}=\frac{c_2e}{2}\left(z-\varphi\frac{e}{2}\right)-\frac{c_1e_1}{2}\left(z-\varphi\frac{e}{2}\right)+\frac{в_2e_2}{2}\left(\dot{z}+\dot{\varphi}\frac{e}{2}\right)-\frac{в_1e}{2}\left(\dot{z}-\dot{\varphi}\frac{e}{2}\right)+M_к\pm\delta M_к \quad (1)$$

It should be noted that the center of gravity of the transported mineral moves to the left side of the inclined roller mechanisms on both sides. Therefore, the laws of torsion $\varphi_в$ change with respect to the center of gravity in the oscillations of roller mechanisms have been studied. But it was found that depending on the static deformation values of bushings with belt elements and the difference between c_1 and c_2 in accordance with the weight of the roller mechanism, the mutual laws of $\varphi_в$ will be somewhat different.

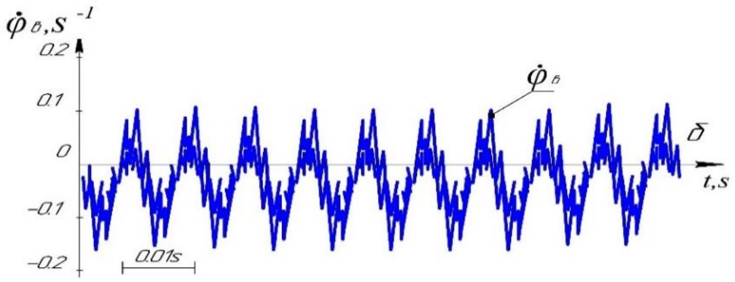
British View ISSN 2041-3963 Volume 8 Issue 2 2023
Universal impact factor 8.528
SJIF 2022: 4.629

RESULTS

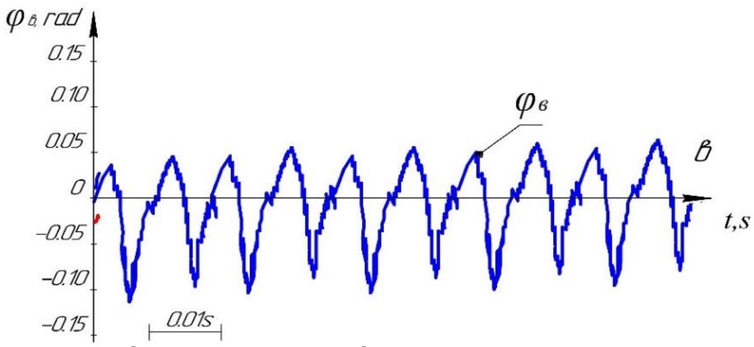
Figure 1 below shows the laws of oscillation of roller mechanisms with belt element support.



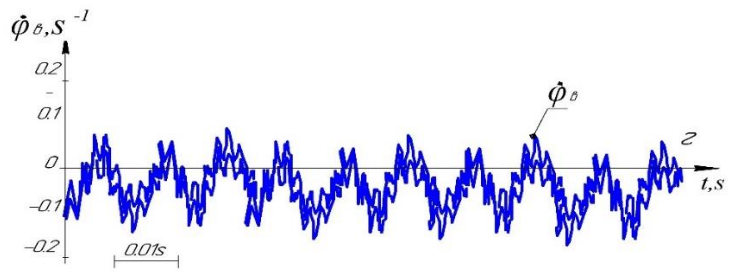
c_1 = 5,0·10^3 *N/m*; c_2 = 7,5·10^3 *N/m*; M_{engine} = (250 ± 12) *N/m*.



c_1 = 5,0·10^3 *N/m*; c_2 = 7,5·10^3 *N/m*; M_{engine} = (300 ± 12) *N/m*;



c_1 = 3,0·10^3 *N/m*; c_2 = 5,5·10^3 *N/m*; M_{engine} = (350 ± 15) *N/m*;



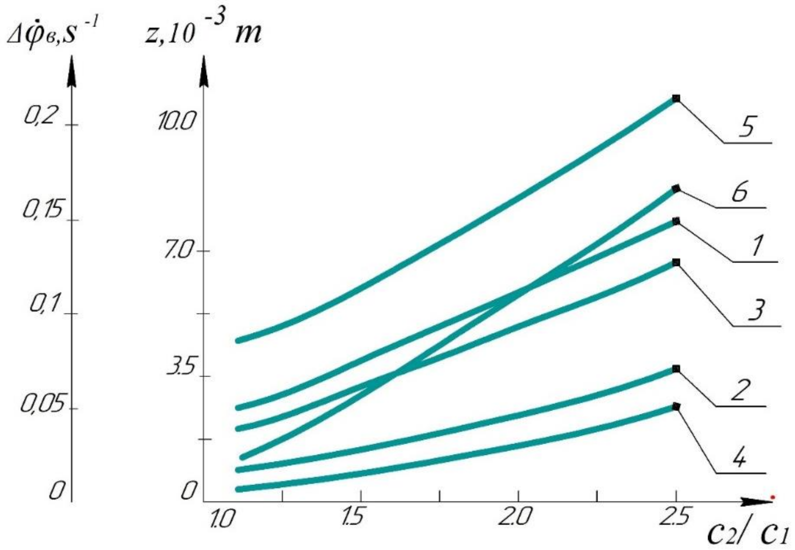
c_1 = 3,0·10^3 *N/m*; c_2 = 5,5·10^3 *N/m*; M_{engine} = (400 ± 15) *N/m*;

Figure 1. Belt conveyor belt-supported roller mechanisms are the laws of oscillation

The analysis of the obtained patterns shows that the increase in the uniformity of the belt support of the roller mechanism reduces the amplitude of the oscillations of the mechanism. The greater the resistance of the transported product, the greater the amplitude of the oscillation and its speed.

It should be noted that the differential increase in the coefficients of stiffness of supports with strap elements increases the range of vibration. In this case, the static deflection angle depends on the values of s1 and s2. Considering that the load is constant, the static deflection angle is always negative.

Fig. 2 shows the graphs of dependence of the components of the vibration amplitudes of the belt conveyor roller mechanisms and the ratio of the angular velocity range to the ratio of the belt support torque coefficients. It is shown that roller mechanisms have sufficiently high oscillations due to various loads.



1, 2 – $z_1 = f\,(c_2/c_1)$; 3, 4 – $z_2 = f\,(c_2/c_1)$; 1, 2, 5 – $J_в$ = 2,46 $kg{\cdot}m^2$; 3, 4, 6 – $J_в$ = 3,64 $kg{\cdot}m^2$

Figure 2. Graphs of the dependence of the components of the vibration amplitudes of the belt conveyor roller mechanism and the angular velocity range on the ratio of the belt support torque coefficients

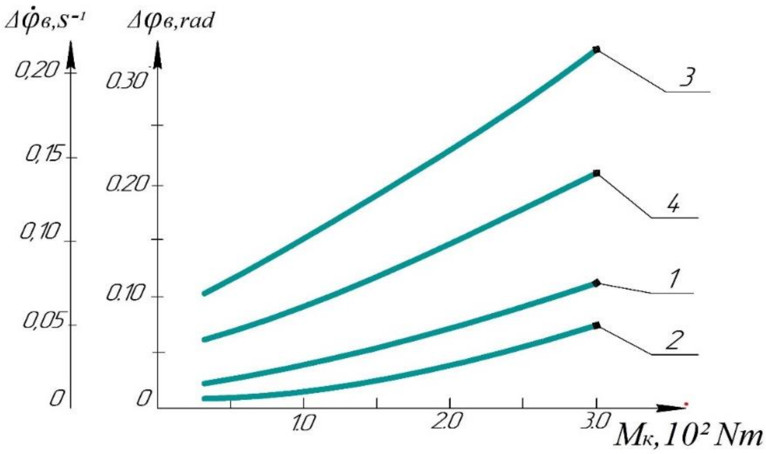
In this case, the shear force corresponding to the deviation angle is determined from the following expressions.

$$z_1 = \frac{l}{2}\sin\varphi_в + z_{cm};\ \ z_2 = \frac{l}{2}\sin\varphi_в - z_{cm}.$$

According to the analysis of the constructed graphs, when the values of c_2/c_1 increase from 1.25 to 2.5 and J_v = 2.46 $kg{\cdot}m^2$ on the left side of the inclined roller mechanisms, the values of z_1 increase from $2.2{\cdot}10^{-3}$ m to $8.3{\cdot}10^{-3}$ m Increases linearly. Accordingly, the values of z_1 do not exceed $3.61{\cdot}10^{-3}$ m when J_v = 3.64 kg·m^2. Similarly, z_2 values are up to $6.69{\cdot}10^{-3}$ m when J_v = 2.64 $kg{\cdot}m^2$, while increasing J_v = 3.64 $kg{\cdot}m^2$ to z_2 values do not exceed $3.24{\cdot}10^{-3}$ m. In this case, the difference between z_1 and z_2 is in the range of $(4.5 \div 5.5){\cdot}10^{-3}$ m, respectively. Therefore, the left side of the inclined roller mechanisms takes up more of the shell surface than the right side by (20 ÷ 25) %. It can be concluded that, as can be seen from the graphs 5, 6 in Figure 2, the impact of the moment of inertia of the roller mechanisms on the change of its vertical vibration speed is not high. Therefore, the following parameter values are recommended: $c_2/c_1 = (1.75 \div 2.25)$; $J_v = (2.46 \div 3.0)$ $kg{\cdot}m^2$; $z_1 - z_2 = (8.0 \div 12){\cdot}10^{-3}$ m $\varphi_в = (0.05 \div 0.15)$ *rad*.

If we take into account the level of loading of the transported product up to (0.3 ÷ 0.5) % of the roller shell when using the recommended belt element roller mechanisms, the vertical and horizontal oscillations of the mechanism allow adequate product transportation. It should be noted that the product can be used in cases of deviations up to (20° ÷ 35°).

Figure 3 shows the graphs of dependence of the resistance of the transported material on the rotation angle and speed ranges of the roller mechanism with belt element support.

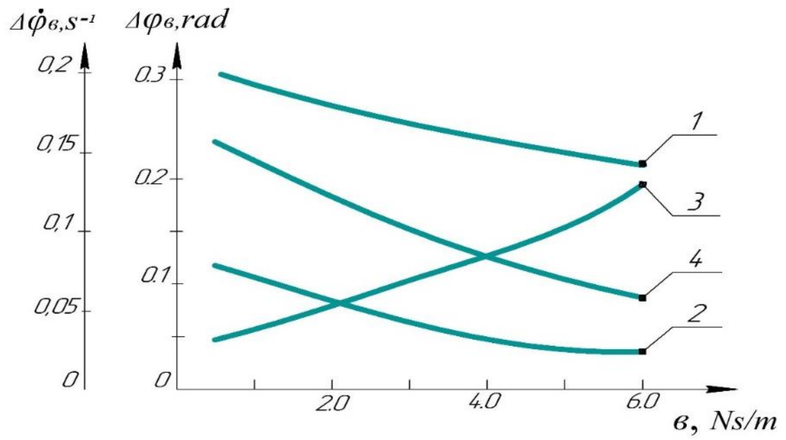


1, 2 – $\Delta\varphi_в = f(M_{res})$; 3, 4 – $\Delta\varphi_в = f(M_{res})$; 1, 3 – $c_2/c_1 = 2{,}5$; 2, 4 – $c_2/c_1 = 1{,}5$

Figure 3. Graphs of dependence of the resistance of the transported material on the rotation angle and speed ranges of the roller mechanism with a belt element support.

When the resistance moment from the transported material increases from $0.5{\cdot}10^2$ *Nm* to $3.0{\cdot}10^2$ *Nm*, the deflection angle coverage of the roller mechanism located at the angle of inclination: when $c_2/c_1 = 1.5$, the values of $\Delta\varphi_в$ are non-linear from 0.021 *rad* to 0.11 *rad* increases in legitimacy. If $c_2/c_1 = 2.5$, the increase in the values of $\Delta\varphi_в$ reaches only 0.064 *rad* (Figure 3, Graph 2). Increasing the values of increases to 0.22 s^{-1} and 0.161 s^{-1}, respectively. Therefore, in order to ensure that the roller mechanisms located at an angle of inclination are in the range of (0.05 ÷ 0.15) *rad*, the resistance of the transported product should be $M_{rev} \geq (3.0 \div 5.0){\cdot}10^2$ *Nm*.

It is known that an increase in the dissipation coefficients of supports with a strap element leads to a decrease in vibration amplitudes. Figure 4 shows the graphs of the dependence of the dissipation coefficients of the bearing belt bushings. From the analysis of the graphs, it can be determined that when the values of the dissipation coefficients $в_1$ and $в_2$ increase from 0.8 *Ns/m* to 6.0 *Ns/m*, the range of oscillations of the roller mechanism placed at an angle of inclination decreases from 0.125 *rad* to 0.038 *rad* for $в_1$, The values of $\Delta\varphi_в$ for $в_2$ decrease from 0.245 *rad* to 0.092 *rad* in a non-linear manner. The main reason for this is that the difference between z_1 and z_2 is mainly when the dissipation coefficient $в_1$ is small and $в_2$ is large.



$$1-\Delta\dot{\varphi}_{в}=f(в_1);\ 2-\Delta\dot{\varphi}_{в}=f(в_1);\ 3-\Delta\dot{\varphi}_{в}=f(в_2);\ 4-\Delta\dot{\varphi}_{в}=f(в_2)$$

Figure 4. Graphs of the dependence of the deflection angle and speed ranges in the oscillations of the belt conveyor roller mechanism on the variation of the dissipation coefficients of the bearing belt bushings

Increasing $в_1$ and $в_2$, respectively, leads to a decrease in the speed of oscillations of the roller mechanism. In this case, when the dissipation coefficient of the belt element bushing support on the left side of the roller mechanism increases from 0.8 *Ns*/*m* to 6.0 *Ns*/*m*, $\Delta\dot{\varphi}_{в}$ values decrease from 0.21 s^{-1} to 0.14 s^{-1}, depending on the increase of $в_2$ $\Delta\dot{\varphi}_{в}$ values increase nonlinearly from 0.0223 s^{-1} to 0.12 s^{-1}. Therefore, $в_1 = (2.5 \div 3.0)$ *Ns*/*m* and $в_2 = (3.5 \div 4.5)$ *Ns/m* in order for the range of vibration of the roller mechanism located at an inclined angle to be in the range of (0.05÷0.15) *rad* It is desirable to get in the range.

CONCLUSION

It was found that the components of the vibration amplitudes of the roller mechanism placed under the slope angle of the belt conveyor and the graphs of the dependence of the angular speed range on the ratio of the belt base stiffness coefficients, the moment of inertia, and its influence on the change of the vertical vibration speed are not high. The resistance of the transported product should be $M_{rev} \geq (3.0 \div 5.0)\cdot 10^2$ *Nm* in order to ensure that the vibration values of the roller mechanism with belt support are in the range of (0.05 ÷ 0.15) *rad*. The rotation angle and speed ranges of the roller mechanism in the oscillations of the rolling mechanism depend on the variation of the dissipation coefficients of the bearing belt bushings. In this case, in order for the range of vibration of the roller mechanism to be in the range of (0.05 ÷ 0.15) *rad*, take $в_1 = (2.5 \div 3.0)$ *Ns*/*m* and $в_2 = (3.5 \div 4.5)$ *Ns*/*m* is appropriate.

REFERENCES

[1]. Веников, В.А. Теория подобия и моделирования. М.: Высш. шк.,1984. 439 с.
[2]. Седов, Л.М. Методы подобия и размерности в механике. М.: Наука, 1987. 432 с.

[3]. Смирнов В.К. Сопротивление движению ленты от шевеления материала при проходе роликов / В.К.Смирнов, И.А.Шпакунов // – В кн.: Горнорудные машины и автоматика. М.: Недра, 1966, вып. П. с.228-235.

[4]. A.Djuraev, B.N.Davidbaev, A.S.Jumaev. Improvement of the design of the belt conveyor and scientific basis for calculation of parameters. Global Book Publishing Services is an International Monograph & Textbook Publisher. Copyright 24 may 2022 by GBPS. 10.37547/gbps – 03. ISBN 978-1-957653-03-7, 1211 Polk St, Orlando, FL 32805, USA. – 151 p. Email info@scientificpublication.org.

[5]. Jumaev Akbarjon Sayfullaevich, Djuraev Anvar, Abduraxmanova Muattar Musurmankulovna. Analysis of the influence of the properties of oil products on the performance of belt conveyor guide roller mechanisms. Harvard Educational and Scientific Review International Agency for Development of Culture, Education and Science. Har. Edu.a.sci.rev. 0362-8027 Vol.2. Issue 2.
Pages 44-52. 10.5281/zenodo.7170607. https://doi.org/10.5281/zenodo.7181271.

[6]. Djuraev A.Dj., Davidbaev B.N., Mirzakhonov Yu.U., Davidbaeva N.B., Umarov B.Kh. Flat-belt transmission with tension roller.\\ Patent Uzbekistan FAR 00780 No. 12. 2012.

[7]. Mirzakhonov Yu.U., Khursanov B.J., Akhrorov A.A., Sulaimonov A. (2019). Application of tensioning roller parameters in theoretical study of the dynamics of transport belts.\\ In Energysaving technologies and equipment in the road and construction industries (pp. 134-138).

[8]. Jumaev Akbarjon Sayfullaevich, Turdaliyeva Makhliyo Yo'ldoshevna, Ibragimova Nodira Ilkhomovna. Dynamic analysis of machine assembly of belt conveyor with roller mechanisms with composite belt elements. British View ISSN 2041-3963. Volume 7 Issue 3 2022 DOI 10.5281/zenodo.7139012, Impact Factor: Universal impact factor 8.528, SJIF 2022: 4.629, 26-33 p. http://britishview.co.uk/.

[9]. Akbarjon Jumaev, Fevzi Istablaev, Mehriniso Dustova. Development of the theory of calculation of constructive and rational parameters of belt conveyor roller mechanisms. Cite as: AIP Conference Proceedings 2467, 060025 (2022); https://doi.org/10.1063/5.0093687. Published Online: 22 June 2022.

[10]. Mansurova M.A., Nigmatova F.U., Ulkanbayeva G.D. Determination of Line Tension Insurense Belts With Additional Shock Absorber. The American Journal of Enginering and Technology, ISSN 2689-0984, USA November 30, 2020, -P. 179-184.