# 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 36-43.
10.5281/zenodo.7170607


Harvard Educational and Scientific Review
International Agency for Development of Culture, Education and Science
United Kingdom
Street: 2 High Street City: Ashby Phone number 079 6425 7122
Zip code DN16 8UZ Country United Kingdom
USA
Soldiers Field Boston, MA 02163 +1.800.427.5577



International Agency for Development of Culture,Education and Science United Kingdom
USA Soldiers Field Boston

Har. Edu.a.sci.rev. 0362-8027
Vol.2. Issue 2 Pages 36-43.
10.5281/zenodo.7170607 

# DEVELOPMENT OF MODELS OF RECRESSION OF DEFATORY STATES OF COMPONENTS AS A RESULT OF EXTERNAL LOADS OF BELT CONVEYOR DRUMS

**Jumaev Akbarjon Sayfullaevich**
Doctor of Philosophy in Technical Sciences (PhD), Associate Professor at Almalyk branch of Tashkent State Technical University named after Islam Karimov
E.mail: akbarjon.jumayev@mail.ru
**Djuraev Anvar**
Doctor of technical sciences, professor at Tashkent Institute of Textile and Light Industry E.mail: anvardjurayev1948@mail.ru
**Pushanov Akbar Nurlan oglu**
Assistant at Almalyk branch of Tashkent State Technical University named after Islam Karimov
E.mail: Akbar_Pushanov@mail.ru

**Abstract**: The article discusses developing and implementing a regression model to calculate various damages to their components due to different external loads from single-belt conveyor drums from vehicles used in mining enterprises. According to the calculation results, high equivalent loads occurring in the members of the guide drums were calculated. As a result, by applying this regression model, it is possible to increase the service life of belt conveyors several times. This, in turn, during the operation of belt conveyors used in mining enterprises, economic efficiency is brought several times.

**Keywords:** conveyor, guide drum, equivalent, loading, regression, deformation, design, parameter, technology

## INTRODUCTION

Today, in order to radically improve the state of the world economy, it is important to further improve the equipment and technology. In particular, it is important to increase the extraction of minerals by increasing labor productivity by increasing the efficiency of complex mechanization and automation in the mining industry.

One of the important links in the technological process in the mining industry is transport. Belt conveyors are increasingly used in transport and technological schemes. Belt conveyors are becoming increasingly important as quarry depths increase, accounting for an average of 50-70 percent of mining costs. The modern condition of belt conveyors is, of course, characterized by an increase in its operating productivity and transport length. This in turn increases the number of conveyor drums. As a result, it reduces the overall reliability of belt conveyors and worsens their technical and economic performance.

## LITERATURE REVIEW

In this regard, the world's leading scientists, including L.G. Shakhmeister, V.G. Dmitriev, V.I. Galkin, V.P. Dyachenko, A.A. Titov, in modern scientific research centers on the effect of plastic oils on the belt conveyor and its components they are

Vol.2. Issue 2 Pages 36-43.
10.5281/zenodo.7170607
conducting a number of scientific and practical researches. L.Ya. Perel and A.A. In his scientific research, Filotov worked on calculating the performance of bearing parts, taking into account the effect of plastic lubricants.

In the analysis of experimental studies of the components that resist the movement of the belt along the pairs of belt conveyor guide roller mechanisms, the effect of the degree of filling of the bearing with lubricants, the design of protective covers and the ambient temperature during the operation was determined [1].

The production of new technical level conveyor belts and the use of innovative design stages will reduce transportation costs, reduce the negative impact of transport facilities on the environment, reduce transportation costs and increase operational safety. Belt conveyors, in turn, will increase the efficiency of ore transportation by 25-30 %, and it is important that these figures increase as quarries deepen [2].

**RESULTS**

As a result of different loads and external shocks of belt conveyor guide drums, it is important to create a regression model to facilitate the performance of various damage verification calculations on their components. To do this, it is necessary to apply a regression model of stress states as a result of external influences of drum components:

$$\varphi\ (X_1, X_2, .......X_n) = B_0 + B_1X_1 + \ldots\ldots + B_nX_n \qquad (1)$$

in which case, each factor changes at two levels. As a result, the use of a linear model is allowed, because the components produced by belt conveyor drums operate in the zone of elasticity. In this case, the stress as a result of external influences is linear, depending on the deformation [3, 4].

To do this, we need to take the following as input and control factors:

$X_0$ – is the width of the conveyor belt, *mm* ($V$);

$X_1$ – diameter of the guide drum, *mm* ($D$);

$X_2$ – thickness of the drum shell (obeychayka), *mm* ($T_0$);

$X_3$ – thickness of drum carcass parts, *mm* ($T_k$);

$X_4$ – is the slope of the drum winding angle, *degree* ($\alpha_{\mathbf{0}}$);

$X_5$ – voltage of the working part of the conveyor belt, *kN* ($S_{СБ}$);

$X_6$ – is the belt conveyor gravity factor ($T_f$).

The output parameters will be the maximum equivalent stresses that occur in the shaft, shell (obeychayka) and carcass material and are calculated according to the fourth force theory. So, to build a linear model, we first write a complex, which is a project of an integer grid, which looks like this [5].

Table 1

Calculate the values of the function $f_j\ (X)$

| Experience № | $X_0$ | $X_1$ | $X_2$ | $X_3$ | $X_4$ | $X_5$ | $X_6$ |
|---|---|---|---|---|---|---|---|
| 1 | 1100 | 700 | 5 | 5 | 230 | 8 | 4 |
| 2 | 1100 | 700 | 7 | 5 | 170 | 12 | 3 |
| 3 | 700 | 700 | 7 | 7 | 170 | 8 | 4 |
| 4 | 1100 | 400 | 7 | 7 | 230 | 8 | 3 |
| 5 | 700 | 700 | 5 | 7 | 230 | 12 | 3 |
| 6 | 700 | 400 | 7 | 5 | 230 | 12 | 4 |
| 7 | 1100 | 400 | 5 | 7 | 170 | 12 | 4 |

Vol.2. Issue 2 Pages 36-43.
10.5281/zenodo.7170607

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 8 | 700 | 400 | 5 | 5 | 130 | 8 | 3 |

We use polynomial variables as basic $f_j$ ($X$) functions:

$f_j$ ($X$) = 1, $f_1$ ($X$) = $X_1$, …, $f_n$ ($X$) = $X_n$;

$f_{n+1}$ (X) = $X_1^2$, …, $f_{2n}$ ($X$) = $X_n^2$;

$f_{2n+1}$ ($X$) = $X_1 X_2$, …, $f_{2n} + \mathbf{c_n^2}$ ($X$) = $X_{n-1} X_n$.

From the given base equations it should be noted that it is always possible to calculate the values of any base function $f_j$ ($X$) from known measurable values of $X$.

In this case, the $N$ = 8 calculations of the belt conveyor guide drums are performed with the values of the factors $n$ = 7 given in Table 1 below.

Eight observational sets on data factor values were developed to obtain the results of point calculations of the regression model parameters. In the form of $X_0$, ..., $X_6$ and the answer $Y$ – matrix, this information can be written as [6]:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | $X_1$ | | $X_{10}$ | $X_{11}$ … | $X_{16}$ | | $y_1$ |
| X= | $X_2$ … | = | $X_{20}$ … | $X_{21}$ … … … | $X_{26}$ … | ; $y$ = | $y_2$ … |
| | $x_8$ | | $X_{80}$ | $X_{81}$ ... | $X_{86}$ | | $y_8$ |

The $X$ – matrix is completed according to Table 1.

Using the initial data in Table 1, the computer software calculations to obtain the $Y$ ($kN$ / $mm^2$) vector as a result of the calculations take the following form:

| Experience № | Y Vector | | |
|---|---|---|---|
| | For Val | For the carcass | For the shell |
| 1 | 0,0176 | 0,0503 | 0,1111 |
| 2 | 0,0095 | 0,0319 | 0,0572 |
| 3 | 0,0128 | 0,0395 | 0,0659 |
| 4 | 0,0039 | 0,0103 | 0,0213 |
| 5 | 0,0232 | 0,0736 | 0,1418 |
| 6 | 0,0231 | 0,0746 | 0,1564 |
| 7 | 0,0067 | 0,0191 | 0,0301 |
| 8 | 0,0081 | 0,0265 | 0,0455 |

In each of these calculations, the numerical values of all the basic functions can also be written in the form of an $F$ – matrix:

| | | | | | |
|---|---|---|---|---|---|
| | $f_{10}$ | $f_{11}$ … | $f_{1,36}$ | | $f^T(X_1)$ |
| $F$ = | $f_{20}$ … | $f_{21}$ … … … | $f_{2,36}$ … | = | $f^T(X_2)$ |
| | $f_{80}$ | $f_{81}$ … | $f_{8,36}$ | | $f^T(X_8)$ |

Each $f^T$ ($X_i$) element of the $F$ – matrix looks like this (to simplify, the $j$ – index is removed):

$f^T(X_i)$ – [1, B, D, $T_0$, $T_K$, $\alpha_0$, $S_{СБ}$, $T_\varphi$, $B^2$, $D^2$, $T_0^2$, $T_K^2$, $\alpha_0^2$, $S_{СБ}^2$, $T^2_\varphi$, DB, $T_0$B, $T_K$B, $\alpha_0$B, $S_{СБ}$B, $T_\varphi$B, $T_0$D, $T_K$D, $\alpha_0$D, $S_{СБ}$D, $T_\varphi$D, $T_K$ $T_0$, $\alpha_0$ $T_0$, $S_{СБ}$ $T_0$, $T_\varphi$, $T_0$, $\alpha_0$ $T_K$, $S_{СБ}$ $T_K$, $T_\varphi$ $T_K$, $S_{СБ,}$ $\alpha_0$, $T_{\varphi,}$ $\alpha_0$, $S_{СБ}$ $T_\varphi$].

Using the above data, it is necessary to estimate the vector of unknown regression coefficients $\beta_0, \beta_1,\ldots.. \beta_d$ or $\beta^T$:

$$\beta^T = \beta_0, \beta_1, \ldots.., \beta_d, \quad (2)$$

 

It is necessary to find the corresponding values of the values of the coefficients $\beta_0$, $\beta_1$, ....., $\beta_n$ or vectors of the given expression (2) [7, 8].

To do this, we use the least squares method, according to which the *b* – values are obtained from the condition of minimizing the sum of the quadratic deviations of the response values obtained using the regression model. That is, by minimizing the amount:

$$\sum = \sum_{g=1}^{N}[y_g - (b_0 f_{g0} - b_1 f_{g1} + \cdots + b_d f_{gd}) = min \quad (3)$$

As a result of calculating the regression coefficients, the values of $b_i$, which is the sum of the squares shown, are obtained. Minimization of the sum of squares is carried out in the usual way by means of differential calculations, equaling the product of $b_0$, $b_1$, ..., $b_d$ to zero (3):

$$\frac{\partial\sum}{\partial b_0} = -2\sum_{g=1}^{n}\left[y_g - \left(b_0 f_{g0} - b_1 f_{g1} + \cdots + b_d f_{gd}\right)\right] f_{g0} = 0;$$

$$\frac{\partial\sum}{\partial b_1} = -2\sum_{g=1}^{n}\left[y_g - \left(b_0 f_{g0} - b_1 f_{g1} + \cdots + b_d f_{gd}\right)\right] f_{g1} = 0;$$

$$\frac{\partial\sum}{\partial b_d} = -2\sum_{g=1}^{n}\left[y_g - \left(b_0 f_{g0} - b_1 f_{g1} + \cdots + b_d f_{gd}\right)\right] f_{gd} = 0;$$

After the given changes we get a system of linear algebraic equations, as a result of which we can solve the necessary calculations $b_0$, b`,..., $b_d$:

$$b_0 \sum_{g=1}^{N} f_{g0}^2 + b_1 \sum_{g=1}^{N} f_{g0} f_{g1} + \cdots + b_d \sum_{g=1}^{N} f_{g0} f_{gd} = \sum_{g=1}^{N} y_g f_{g0};$$

$$b_0 \sum_{g=1}^{N} f_{g0} f_{g1} + b_1 \sum_{g=1}^{N} f_{g1}^2 + \cdots + b_d \sum_{g=1}^{N} f_{g1} f_{gd} = \sum_{g=1}^{N} y_g f_{g1}; \quad (4)$$

$$b_0 \sum_{g=1}^{N} f_{g0} f_{gd} + b_1 \sum_{g=1}^{N} f_{g1} f_{gd} + \cdots + b_d \sum_{g=1}^{N} f_{gd}^2 = \sum_{g=1}^{N} y_g f_{gd};$$

The system of algebraic equations given above is usually called the system of normal equations. These can actually be written in the form of a matrix:

$(F^T F)\, B = (F^T Y)$.

Given the high level of complexity of the calculations developed, it seems very complex and problematic to perform without the use of n on a computer. A computer program was developed to calculate the regression coefficient. In this case, before performing the calculations described above, we obtain the $b_i$ regression coefficients (Table 2):

Table 2

Algorithm for checking the state of deformation of belt conveyor guide drums as a result of loads

| For Val | For the carcass | For the shell |
|---|---|---|
| 1 | 2 | 3 |
| -0,111975774453902 | -0,007182716795157 | -0,678842078827927 |
| -0,000111085629599 | -0,001775676145644 | -0,000499831353150 |

| | | |
|---|---|---|
| -0,000019499513258 | -0,000367485547590 | -0,000073872720566 |
| -0,008225058245730 | -0,020076296861090 | -0,058439613951772 |
| -0,042578033734349 | -0,169546960839296 | -0,040418810009243 |
| -0,000300123516799 | -0,004413579834527 | -0,003280436873993 |
| -0,011618953900042 | -0,026875603737340 | -0,038454412674486 |
| -0,066850217276722 | -0,059206233012687 | -0,163007846065340 |

In the following equation:

$$\boldsymbol{Y} = \sum_{j=0}^{d} \boldsymbol{b_j f_j}\ (\boldsymbol{X}) \quad (5)$$

It is important to determine whether the coefficients of the function values can be calculated for any value and, as a result, to obtain $Y$ – values, ie to design the belt conveyor shaft, shell and carcass structures taking into account the loads on it [6].

Of course, the calculations are made in three stages:

– in the first stage, the values of the functions are calculated. In this case, as mentioned above, the values of the functions depend only on the parameters of the drum and the conditions of the various loads that fall on it. The values of these functions presented in the form of this vector are written as follows:

$f^T(X)$ = [1, B, D, $T_0$, $T_{K,}$ $\alpha_0$, $S_{СБ}$, $T_\varphi$, $B^2$, $D^2$, $T_0{}^2$, $T_K{}^2$, $\alpha_0{}^2$, $S_{СБ}{}^2$, $T^2{}_\varphi$, DB, $T_0$B, $T_K$B, $\alpha_0$B, $S_{СБ}$B, $T_\varphi$B, $T_0$D, $T_K$D, $\alpha_0$D, $S_{СБ}$D, $T_\varphi$D, $T_K$ $T_0$, α0 $T_0$, $S_{СБ}$ $T_0$, $T_\varphi$ $T_0$, $\alpha_0$ $T_{K,}$, $S_{СБ}$ $T_K$, $T_\varphi$ $T_K$,SСБ$_,$ $\alpha_0$, $T_\varphi$,α0, $S_{СБ}$ $T_\varphi$].

– in the second stage, the corresponding regression coefficients bi and the basic functions fj obtained in the first stage are multiplied.

– in the third stage, the obtained numbers are summed according to formula (1). These calculations occur in the components of the guide drums of a belt conveyor. This determines the maximum equivalent load values calculated according to the IV force theory.

A program is developed according to the above algorithm to perform the calculations of checking the guide drums of the belt conveyor.

Preliminary data for calculation in the program:

– belt tension during operation;

– the angle of wrapping the drum with tape;

– bandwidth;

– drum diameter;

– thickness of the shell (obeychayka);

– carcass thickness.

The length of the drum shell is automatically selected according to the recommendations.

**DISCUSSION**

A number of measures are being taken to increase the periodicity of belt conveyors in the mining industry, to conduct in-depth theoretical and experimental research, in particular, to develop new generations of high-efficiency and resource-saving mechanisms for technological machines in mining companies. Implementation of this task, including the development of design parameters and calculation methods of belt conveyor guide drums is one of the important tasks [9].

As the depth of quarries in the world increases, research is being conducted to create new types of vehicles, designs and resource-saving technologies, including the development of belt conveyors, their scientific and technical solutions. In this regard, in research centers of developed countries, including Germany, USA, France, Russia, Japan, China and other countries, special attention is paid to the creation of efficient designs of conveyors, reducing work noise, justifying their technological processes and parameters.

Conveyors used in mining enterprises are characterized by constant operating conditions, ie the presence of constant moisture and dust. As a result of the constant high chemical activity of water in underground mines, the effects of constant dust, sand particles and precipitation in open pit mining, the belt conveyor can enter the drum housings and subsequently affect the quality of oil products. In addition, an increase in relative humidity of 86 – 90 % as a result of the ambient temperature of the equipment at the place of use from – 40 ° C to +40 °C will inevitably affect the periodicity of operation of the equipment [10].

## CONCLUSION

During the execution of the program, a regriss model was constructed based on the given parameters of the routing drum. According to the results of the calculations, the maximum equivalent loads (calculated according to the fourth power theory) occurring in all components of the belt conveyor guide drums were calculated. Calculations made by the above method show that the error in the calculation of drums up to 2800 *mm* in length and up to 2500 *mm* in diameter does not exceed 3.5 %.

## REFERENCES

1. Шахмейстер Л.Г. Теория и расчет ленточных конвейеров / Л.Г. Шахмейстер, В.Г. Дмитриев // М.: Машиностроение, 1978. 392 с.

2. Дмитриев В.Г. Насыпные грузы на движущейся конвейерной ленте / В.Г. Дмитриев, В.П. Дунаев, Г.И. Перминов // Шахтный и карьерный транспорт, вып. 5 - М.: Недра, 1980, с. 14-17.

3. Зедгинидзе И.Г. Планирование эксперимента для исследования многокомпонентных систем. -М.: Наука, 1976. -390с.

4. Лизин В.Т., Пяткин В.А. Проектирование тонкостенных конструкций. -М.: Машиностроение, 1985. -344с.

5. Красовский Г.И., Филаретов Г.Ф. Планирование эксперимента. -Мн.: Изд-воБГУ, 1982. -302с.

6. Конвейеры: Справочник / Р.А. Волков, А.Н. Гнутов, В.К. Дьячков и др. Под общ. ред. Ю.А. Пертена. -Л.: Машиностроение, Ленинград. отд-ние, 1984. -367с.

7. Методы расчета деталей машин на выносливость в вероятностном аспекте: Методические указания. -М.: Изд. стандартов, 1980. -32с.

8. Модели и методы оптимизации надежности сложных систем / Волкович В.Л., Волошин А.Ф., Заславский В.А., Ушаков И.А.; Отв. ред. Михалевич В.С.; АН Украины. Ин-т кибернетики им. В.М. Глушкова. -Киев: Наук, думка, 1992. -312с.

9. А.Джураев и др. Теория механизмов машин. Изд. Г. Гулом 2004 г. с. 582.

10. Джураев А.Ж., Давидбаев Б.Н., Жаляев А.А., МирзахановЮ.У. Плоскоременная передача с натяжным роликом. // Патент Уз. Рес. UZIAP 4228, 31.03.97. № 1

11. 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. Page No. 4842-4847

12. DjuraevA.D, Jumaev A.S. 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 Copyright to IJARSET www.ijarset.com 9795

13. A.S.Jumaev, A.J.Juraev, N.N.Juraev, B. B.Qayumov. Parameters of choice and calculation of materials by the guiding composite roller mechanisms of tape conveyors / International Journal of Engineering and Information Systems (IJEAIS) // ISSN: 2643-640X, Vol. 4, Issue 8, August 2020. – p. 235 – 240.