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# LIFETIME DETERMINATION OF CONVEYOR BELTS BASED ON A PRODUCTION MONITOR AND MATHEMATICAL CALCULATION

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***Abstract:***
*The article illustrates of conveyor belts lifetime, they are the main strength support element of mining conveyors. The belt transport is very important element for application of material transports. The abrasion occurs of different materials very often. A transport stop of material production causes higher maintenance costs for rubber repair of conveyor belts. With precise lifetime analysis of conveyor belts can be eliminated downtime costs and towards maintenance too. Article does not describe how to complex solve problem of lifetime conveyor belts, only evaluate 20 pcs conveyor belts during put in selected conveyor belts by a specific production. The article conclusion determines and compares the calculated operating lifetime of conveyor belts.*

***Key words:***
*conveyor belts, production lifetime*

## 1 INTRODUCTION

At present is constantly increasing requirements for production, distribution and manipulate with different materials in the company. For this type transport it is appropriate to use the conveyors transport. The choice of such a mode of transportation and placing to logistics chain is possible greatly influence also performance and economic results of the company [1].

According toRistovic means of transportation are the most important aspect of the conveyance system. Thus, the adequate selection of conveyance means significantly influence safety and cost-efficiency, and as a result has important influence on the entire mining production cost-efficiency. The most employed element of the conveyance systems is the belt conveyer [2].
It must not be forgotten of wear impact of conveyor belts by their use running. This topic is investigated by Andrejiová and Pavlisková in the publication "Linear regression model dependence of conveyor belt lifetime of some its parameters"[3]. Similarly mathematical calculations of lifetime of conveyor belts also models, is investigated by Pavlisková in its publication "Deterministic strategy lifetime of conveyor belts"[4]. In terms of practical application of deterministic strategies are especially important for their relative simplicity. Lifetime by conveyor belt is greatly affected by transport material of potential impacts of the material on the conveyor belt.
In publication [5] the authors deal in the analysis of the issues, its impacts and proposals for reducing these negatives. Reduce these effects, the authors also deal with the article entitled „Increasing conveyor-belt life", where indicated that lifetime conveyor belt can be extended up to three times if adjust the height, which from the material falls onto a conveyor belt [6]. This fact is not taken into account and it is a fundamental mistake.
Work [7] provides information about the determining the wear of conveyor belts based on wear of cover layers in operative conditions, with using experiments, statistical methods and software products.
**Should not be to forget**
In the production of which is provided by material transport just using belt conveyors is important also its reliability. Despite the relatively simple structure it can break, due to the conveyor belt wear or damage. In order to minimize failure as low as possible, it is first necessary to choose the appropriate type of conveyor belt, just because this is an essential part of the entire conveyor. So that we can assess the conveyor belts in terms of their lifetime, it is necessary to know the laws in the ongoing process of their damage. Therefore it is important to keep records of the conveyor failures during their production running. Based on the evaluation of these records could be more specifically determine the lifetime of conveyor belts.

## 2 METHODS

To determine the service lifetime of the conveyor belts we can depend on from measurement ofloss of the covering layers 100,000 cycles. In the case of normal wear loss is calculated in the cover layers of 3-6 mm at 100,000 cycles. From the wear rate norm then we can derive the lifetime of the conveyor belt T [8]:

$$T = \frac{100.10^3.s.L}{3600.v.W}, \qquad (1)$$

where

$T$ is the lifetime conveyor belt in $[h]$,
$s$ is the thick rubber covering layer in $[m]$,
$L$ is the length of the belt conveyor in $[m]$,
$v$ is the speed of the conveyor belt in $[m.s^{-1}]$,
$W$ isthe wear rate in $[mm.100000cycle^{-1}]$.

The values of wear of the covering layers 100,000 cycles are shown in table 1.

***Tab. 1** Index wear strip W*

| **Hopper conditions** | **Belt speed** [m.s$^{-1}$] | **Impact height** [m] | **Conveyed material** Wear index W [mm] | | |
|---|---|---|---|---|---|
| | | | **The class 1** granularity0-15 mm high proportion soft fraction, little excoriating , low sift weight | **The class 2** granularity 50-100 mm high proportion soft fraction, little excoriating , low sift weight | **The class 3** granularity 150-400 mm high proportion soft fraction, little excoriating , low sift weight |
| Favorable | < 1 | < 0,5 | 0,4 | 0,6 | 1,4 |
| Normal | 1 - 3,5 | 0,5 - 3,5 | 0,8 | 1,4 | 2,4 |
| Adverse | > 3,5 | > 2,5 | 1,6 | 2,6 | 4 |

## 3 RESULTS

For a sample of 20 conveyor belts the mathematical formula (1) been verified. Data on samples of conveyor belts are from running production, where the transport agglomerate, additives, glowing material, pellets and coke. The running conditions are normal incident, height ranges from 0.5 meters to 2.5 meters, management of bulk material is optimal and belts have a mean relative speed. The real lifetime of conveyor belts, we have found from the records in the production and theoretical life was calculated by the formula (1). Technical characteristics of conveyors are shown in table 2.

***Tab. 2**Technical data of conveyor belts*

| Serial number | Title conveyor | Type of belt | Coverl ayers | Length DP [m] | Width DP [mm] | Speed DP [m.s-$^{1}$] | Granularit ymaterial [mm] | Output [t.h$^{-1]}$ | Engine [kW] |
|---|---|---|---|---|---|---|---|---|---|
| 1 | S 503 | P 1250/3 | 5 + 2D | 100 | 1200 | 1, 25 | 0, 15 | 1000 | 50 |
| 2 | S 504 | P 1000/3 | 4 + 2A | 12 | 1200 | 1, 25 | 0, 15 | 450 | 15 |
| 3 | S 505 | P 1250/3 | 5 + 2D | 100 | 1200 | 1, 25 | 0,15 | 1000 | 50 |
| 4 | S 506 | P 1250/3 | 5 + 2D | 130 | 1200 | 1, 25 | 0, 15 | 1000 | 55 |
| 5 | S 603 | P 1250/3 | 5 + 2A | 130 | 1200 | 1, 25 | 0, 15 | 1000 | 50 |
| 6 | S 604 | P 1000/3 | 4 + 2A | 40 | 1200 | 1, 25 | 0, 15 | 1000 | 50 |
| 7 | MS 71 | P 1000/3 | 4 + 2A | 20 | 1 000 | 1, 25 | 100 – 300 | 300 | 50 |
| 8 | MS 76 | P 1000/3 | 4 + 2A | 20 | 1 000 | 1, 25 | 100 – 300 | 300 | 50 |
| 9 | MS 81 | P 1000/3 | 4 + 2A | 20 | 1000 | 1, 25 | 100 – 300 | 300 | 50 |
| 10 | MS 86 | P 1000/3 | 4 + 2A | 20 | 1 000 | 1, 25 | 100 – 300 | 300 | 50 |
| 11 | MS 510 | P 1000/3 | 4 + 2A | 24 | 1200 | 1, 25 | 100 – 300 | 1000 | 10 |
| 12 | MS 610 | P 1000/3 | 4 + 2A | 24 | 1200 | 1, 25 | 100 – 300 | 1000 | 10 |
| 13 | RM 21 | P 1000/3 | 4 + 2A | 15 | 1200 | 1, 6 | 5 – 80 | 120 | 22 |
| 14 | RM 186 | P 800/3 | 4 + 2A | 420 | 650 | 2 | 5 – 80 | 100 | 18,5 |
| 15 | RM 187 | P 800/3 | 4 + 2A | 420 | 650 | 2 | 5 – 80 | 100 | 18,5 |
| 16 | RM 287 | P 800/3 | 4 + 2A | 420 | 650 | 2 | 5 – 80 | 100 | 18,5 |
| 17 | RM 311 | P 1200/4 | 6+3D | 350 | 1200 | 1, 25 | 100 – 300 | 450 | 22 |
| 18 | RM 314 | P 1000/3 | 4 + 2A | 50 | 1200 | 1, 6 | 5 – 80 | 120 | 22 |
| 19 | RM 315 | P 1000/3 | 4 + 2A | 30 | 1200 | 1, 6 | 5 – 80 | 120 | 22 |
| 20 | RM 368 | P 800/3 | 4 + 2A | 350 | 650 | 1, 25 | 5 – 80 | 160 | 15 |

For better illustration it is useful to include computations outputs in graphical form. In the figures (Fig.1 , Fig.2 ) is shown the maximum and minimum lifetime for each conveyor .

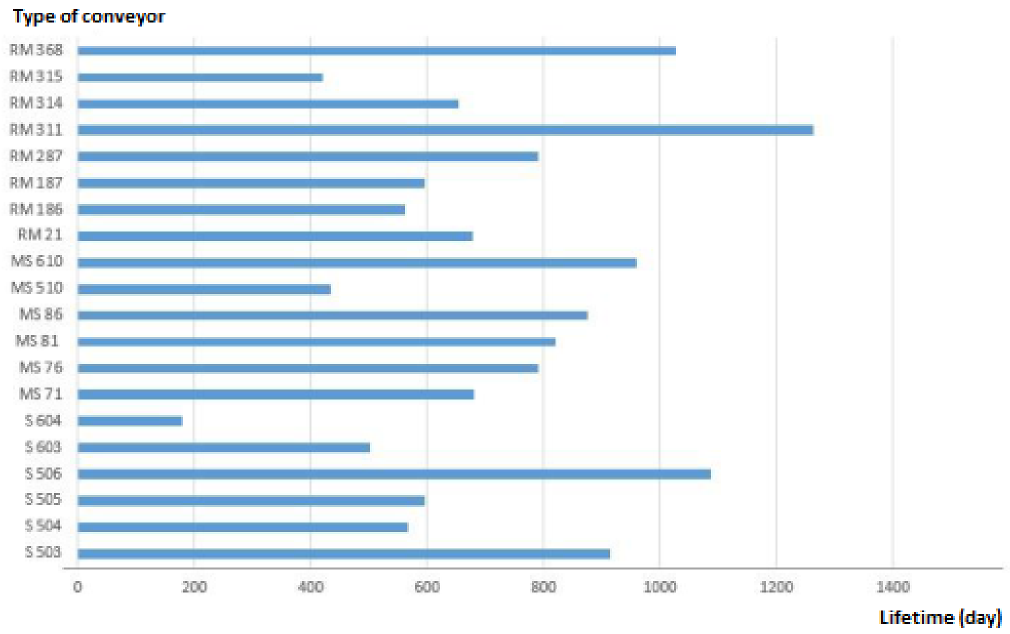


***Fig.1*** *Maximum lifetime of the individua lconveyors [autor]*

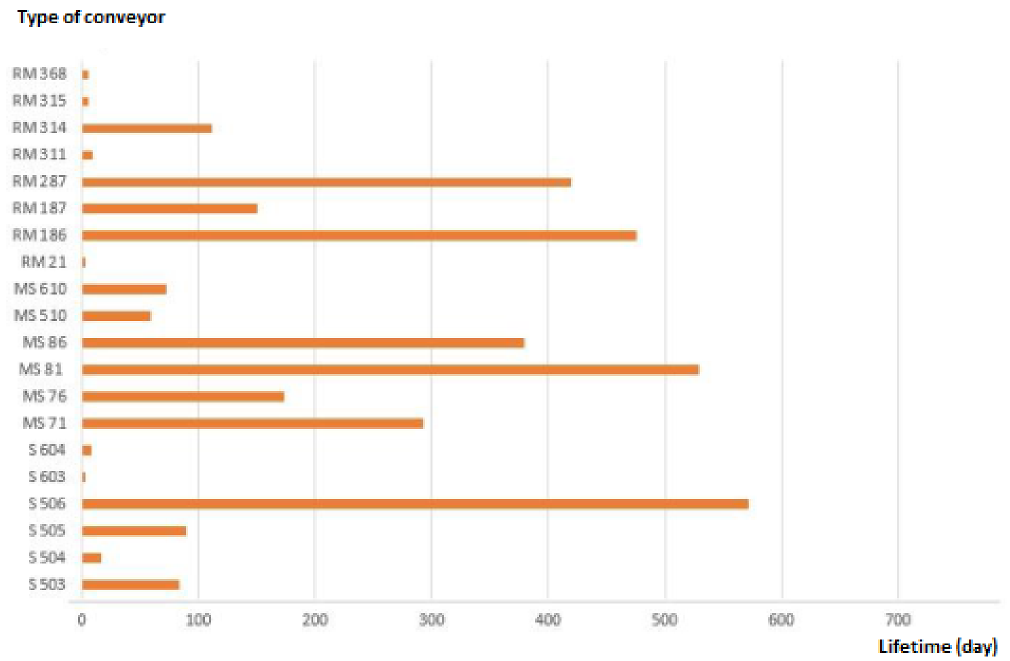


***Fig. 2*** *Minimum service lifetime of the individual conveyors [autor]*

These values are shown in Figure 3 for comparison and calculated operating lifetime. Some of the values measured and calculated of lifetime does not match the ground, that in calculating of the lifetime we used to wear of cover layer strip (W), define for transport coal. Judged transported material was not available for a particular transported material.

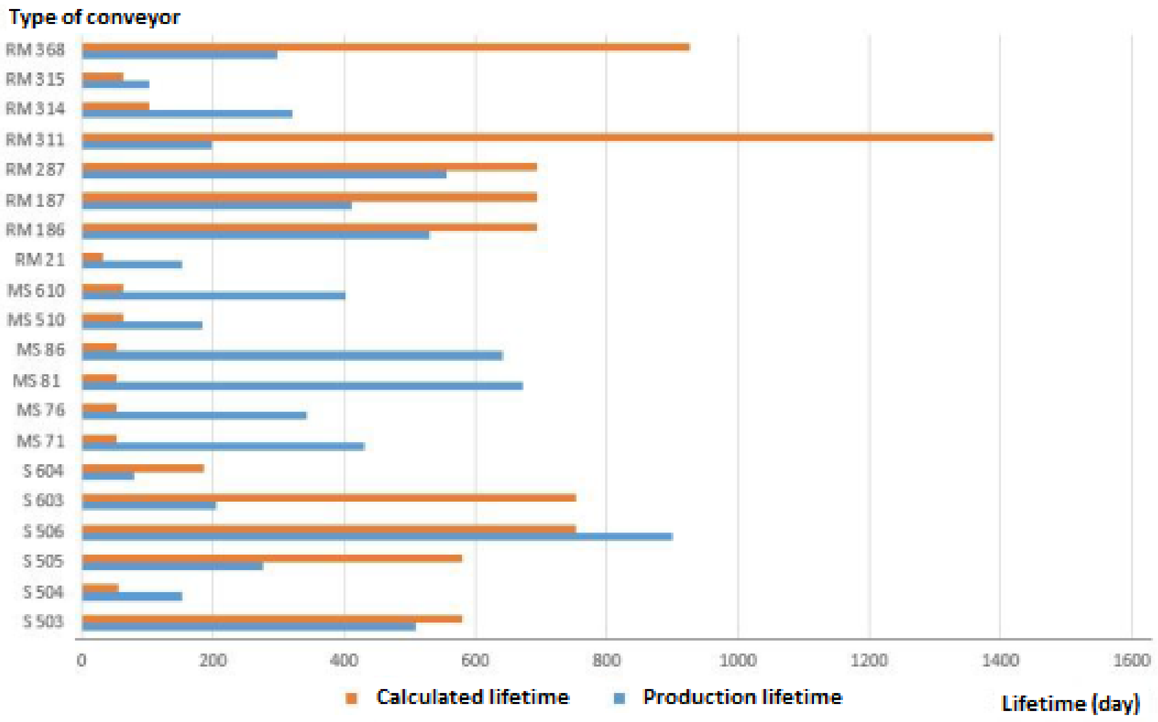


*Fig. 3* *Comparison of the calculated operating lifetime [autor]*

## 6 CONCLUSIONS

The article contains mathematical apparatus suitable for determining lifetime DP.The results allow a comparison of identified observation values from production and calculated lifetime values of conveyor belts, thus was creating a suitable database of data to predict in advance the optimal preventive for maintenance interval, so as the cost of the conveyor belts where minimized. The theoretical results of article offer forpracticeacceptable estimates.In conclusion that for practice is the most preferred these steps:

1. Keep regular record details of each conveyor belt.
2. After obtaining a sufficient amount of data to verify the models in conditions of particular production.
3. Evaluate which model is most acceptable for theparticular production and use this.

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