STUDY OF MINING ROLL BELT CONVEYERS IN LUPENI MINE

SUSANA ECATERINA APOSTU[1], IOSIF DUMITRESCU[2]

Abstract: Roll belt conveyers are the most widespread transportation means in galleries and inclined planes in coal mines. Due to the large number of belt conveyers, their correct dimensioning is essential, in order to estimate the power of the electrical network and energy consumption, automation of transport flow to improve the economic efficiency of the transport per ton of coal from underground to the surface. The paper presents the study performed for the transport flow in Lupeni Mine.

Key Words: Mine conveyer, belt, roll, driving drum, stretching drum

1. INTRODUCTION

Roll belt conveyers are the most widely used in galleries and inclined planes in coal mines, and in coal quarries only those are used. The belt is the most expensive element of the conveyer and the economic efficiency of the use of belt conveyers depends on its durability

Figure 1 presents the constructive scheme of a stationary belt conveyer, where: *1*- evacuation box; *2* – driving drum; *3* – rubber belt; *4* – upper rolls; *5* – support rolls; *6* – feeding funnel; *7* – stretching and returning drum; *8* – carriage; *9* – stretching cable; *10* – guiding roll; *11* – counterweight; *12* – stretching system framework; *13* – stretching head support; *14* – lower rolls; *15* –electric motor; *16* – metal construction; *17* – coupling with electromagnetic brake; *18* – reduction; *19* – hauled material.

The endless rubber belt 3 winding around the driving drum 2 and the stretching drum 7. The belt is supported by upper rolls 4 and lower rolls 14, mounted in supports on metal construction 5 and 16. The belt is loaded by funnel 6, at the stretching drum. The belt is unloaded at the driving drum, the material reaching bunker 1, or at any point along the conveyer with the help of a mobile unloading device.

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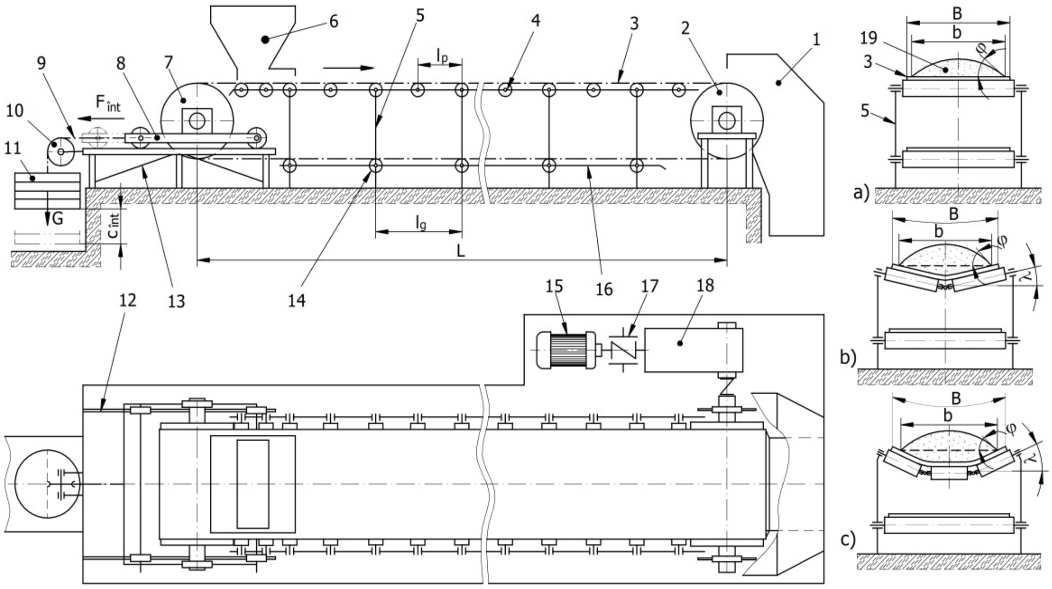

Figure 1. Construction diagram of a stationary roll belt conveyer

Depending on the width, the belt can be supported in the loaded part, on a single row of rolls, the belt being plane (Figure 1. a) or it can lean on two or three rows of rolls, when the belt is in the shape of a chute (Figures 1.b and 1.c), the roll axes inclination angle being $\lambda = 15° \ldots 45°$.

2. PRESENTATION OF THE TRANSPORTATION FLOW IN LUPENI MINE

Figure 2 shows the situation of nine 9 TMB 1000 belt conveyers, with their technical characteristics (length and installed power), included in the underground transportation flow diagram.

This ensures coal being hauled at level 300 and level 330 up to the 1300 t silo, where with the help of the 14 ton skip, it is taken out to the surface and transferred with TMB 1400 roll belt conveyers to the processing plant. At the skip there are two more 10 m belt conveyers to dose the coal underground $B_{3,4}$ .The length of the nine TMB 1000 conveyers varies in the range of 43 m and 547 m, these are equipped with two to seven 45 kW driving groups.

The nine TMB belt conveyers have a total hauling length of 2546 m and 43x45 = 1935 kW = 1,935 MW, installed power, of which 28x45=1260 kW = 1,26 MW in function.

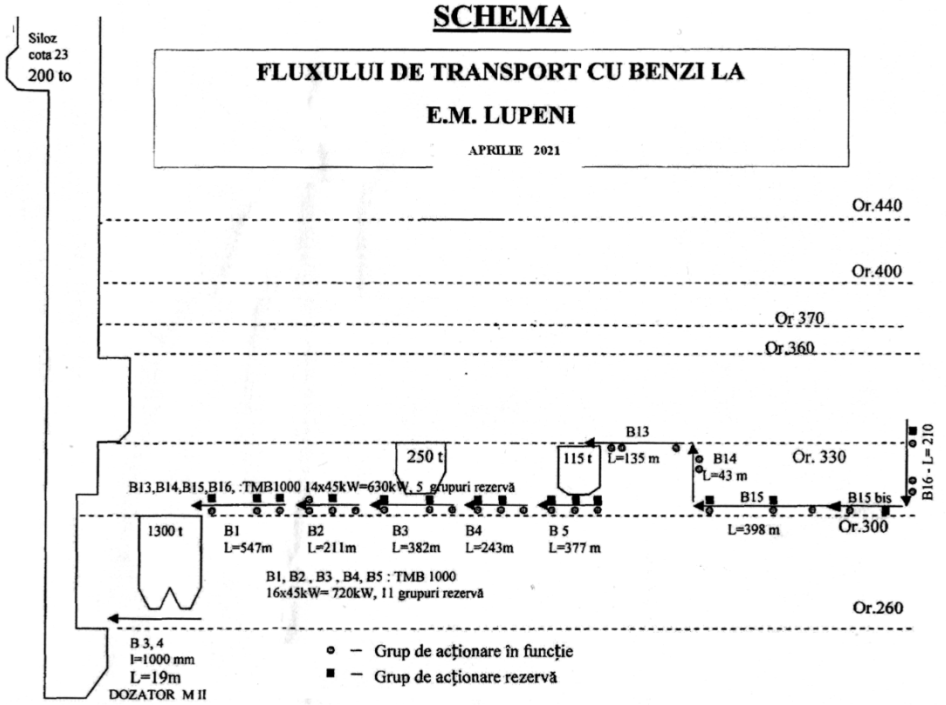

Figure 2. Diagram of haul flow with roll belt conveyers TMB1000-E.M.Lupeni

DIAGRAM OF HAUL FLOW WITH CONVEYERS IN LUPENI MINE
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Silo 23
200 level
Spare groups
Functioning driving group\\
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3. STUDY OF HAULING FLOW IN LUPENI MINE

Due to the variable length of the TMB belt conveyers, an analysis of the efficiency of their use has been carried out for lengths in the range of 80 and 520 m and a hauling flow rate in the range of 0 - 455 t/h, presented in chapter III. According to the instruction manual of the TMB 1000 (L. 37051 – UNIO Satu Mare) belt conveyer, page 3/53, the hauling flow rate is 450 t/h and can function at an inclination of 14°. This has been mentioned, because the coal transportation between levels 300 and 330 is done at 12° inclined planes.

For the analysis of the coal hauling efficiency with TMB conveyers, a conveyer scheme with two vertical inflections has been applied; the section of the hauled coal flow is for a directing of the belt on a chute with three support rolls, with a

30° lateral angle. Figure 3.a shows the diagram of the TMB belt conveyer with two driving groups, and in Figure 3.b. with four driving groups.

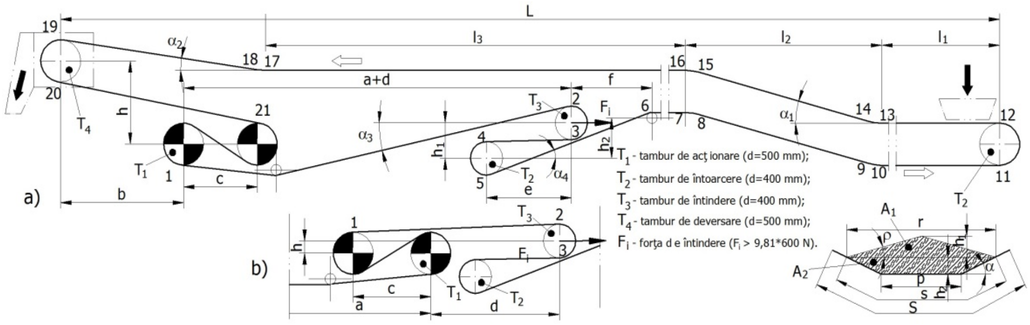

Figure 3. Diagram of the TMB conveyer with the inflection points along the route of the chain [driving drum, returning drum, stretching drum, dumping drum stretching force]

In the presented conveyer scheme, two hauling variants have been considered, when the hauling is horizontally, and two, when it is ascending at 12° with a horizontal part of 10% of its length L. For these variants, traction forces have been calculated in the 21 points of the conveyer and their variation graphs have been traced along the belt, Figure 4.

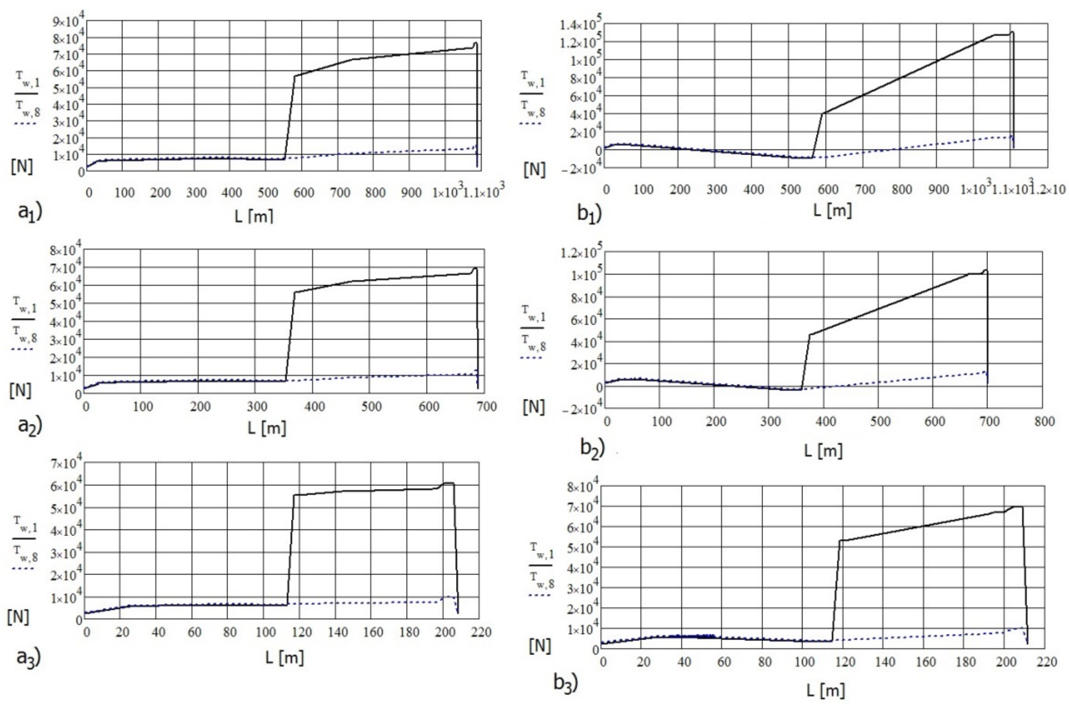

Figure 4. Graph of the traction forces in the conveyer belt

Variation graphs of the forces in the belt have been established for three lengths of the conveyer, thus: a_1, b_1 – for length L = 520 m; a_2, b_2 – for length L = 320 m; a_3, b_3 – for length L = 80 m.

At the second variant with ascending inclination of 12°, the deployed length of the belt is higher because the same length has been taken of the projection in horizontal plane as in the first case. In the graphs, force variation is presented for maximum hauling flow rate of 455 t/h (continuous line) and for idle run (discontinuous line).

In the traction forces in the belt graphs it is noticed that the higher rise occurs in the loading area of the coal, due to the difference between the belt speed and the component of the speed of the coal to be loaded along the transport direction.

Figure 5 shows the variation of the driving force of the belt depending on the coal flow rate being hauled for the two cases, Figures 5.a_1 and 5.b_1, function of the conveyer length for the two cases, Figures 5.a_2 and 5.b_2 and the percentage variation of the force, depending on the length of the conveyer, Figures 5.a_3 and 5.b_3.

It is noticed that the coal flow rate hauled has greatest influence on the driving force of the belt, being seven times greater at maximum flow rate compared to idle run, and less in the case of the length, where variations are maximum 46%, and at hauling on inclined plane 60%, respectively.

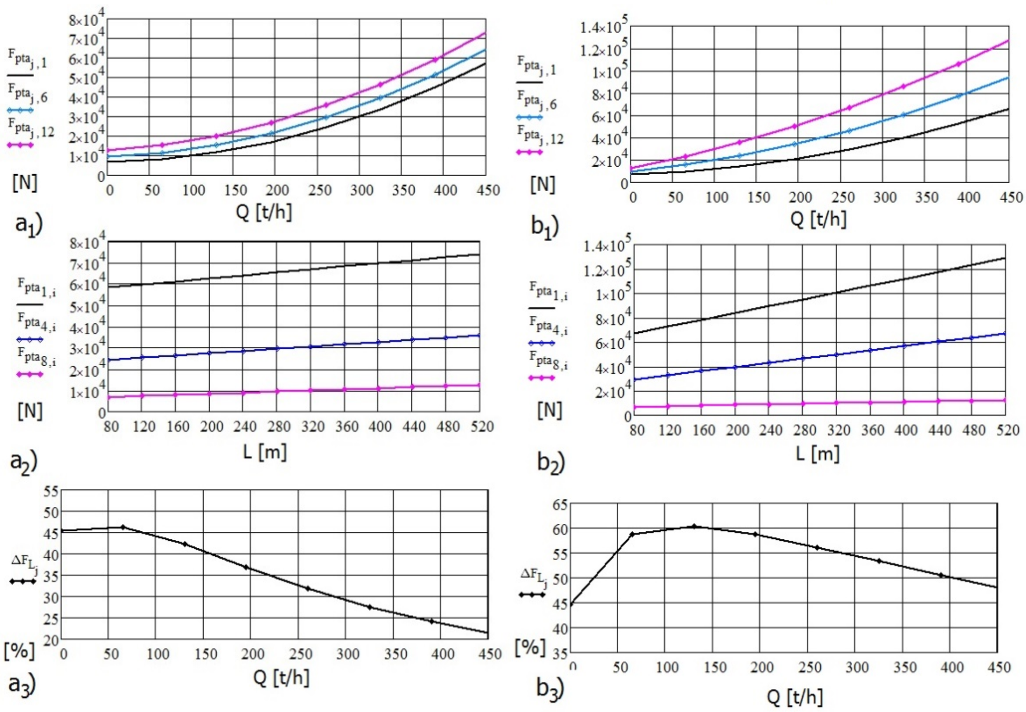

Figure 5. Variation of belt driving force function of the flow rate and length

Based on traction forces TMB 100 conveyer belt has been checked, PES/PA 1000/4/1000/14 belt with insertion (1000 mm width, with four insertions in

4x250=1000 daN/cm class of resistance, 14 mm thick) resisting at a tear force of 1000 kN. For 9 static strain safety coefficient, for normal STAS 7539-84 exploitation conditions (Table 36), a variation of the degree of belt use resulted, function of the length and flow rate hauled, shown in Figure 6.a, for horizontal functioning and Figure 6.b for ascending inclination of 12°. In these figures: 1 – 80 m long belt; 2 – 320 m long belt; 3 – 520 m long belt. It is noticed that the degree of belt use (strain) has values in the range of 10,6 – 83,8 % for horizontal haul, and 8,8 – 117,6 % in ascending coal transportation at 12°, the situation of the two inclined planes, between levels 300 – 330.

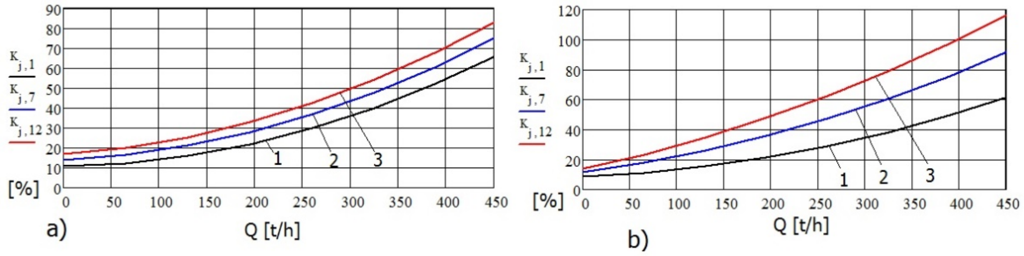

Figure 6. Variation of the degree of use of the conveyer belt

For the two variants, the necessary driving powers for TMB 1000 belt conveyer have been determined, and the installed driving powers are compared for two or four 4,5 kW groups. The power variation function of the length is shown in Figure 7.a for horizontal functioning, and Figure 7.b for ascending inclination of 12°, where: 1 – 455 t/h flow rate; 2 – 390 t/h flow rate; 3 – 260 t/h flow rate; 4 – 195 t/h flow rate; 5 – 0 t/h flow rate (idle run). It is noticed that the maximum rate of 455 t/h can be achieved with only four driving groups for 300 m conveyer lengths, and with six groups for inclinations of 12° and lengths of up to 300 m. The consumed power for idle run, depending on the length varies in the range of 18,5 kW - 33,8 kW at horizontal functioning, and 18,7 kW - 33,8 kW at ascending functioning at 12°, respectively. This power consumption at idle run in the two cases, horizontal and ascending at 12°, is due to the weight component of the belt on the empty branch of the conveyer.

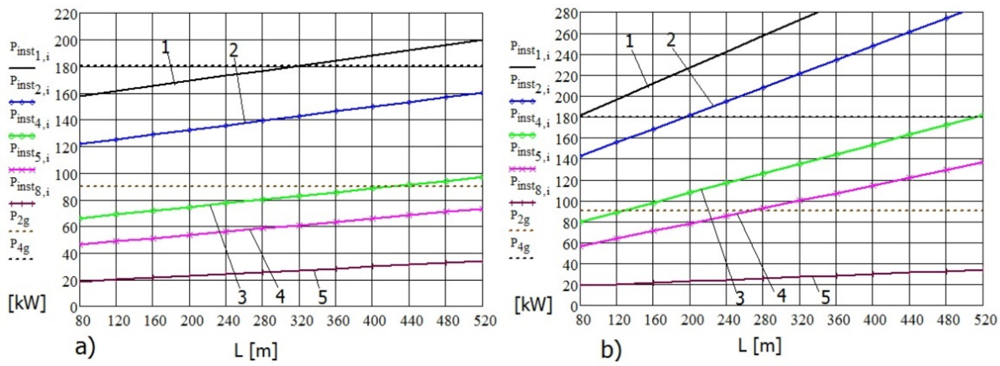

Figure 7. Variation of the necessary powers for the drive of the conveyer

If the idle run power losses percentage is reported, for the necessary power to achieve the maximum transport capacity 455 t/h, for the two cases the following variations have resulted, shown in Fig. 8. It is noticed that in all the cases the consumed power for the idle run of the conveyer is less than 17%, and in the case of conveyers functioning ascending on an inclined plane at 12° a less than 10,3 % results with decrease at the increase of the length, due to the weight of the belt on the empty branch.

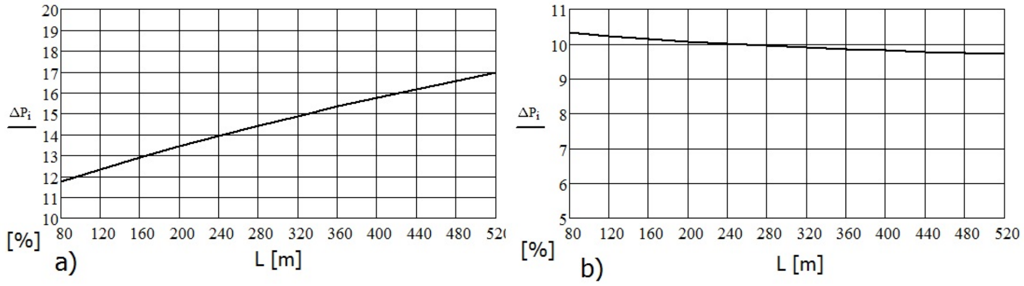

Figure 8. Percentage variation of power in idle run compared to the power for maximum capacity

Figure 9 shows the variation of the acceleration when the belts starts, depending on the flow rate of the hauled coal and the belt length for the two cases, horizontal Figure 9.a and ascending at 12° in Fig. 9.b. The weight to be put to motion at idle run is 11,7 kN, and at maximum flow rate it reaches 334,1 kN for maximum belt length, 520 m. Where: 1 – range of possible accelerations to be achieved with two driving groups; 2 – range of possible accelerations to be achieved with four driving groups. It is noticed that for flow rates higher than 250 t/h the belt slides on the drum horizontally, and on inclined plane at 150 t/h.

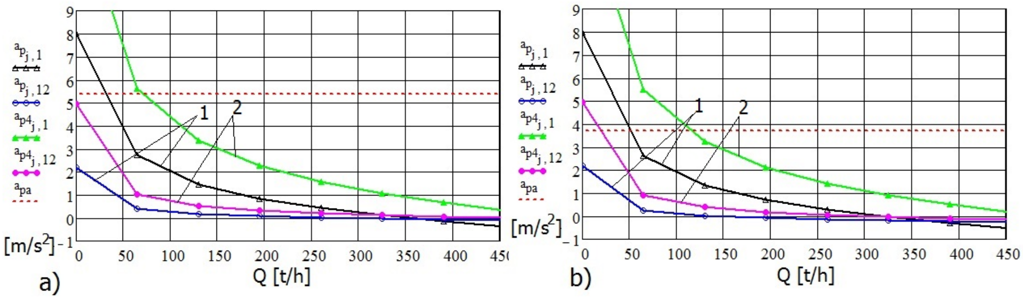

Figure 9. Starting accelerations variation depending on the belt sliding on the drum and on the coal sliding on the belt

4. CONCLUSIONS

Based on the study that has been performed, the following improvement measures of the hard coal hauling flow from the face to the surface of Lupeni mine are required:

- improvement of the loading system of the coal on the belt conveyer, by directing it in the sense of the transport and reducing the friction against the walls of the loading chute;
- periodic control of the stretching force of the belt in order to keep the arrow close to the admitted limit of 1% of the distance between the rolls at maximum transport flow rate;
- investments aimed towards automation and reliability increase of the transport flow in Lupeni Mine.

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