THE INFLUENCE OF THE PROPERTIES OF OIL PRODUCTS ON THE OPERATION OF BELT CONVEYOR GUIDE ROLLER MECHANISMS IN MINING INDUSTRY ENTERPRISES

Jumaev Akbarjon Sayfullayevich
Almalyk State Technical Institute Doctor of Philosophy (PhD) in Technical Sciences, Associate Professor
E-mail: akbarjumayev011@gmail.com
Khusanova Djamilya Kurambaevna
Institute of Ground Forces UMSD Republic of Uzbekistan, Chirchik, Uzbekistan
Doctor of Philosophy (PhD) in Technical Sciences, Associate Professor
E-mail: dzamilahusanova75@gmail.com
Turabov Ilyos Shukhrad o‘g‘li
Almalyk Mining and Metallurgical Complex JSC Engineering School, Almalyk, Uzbekistan Teacher
E-mail: ilesturabov1@gmail.com

Annotation

This article analyzes the wide application of various types of lubricating materials used on the internal surfaces of parts performing the function of a sliding support in the guiding roller mechanism of a belt conveyor. Despite all the advantages of lubricants, based on the operational experience of mechanisms working in different industries, it has been determined that the reliability and strength of lubrication system components of belt conveyors, especially under low-temperature conditions, are insufficient. This drawback is characterized by the specific properties of lubricating materials, their structural lattice structure, and operational characteristics.

Keywords: belt conveyor, roller mechanism, sliding support, lubricants, structural grid, operation, temperature, reliability, durability.

Annotatsiya. Ushbu maqolada tasmali konveyer yo‘naltiruvchi rolikli mexanizmi sirpanuvchi tayanch vazifasini bajaruvchi detal ichki yuzalarida qo‘llaniladigan turli xil moylash materiallari keng qo‘llanilishi tahlil qilinadi. Moylash materiallarining barcha afzalliklariga qaramay, turli sohalarda ishlaydigan mexanizmlar tajribasi asosida, ayniqsa past harorat sharoitida tasmali konveyerlarning moylash tizimi tarkibiy qismlarining ishonchliligi va mustahkamligi yetarli emasligi aniqlangan. Ushbu noqulaylik moylash materiallarining o‘ziga xos xususiyati, strukturaviy panjara tuzilishi hamda ekspluatatsion xususiyatlari bilan tavsiflanadi.

Tayanch so‘zlar: tasmali konveyer, rolikli mexanizm, sirpanuvchi tayanch, moylash materiallari, strukturaviy panjara, ekspluatatsiyar, harorat, ishonchlilik, mustahkamlik.

Аннотация. В данной статье анализируется широкое применение различных видов смазочных материалов, используемых на внутренних поверхностях деталей, выполняющих функцию скользящей опоры в направляющем роликовом механизме ленточного конвейера. Несмотря на все преимущества смазочных материалов, на основе опыта эксплуатации механизмов в различных отраслях установлено, что надежность и прочность элементов системы смазки ленточных конвейеров, особенно при низких температурах, являются недостаточными. Данный недостаток характеризуется специфическими свойствами смазочных материалов, их структурной решетчатой организацией и эксплуатационными характеристиками.

Ключевые слова: ленточный конвейер, роликовый механизм, скользящая опора, смазочные материалы, конструктивная сетка, эксплуатация, температура, надежность, долговечность.

The use of new types of lubricants used in the guide roller mechanisms of belt conveyors of mining enterprises has necessitated a review of scientific research work on

determining the resistance of the belt to movement occurring in the details acting as sliding supports, which are used instead of roller bearings. In the past, extensive research has been carried out in our Republic and foreign countries on the use of new types of lubricants used in the guide roller mechanisms of belt conveyors.

Various types of lubricants are widely used as lubricants for the internal surfaces of the parts that act as sliding supports of the belt conveyor guide roller mechanism. Despite all the advantages of lubricants, based on the experience of mechanisms operating in various industries, it has been established that these components of belt conveyors and their lubrication systems at low temperatures are not reliable and durable enough. This disadvantage is due to the specific nature of the lubricants, the structure of the structural grid, and the operational properties of the lubricants. At the same time, in order to understand the processes by which lubrication occurs, as well as their impact on the operation of the parts as sliding supports, it is necessary to consider the properties of the lubricants in detail [1].

Using plastic lubricants, it is possible to simplify the design of protective covers of guide roller mechanisms, reduce the weight and dimensions of the mechanisms, increase the operating time of the mechanism, while not requiring replenishment or replacement of the plastic lubricant, using plastic and composite materials with belt elements. When analyzing experimental studies of components that resist belt movement along pairs of guide roller mechanisms, the influence of the degree of filling of the bearing with lubricants, the design of protective covers and the ambient temperature during operation was determined [2,3].

It is important to observe the effect of the level of filling of the trapezoidal grooves opened on the inner surface of the part acting as a sliding support with lubricants, as well as the movement of the protective cover parts of the new design used in the guide roller mechanism. When the part acting as a sliding support is filled with 60% lubricants,

the lubricants do not affect the protective covers, since the lubricants are distributed only along the axis and the inner surface of the part. Of course, this reduces the resistance of the belt conveyor (Fig. 1).

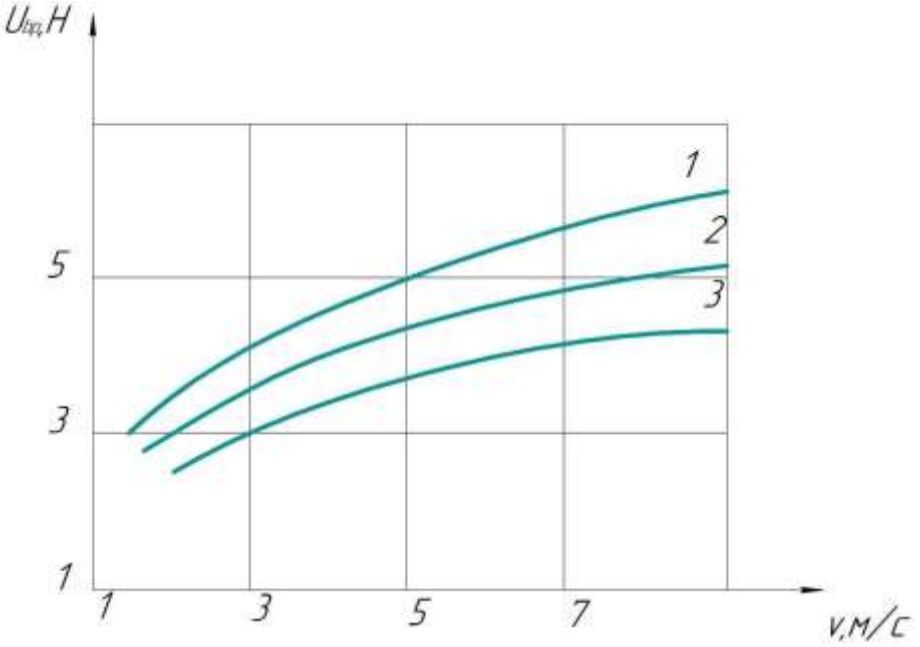

FIGURE 1. The dependence of the resistance to rotation of the guide roller mechanism on the external rotation speed and the lubrication of the inner surface of the part acting as a sliding support; 1, 2, 3 are 45, 30, 10%, respectively.

Due to the principle of operation of the guide roller mechanism, after some time, the temperature of the parts acting as sliding supports increases. As the ambient temperature Θ_{OX} decreases, the viscosity of the lubricant increases, resulting in a temperature rise Θ_Y in the protective covers (Figure 2).

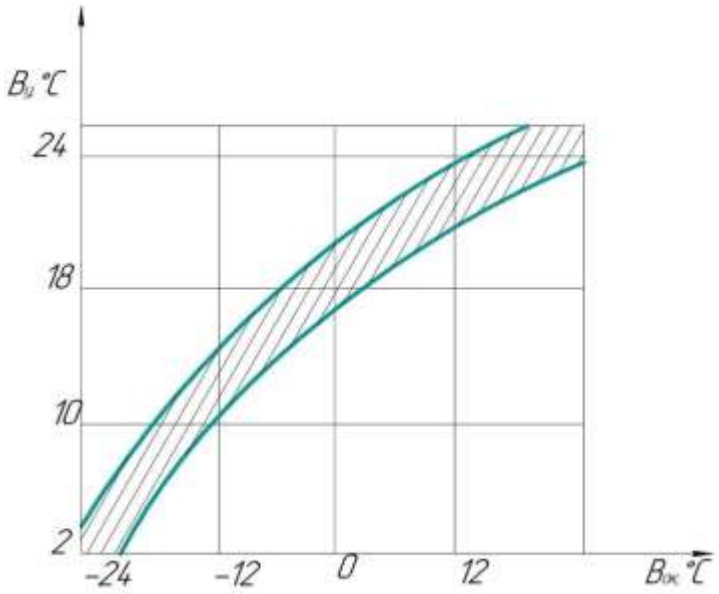

FIGURE 2. Temperature dependence of the operating area of the protective covers of the guide roller mechanisms, depending on the ambient temperature

It is recommended to consider the effect of the average temperature coefficient of the ambient temperature here [5, 6]:

$$k_0 = \frac{U_{BP}(\Theta)}{U_{BP}(30^0 C)}; \quad (1)$$

It was k_0 also found that the coefficient depends on the type of lubricant and the speed. It is calculated according to the following formula [7, 8]:

$$k_\Theta = \exp(k_1 - k_2\Delta), \quad (2)$$

where $\Delta -$ is the difference between the internal and external temperatures; $k_1 - k_2$ are coefficients determined based on experimental data (Figure 2).

The following formula is given to calculate the rotational resistance of guide roller mechanisms:

$$U_{BP} = (a + bv)k_\Theta + C_0 F + C_P P \quad (3)$$

Most of the previous research was focused on the selection of lubricants for belt conveyors operating in northern conditions with ambient temperatures ranging from + 40° to – 40 °C [9, 10].

Therefore, the requirements for belt conveyor guide roller mechanisms and their lubricants are increasing. The reason for the increase in the coefficient of resistance to rotation of guide roller mechanisms is considered to be the dependence of the quality of lubricants, which requires research and development to create special lubricants. When the temperature changes within the above limits, the belt conveyor guide roller mechanisms operate without significant changes in the coefficient of resistance to rotation.

Typically, the resistance to rotation of the conveyor guide roller mechanisms accounts for 30 to 50 % of the total resistance to belt movement. The magnitude of the resistance to rotation of the guide roller mechanisms depends on the design of the protective covers, the type of lubricant, the load, the rotation speed and the ambient temperature. In mining enterprises, the greatest influence on the resistance to rotation of the guide roller mechanisms is exerted when belt conveyors are operated at low temperatures after a long stop.

Based on the performance characteristics of the part that acts as a sliding support that provides the supporting rotational movement of the belt conveyor guide roller mechanisms of mining enterprises, the most important operational properties of oil products are the following [11]:

- mechanical stability is the ability of the lubricant to resist wear. It depends on the type and concentration of the thickener, the chemical composition of the oil, the temperature of the oil, and the intensity of mechanical stress;

- chemical stability is the resistance of oil products to oxidation during storage and use. Oxidation of oils reduces their wear and anti-corrosion properties, reduces

colloidal stability, lubricating and protective properties. With increasing temperature, oil oxidation accelerates;

- thermal stability characterizes the operation of plastic oils at very high operating temperatures;

It is of great interest to study the effect of the properties of plastic oils on the operation of belt conveyor rollers during operation, to study changes in the viscosity of the oil as a result of exposure to negative temperatures. When a belt conveyor operates at low temperatures, due to the increased viscosity of the lubricants used in the guide roller mechanisms, the moments of resistance to the rotation of the rollers become equal to or greater than the friction moments of the conveyor belt on the outer shell of the rollers. As a result, the guide roller mechanisms of the belt conveyor stop rotating, which leads to damage to the equipment, and if the malfunction is detected late, it leads to the breakdown of the conveyor guide roller mechanisms and equipment failure.

It is worth noting that the use of poor-quality plastic lubricants can be one of the reasons for the appearance of wear during the rotational movement of parts acting as sliding supports. The effect of plastic lubricants on the appearance of vibration of parts acting as sliding supports is the destruction of the oil layer in the friction areas, as a result of which the vibration leads to the impact of the friction surfaces on each other.

REFERENCES

[1]. Jumaev, A., Istablaev, F., Dustova, M. Development of the theory of calculation of constructive and rational parameters of belt conveyor roller mechanisms. AIP Conference Proceedings, 2022, 2467, 060025. https://api.scienceweb.uz/storage/publication_files/9737/26397/666af69e34968.

[2]. 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.

[3]. Abduvaliev, U., Jumaev, A., Nurullaev, R., Ashirov, A., Abdurafikov, B. Influence of the Sectional Shape of the Grabbing Element of a Screw Composite Spindle on Agricultural Performance and Stability of Operation of a Cotton-Picking Machine. Lecture Notes in Networks and Systems, 2024, 1129. https://link.springer.com/chapter/10.1007/978-3-031-70670-7_25

[4]. Djuraev, A., Jumaev, A.S., Abduraxmanova, M.M. Analysis of the results of physical and mechanical experimental studies of the modernized belt conveyor. Journal of Physics: Conference Series, 2023, 2573(1), 012012. https://iopscience.iop.org/article/10.1088/1742-6596/2573/1/012012

[5]. Djuraev, A., Jumaev, A.S., Ibragimova, N.I., Turdaliyeva, M.Y. Analysis of the dynamics of a belt conveyor with composite guide rollers and elastic elements. Journal of Physics: Conference Series, 2023, 2573(1), 012026. https://api.scienceweb.uz/storage/publication_files/9737/26378/666ad94ba5c1b

[6]. Abduvaliev, U., Jumaev, A., Nurullaev, R., Jakhonov, S., Investigation of the process of the influence of winding spindles with cotton fiber on the performance of a cotton picker. E3S Web of Conferences, 2024, 548, 04013. https://www.e3s-conferences.org/articles/e3sconf/abs/2024/78/e3sconf_agritech x_04013/e3sconf_agritech-x_04013.html.

[7]. Tilabov, B., Jumaev, A., Sherbutaev, J., Normurodov, U., Salimov, G. Testing of heat-treated surfaced samples and machine parts for hardness and wear resistance. E3S Web of Conferences, 2024, 548, 03014. https://www.e3s-conferences.org/articles/e3sconf/abs/2024/78/e3sconf_agritech-x_03014/e3sconf_agritech-x_03014.html

[8]. Jumayev A.S., Abduraxmanova M.M. Modernizatsiya qilingan tasmali konveyyer rolikli mexanizmlarining tajribaviy tadqiqot natijalari tahlili. Scientific Journal of Mechanics and Technology. ISSN 2181-158X, volume 6, Issue 1, 2025.

[9]. Djuraev, A. Jumaev. Providing the development of new designs for the design of the roller mechanism transmitting rotational motion in belt conveyors. International Journal of Emerging Trends in Engineering Research. ISSN 2347 – 3983. Volume 8. No. 9, September 2020.

[10]. A. Djuraev, Sh. S. Khudaykulov, A. S. Jumaev. Development of the design and calculation of parameters of the saw cylinder with an elastic bearing support jin. International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-8 Issue-5, January 2020. https://www.ijrte.org/portfolio-item/E6952018520/

[11]. [12]. A.S. Jumaev, A. Djuraev, M.M. Abduraxmanova. 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. Vol.2. Issue 2 Pages 44-52. 2020.

[12]. A.S. Jumaev, A. Djuraev, A.N. Pushanov. Development of models of recression of defatory states of components as a result of external loads of belt conveyor drums. Harvard Educational and Scientific Review International Agency for Development of Culture. Vol.2. Issue 2 Pages 36-43. 2020.

[13]. A.D. Djuraev, A.S. Jumaev. Study the influence of parameters of elastic coupling on the movement nature of support roller and rocker arm crank-beam mechanism. International Journal of Advanced Research in Science, Engineering and Technology Vol. 6, Issue 6, June 2019.

[14]. A.S. Jumayev. Tasmali konveyer rolikli mexanizmlarini resurstejamkor konstruksiyalarini ishlab chiqish va nazariy tahlil qilish. Scientific journal of mechanics and technology ISSN 2181-158X, volume 5, Issue 1, 2024.