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DYNAMICS OF NON-UNIFORMITY LOADS OF AFC DRIVES

DYNAMIKA NIERÓWNOMIERNOŚCI OBCIĄŻEŃ NAPĘDÓW W ŚCIANOWYM PRZENOŚNIKU ZGRZEBŁOWYM

The length of armoured face conveyors currently used in hard coal mines most often ranges between 200 m and 300 m. The machines are equipped with a main and auxiliary drive. Asynchronous motors mounted in conveyor drives feature the capacity of several hundreds of kilowatts.

The non-uniform distribution of loads onto individual drives is observed in practice. The numerical value of loads distribution onto the individual armoured face conveyor drives is represented by a drive load distribution factor. It is defined as a ratio between the load of an electric motor installed in a given drive and the total conveyor load.

The article presents a physical armoured face conveyor model intended for examining dynamic phenomena influencing the load non-uniformity of drives. Motion in this physical model is described with the system of $(4 \cdot j + 5)$ non-linear ordinary differential quotations of the second order. A mathematical model is obtained by adding functions describing the interwork of sprocket drums with chains and functions approximating the mechanical characteristics of asynchronous motors powered by means of frequency inverters. A large number of computer simulations was performed using this model enabling to study the impact on the load non-uniformity of drives of such parameters as motor slip, motor supply voltage drop, variations in supply voltage frequency, differences in the gear ratio of transmissions and differentiation in the pitch of scraper chain links along the chain contour.

Keywords: armoured face conveyor, dynamic model, dynamic loads, non-uniformity of dynamic loads

Długość przenośników zgrzebłowych ścianowych stosowanych obecnie w kopalniach węgla kamiennego najczęściej mieści się w przedziale od 200 m do 300 m. Maszyny te wyposażone są zawsze w napęd główny i pomocniczy, przy czym pierwszy z nich wyniesiony jest do chodnika podścianowego. Silniki napędowe o mocy kilkuset kilowatów napędzają bęben łańcuchowy przez sprzęgło i przekładnię zębatą. Z kolei bębny łańcuchowe poruszają łańcuch zgrzebłowy, który tworzą dwa środkowe łańcuchy ogniwowe ze zgrzebłami przymocowanymi do ogniw poziomych łańcuchów. Ze względu na znaczne wydłużenia sprężyste łańcucha zgrzebłowego obciążonego urobkiem węglowym, konieczne jest jego wstępne napinanie. W zależności od wartości napięcia wstępnego łańcucha zgrzebłowego, oporów ruchu

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w gałęzi górnej i dolnej przenośnika oraz występujących drgań wzdłużnych, łańcuch może się znajdować w jednym z trzech stanów dynamicznych: w stanie stałego luzowania, w stanie okresowego luzowania lub w stanie nieluzowania.

W przenośnikach ścianowych obserwuje się nierównomierny rozdział obciążeń na poszczególne napędy. Jego liczbową miarą jest współczynnik rozdziału obciążenia napędu. Jest on definiowany, jako stosunek obciążenia silnika elektrycznego zainstalowanego w danym napędzie do całkowitego obciążenia przenośnika (wzory 1 i 2).

W praktyce niemożliwa staje się eliminacja wszystkich przyczyn nierównomiernego obciążenia napędu głównego i pomocniczego w przenośniku ścianowym. Wobec tego podejmuje się działania mające na celu wyrównywanie obciążeń napędów poprzez sterowanie wybranymi parametrami techniczno-ruchowymi przenośnika ścianowego. Badania komputerowe za pomocą własnego modelu dynamicznego wykazały, że jest to możliwe. Tymi parametrami są częstotliwości napięcia zasilania silników asynchronicznych, które powodują zmiany prędkości kątowych bębnów łańcuchowych.

W artykule przedstawiono model fizyczny ścianowego przenośnika zgrzebłowego przeznaczony do badania zjawisk dynamicznych wpływających na nierównomierność obciążenia napędów (rys. 1). Opis ruchu w tym modelu fizycznym tworzy układ $(4 \cdot j + 5)$ nieliniowych równań różniczkowych zwyczajnych drugiego rzędu. Dokładając do tego funkcje opisujące współdziałanie bębnów łańcuchowych z łańcuchami oraz funkcje aproksymujące charakterystyki mechaniczne silników asynchronicznych zasilanych za pomocą przemienników częstotliwości (wzory od 3 do 9) otrzymuje się model matematyczny. Za pomocą tego modelu matematycznego wykonano dużą liczbę symulacji komputerowych umożliwiających badanie wpływu takich parametrów jak poślizg silnika, spadek napięcia zasilania silnika, zmiana częstotliwości napięcia zasilającego, różnica w przełożeniu reduktorów i zróżnicowanie podziałek ogniw łańcucha zgrzebłowego wzdłuż konturu łańcuchowego na nierównomierność obciążenia napędów. Na rysunkach od 4 do 10 pokazano wybrane charakterystyki czasowe przedstawiające wpływ wyżej wymienionych parametrów na nierównomierność obciążenia napędów w przenośniku ścianowym.

Słowa kluczowe: przenośnik ścianowy, model dynamiczny, obciążenia dynamiczne, nierównomierność obciążenia dynamicznego

1. Introduction

Armoured face conveyors commonly used in hard coal mining are transporting mined rock along the face. Their length can be even more than 400 m, most often, however, it is within 200 to 300 m. Face conveyors always feature two drives situated at the end of a face. An auxiliary drive is located by the top gate while the main drive is elevated to the bottom gate. Face conveyor drives are fitted with asynchronous motors with the capacity of several hundreds of kilowatts. They transmit driving torque onto the sprocket drum through a coupling and transmission gear. Sprocket drums are moving the scraper chain which consists of two central link chains and scrapers mounted to horizontal links. Due to the substantial elastic elongation of the scraper chain loaded with the mined rock, its initial tightening is required. Depending on the value of initial chain tension, motion resistance in the top and bottom chain strands and the occurring longitudinal vibrations, the chain may be under one of the three dynamic states:

- in the state of permanent slackening - there is slackening between the horizontal and vertical links in the run-off point from the drive sprocket of the main or auxiliary drive;
- in the non-slackened state, where no interlink slackening exists anywhere within the chain contour, or
- in the state of periodical slackening, if longitudinal chain vibrations are causing, alternately, the state of slackening and non-slackening.

In practice, the non-uniform distribution of loads onto the individual drives is observed (Ahrens, 1981, 1986; Brychta & Kaci, 1989; Dolipski & Sobota, 1993, 1997; Dolipski et al., 1995). The numerical measure of loads distribution onto the individual armoured face conveyor drives is represented by the drive load distribution factor. It is defined as a ratio between the load of an electric motor installed in a given drive and the total conveyor load. The main drive load distribution factor u_A is determined from the following dependency:

$$u_A = \frac{P_A}{P_A + P_B} \tag{1}$$

where:

P_A — power consumption of the motor in the main drive,
P_B — power consumption of the motor in the auxiliary drive.

On the other hand, the auxiliary drive load distribution factor u_B is calculated from the following formula:

$$u_B = \frac{P_B}{P_A + P_B} = 1 - u_A \tag{2}$$

A theoretical value of such factor – for a conveyor with a single main drive and a single auxiliary drive – with uniformly distributed power, should be $u_A = u_B = 0{,}5$.

The reason for the non-uniform distribution of power into individual drive motors in an armoured face conveyor are any mechanical and electrical asymmetries existing both, in the configuration, construction and structure of drives as well as in a scraper chain.

2. Dynamic model

In practice, it is impossible to eliminate all causes of non-uniform loads of the main drive and auxiliary drive in a face conveyor. Efforts are thus taken aimed at equalising loads on drives by controlling the selected technical and operating parameters of a face conveyor. Computer tests carried out with an own dynamic model have revealed it is feasible. Such parameters include the supply voltage frequencies of asynchronous motors leading to changes in angular speeds of sprocket drums.

The dynamic model is made up of a physical model and mathematical model.

Chains in the top and bottom strands were divided into j sections (Fig. 1) in the process of physical modelling of an armoured face conveyor enabling to simulate the dynamic phenomena impacting the load non-uniformity of drives. The mass of each of j sections was concentrated at the centre of such section. The mass of the scrapers and the mined rock loading the chain section with the length L_x/j (where L_x is the variable length of the modelled face conveyor) was reduced to such points. The substitute masses obtained this way were linked with mass-free elastic bonds. An assumption was made that the chain can transmit tensile loads exclusively. Each of the substitute masses is displaced on the substrate which is modelling external friction. Each of the drive systems was replaced with a rigid polygon modelling the activity of a sprocket drum and with rotating masses linked with viscoelastic constraints. The moment of inertia of the sprocket drum, transmission and output element of the coupling were reduced to polygons. On the other hand, the moment of inertia of the motor rotor and the input element of the coupling were reduced to the rotary solids. The reduced driving torques of asynchronous motors were applied to the rotary solids.

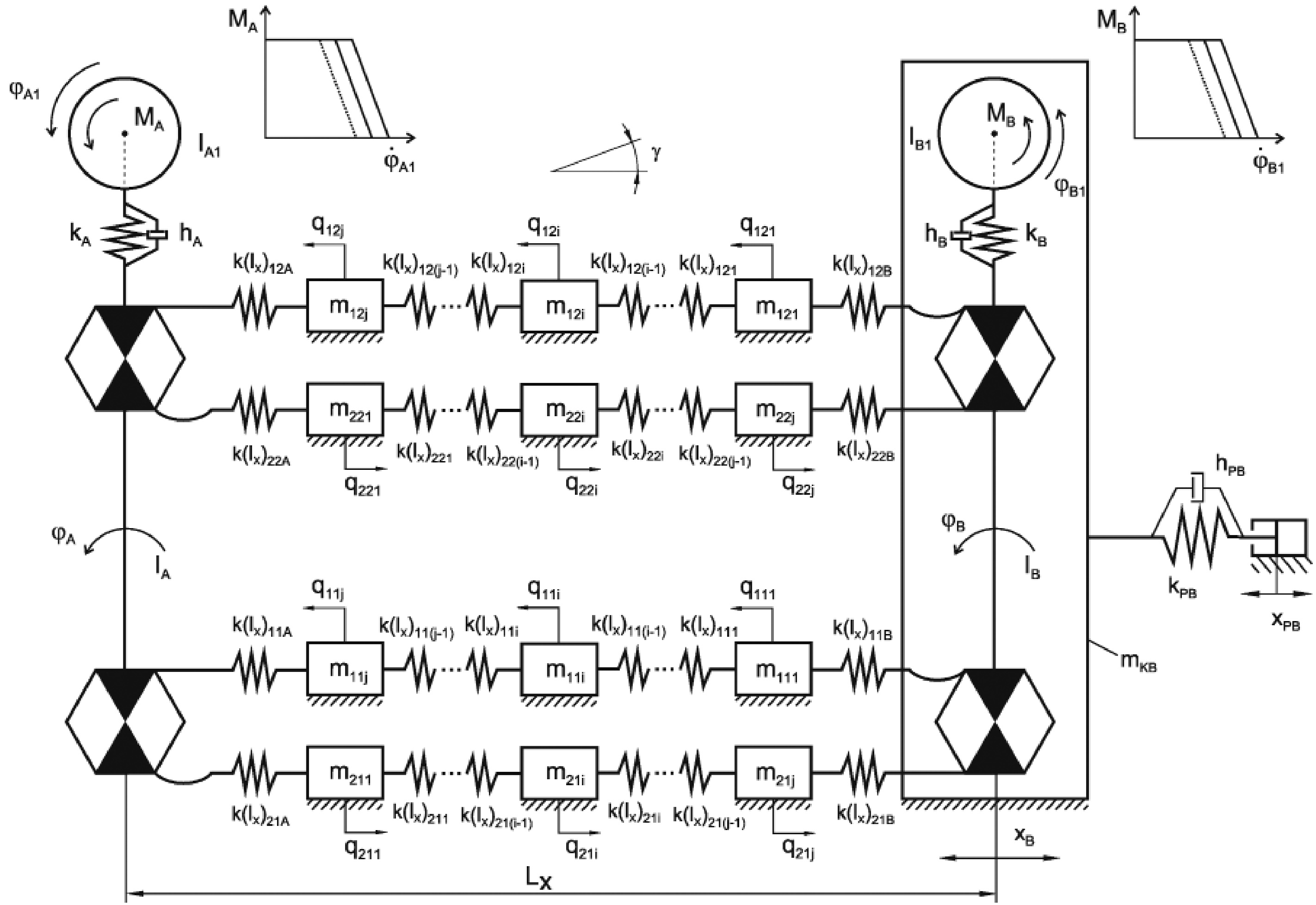

Fig. 1. Physical armoured face conveyor model intended for examining load non-uniformity of drives

A possibility of the stepless change of the chain link contour was considered by introducing an auxiliary drive sliding frame with the translation coordinate x_B. It was assumed that the auxiliary drive frame is an ideally rigid body and is displaced on the substrate, as modelled with external friction. The frame is moved by means of hydraulic actuators, as modelled with relevant viscoelastic constraints, piston and frame.

A mathematical model is represented by a system of $(4 \cdot j + 5)$ non-linear ordinary differential quotations of the second order together with functions describing the interwork of sprocket drums with chains and functions approximating the mechanical characteristics of asynchronous motors.

Armoured face conveyors are currently driven with asynchronous motors whose starting torque is higher than the pull-out torque. For instance, the 2SG2 400M-4f motor with the capacity of 355 kW by DAMEL is characterised by the starting torque of 6440 Nm and pull-out torque of 5520 Nm. A multiplication factor for starting torque and pull-out torque for this motor is, respectively, 2,8 and 2,4. A static mechanical characteristic of an asynchronous motor can, therefore, be approximated with two lines (Dolipski, 1997): a horizontal line transiting through the critical point K and an inclined line transiting through the points S and N (Fig. 2). The point S corresponds to the synchronous speed of the motor rotor, while the point N corresponds to nominal slip. In case of supply voltage drop, the horizontal line is transiting through the point K' whereas the inclined line through the points S and N'.

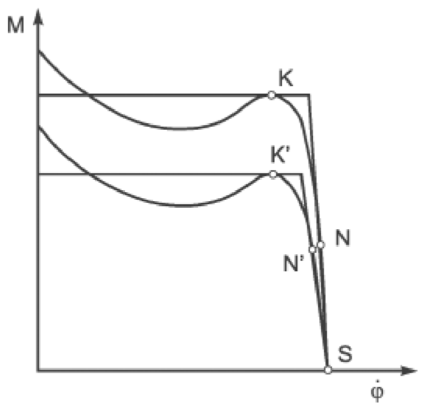

Fig. 2. Actual and approximated mechanical characteristic of asynchronous motor for supply with electricity directly from power mains

The rotational speed of asynchronous motors rotors can be changed by:
- Changing the supply voltage value causing slip change. This method allows to slightly change the rotational speed of a motor rotor, but causes high losses in windings.
- Changing the resistance in a motor rotor circuit – increase in resistance is accompanied by increase in critical slip and a new work point is set. High power losses in adjusting resistors occur with this method of control. The range of adjustment in high-capacity motors is small (10÷15%).
- Changing the number of pole pairs – multi-speed motors. This method is applied for face conveyors, however, does not allow the smooth adjustment of angular speed in a motor rotor.

- Changing supply voltage frequency – it changes the rotational speed of a magnetic field, hence of motor rotor speed. Smooth adjustment of rotational speed in a motor rotor within a wide range is possible.

The actual and approximated mechanical characteristic of an asynchronous motor supplied with a frequency inverter is shown in Fig. 3. The synchronous speed of the motor rotor for the set supply voltage frequency is calculated according to the following formula:

$$\dot{\varphi}_{0A} = \frac{2 \cdot \pi \cdot f_A(t)}{b_A} \tag{3}$$

where:

$f_A(t)$ — temporary value of asynchronous motor supply voltage frequency in the main drive (index A),

b_A — the number of pairs of motor poles in the main drive.

The reduced driving torque of a motor in the main drive is determined from the following relationship:

$$M_A(f, \dot{\varphi}_A) = \begin{cases} M^*_{KA} & \text{, where} \quad 0 \le \dot{\varphi}_A \le \dot{\varphi}_{RA} \\ MS_A \cdot (1 - \dfrac{i_{rA}}{\dot{\varphi}_{0A}} \cdot \dot{\varphi}_A) & \text{, where} \quad \dot{\varphi}_A > \dot{\varphi}_{RA} \end{cases} \tag{4}$$

whereas:

$$M^*_{KA} = \left(1 - \frac{\Delta U_A}{U_n}\right)^2 \cdot i_{rA} \cdot \eta_A \cdot \Psi_A \cdot M^*_{nsA} \tag{5}$$

$$MS_A = \frac{M^*_{nsA} \cdot i_{rA} \cdot \eta_A \cdot f_A(t)}{\left(s_{nsA} + s_{ncA}\right) \cdot f_{eckA}} \tag{6}$$

$$M^*_{nsA} = \begin{cases} M_{nsA} & \text{, where} \quad f_{\min A} \le f_A(t) \le f_{eckA} \\ M_{nsA} \cdot \dfrac{(1 - s_{nsA} - s_{ncA}) \cdot f_{eckA}}{f_A(t) - (s_{nsA} + s_{ncA}) \cdot f_{eckA}} & \text{, where} \quad f_{eckA} < f_A(t) \le f_{\max A} \end{cases} \tag{7}$$

$$\Psi_A = \begin{cases} \dfrac{M_{KA}}{M_{nsA}} & \text{, where} \quad f_{\min A} \le f_A(t) \le f_{eckA} \\ \dfrac{M_{KA} \cdot f_{eckA}}{M_{nsA} \cdot f_A(t)} & \text{, where} \quad f_{eckA} < f_A(t) \le f_{\max A} \end{cases} \tag{8}$$

$$\dot{\varphi}_{RA} = \left[1 - \Psi_A \cdot \left(s_{nsA} + s_{ncA}\right) \cdot \frac{f_{eckA}}{f_A(t)} \cdot \left(1 - \frac{\Delta U_A}{U_{nA}}\right)^2\right] \cdot \frac{\dot{\varphi}_{0A}}{i_{rA}} \tag{9}$$

where:

f_{eckA} — frequency curve,
$f_{\min A}$ — minimum value of asynchronous motor supply voltage frequency in the main drive,
$f_{\max A}$ — maximum value of asynchronous motor supply voltage frequency in the main drive,
i_{rA} — gear ratio of transmission in the main drive,
M_{nsA} — rated driving torque of the motor in the main drive,
s_{nsA} — nominal slip of asynchronous motor in the main drive,
s_{ncA} — nominal slip of coupling in the main drive (in case of flexible coupling $s_{ncA} = 0$),
U_{nA} — nominal value of voltage in an electric system supplying an electric motor in the main drive,
ΔU_A — drop in the electric motor supply voltage value in the main drive,
η_A — driving system efficiency,
$\dot{\varphi}_{0A}$ — synchronous speed of the drive motor rotor.

If the value of supply voltage frequency *f* declines, when the condition U/f = const is met, where U is a supply voltage value, then the mechanical characteristic of the motor is shifted to the left (Fig. 3) with its shape being maintained. The rotational speed of the motor rotor is then decreased below the nominal value while maintaining the constant value of the driving torque. An area of a so-called weakened stream exists within the frequency range of supply voltage where the constancy condition U/f cannot be maintained. The rotational speed of the motor rotor is increased within this range while maintaining the constant value of the motor power and is substantially decreasing the pull-out torque value. In armoured face conveyors loaded heavily with the mined rock this may lead to even halting the sprocket drums.

The mechanical characteristic of an asynchronous motor in the auxiliary drive is modelled by inserting index *B* in the formulae (3) to (9) instead of index *A*.

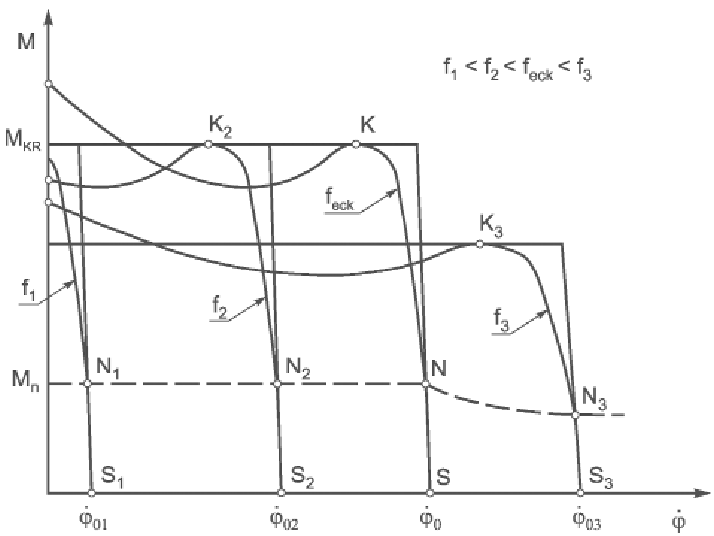

Fig. 3. Mechanical characteristic of an asynchronous motor with adjustment of rotational speed of the rotor by means of frequency inverter

The possibility of anticoincidental activation of drive motors is modelled with the following relationship:

$$M_A = \begin{cases} 0 & \text{, where} \quad 0 \le t_s < \Delta T_{0A} \\ M_{KA} & \text{, where} \quad t_s \ge \Delta T_{0A} \end{cases} \tag{10}$$

$$M_B = M_{KB} \quad \text{, where} \quad 0 \le t_s < \Delta T_{0A} \tag{11}$$

where:

M_A — reduced driving torque of the motor in the main drive,
M_B — reduced driving torque of the motor in the auxiliary drive,
M_{KA} — reduced pull-out driving torque of the motor in the main drive,
M_{KB} — reduced pull-out driving torque of the motor in the auxiliary drive,
t_s — current time of computer simulation,
ΔT_{0A} — activation delay of electric motor in the main drive.

3. Computer simulations

The object of computer simulations was an armoured face conveyor with the length of L = 250 m equipped with a single main drive and a single auxiliary drive. Each asynchronous drive motor with the capacity of 315 kW possessed the following parameters:

- supply voltage – 1000 V,
- rated torque – 2035 Nm;
- multiplication factor of driving torque – 2,7;
- multiplication factor of pull-out torque – 2,6;
- nominal slip – 0,015.

Both conveyor drives were equipped with flexible couplings, planetary gears and sprocket drums with the number of teeth z = 7 interworking with the plain link chain with closed contour. The activity of a scraper conveyor equipped with two central chains size 34 × 126 mm and with scrapers mounted with the pitch p_z = 1,26 m was simulated.

The drive motors of a face conveyor possess a production characteristic that depends on the production accuracy of its individual components. A large nominal slip tolerance exists, therefore.

The investigated face conveyor was equipped with asynchronous motors with the nominal slip of 1,5%. The top strand was loaded with a stream of mined rock at a rate of 100 kg/m. The value of initial chain tension set during conveyor stoppage of 260 kN completely compensated the elastic elongation of the chain and the non-slackening state of the chains occurred in the conveyor.

In the case where asynchronous motors in the main and auxiliary drive were characterised by nominal slip, the both drives were loaded uniformly. The non-uniform load on the drives occurred by decreasing the slip value of the motor in the main drive to 0,5% while maintaining its nominal value in the auxiliary drive. The value of the power received by the main drive increased while the power in the auxiliary drive decreased (Fig. 4a). However, by increasing the slip value in the motor in the main drive above the nominal value to 2,5%, the load on the auxiliary drive rose (Fig. 4b).

The operational characteristic of the conveyor drive motor depends, most of all, on the supply voltage value on the stator terminals. Drop in the supply voltage value in the main drive was

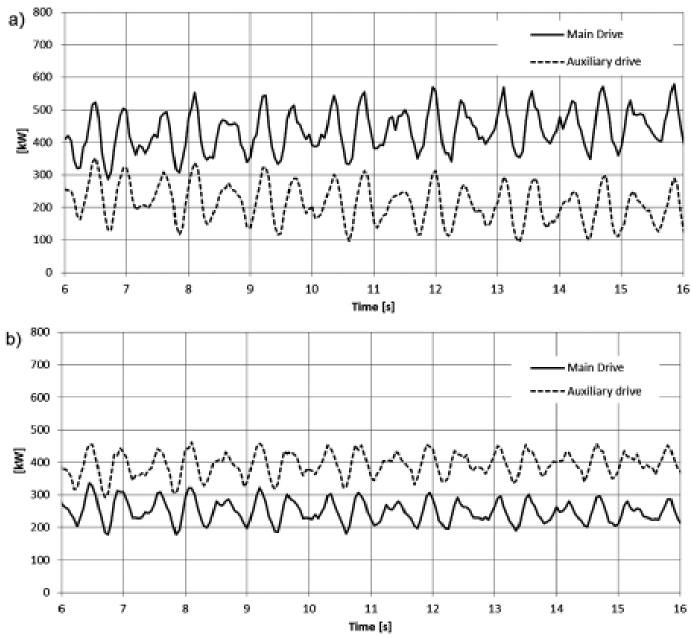

Fig. 4. Power consumption of drives in the set motion of the conveyor with the length of $L = 250$ m for various motor slip values in the main drive ($s_B = 1{,}5\%$,): a) $s_A = 0{,}5\%$, b) $s_A = 2{,}5\%$

simulated in the computer tests while maintaining its nominal value of 1000 V in the auxiliary drive. In the case where the both motors were supplied with rated voltage, the scraper chain was in the non-slackening state and the main and auxiliary drive were loaded uniformly. Drop in motor supply voltage in the main drive by 60 V led to the load non-uniformity of the drives, while the auxiliary drive was loaded more than the main drive (Fig. 5a). By decreasing the motor supply voltage value in the main drive by 140 V in relation to its nominal value, the load non-uniformity of the drives of the investigated conveyor was further increased (Fig. 5b).

The currently used armoured face conveyors can be supplied with frequency inverters. By changing the value of asynchronous motor supply voltage frequency in either drive, the value of sprocket drum rotational speed in this drive is influenced along with the load distribution of the drives. Both drives were loaded uniformly in the investigated face conveyor load with the mined rock along its entire length at a rate of 100 kg/m, in which initial chain tension was set with the value of $S_0 = 260$ kN, and the supply voltage frequency of motors in the main and auxiliary drive was equal to $f_A = f_B = 50$ Hz. A high load non-uniformity of drives was seen by decreasing the value of supply voltage frequency of the motor in the main drive f_A by 0,5 Hz (while maintaining the nominal value of $f_B = 50$ Hz), and the auxiliary drive was loaded more (Fig. 6a). The maximum load value of this drive in the set motion of the conveyor was nearly 70% of total capacity. On the other hand, by increasing the frequency value of supply voltage f_A by 0,5 Hz above the nominal value, the load of the main drive was increased and of the auxiliary drive decreased (Fig. 6b).

In the case where the motor of the main drive was supplied with voltage with the nominal frequency of $f_A = 50$ Hz, and the motor in the auxiliary drive was supplied with voltage with

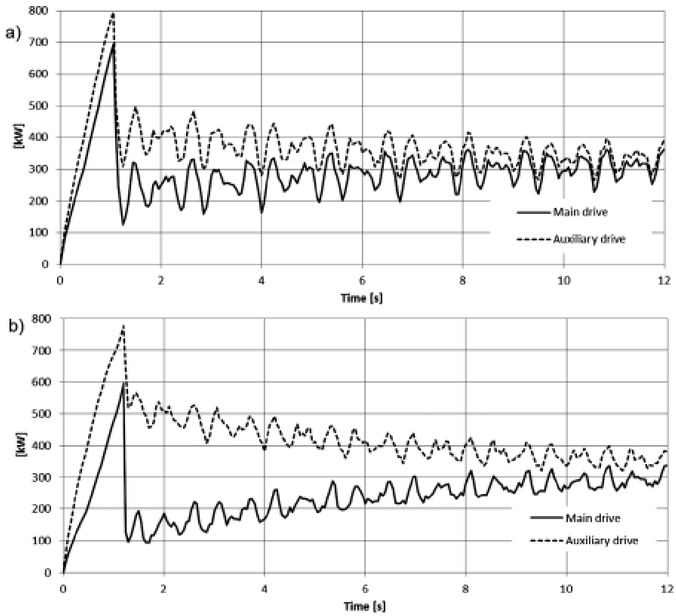

Fig. 5. Power consumption of drives in the set motion of the conveyor with the length of L = 250 m for various values of motor supply voltage drops in the main drive: a) ΔU_A = 60 V, b) ΔU_A = 140 V

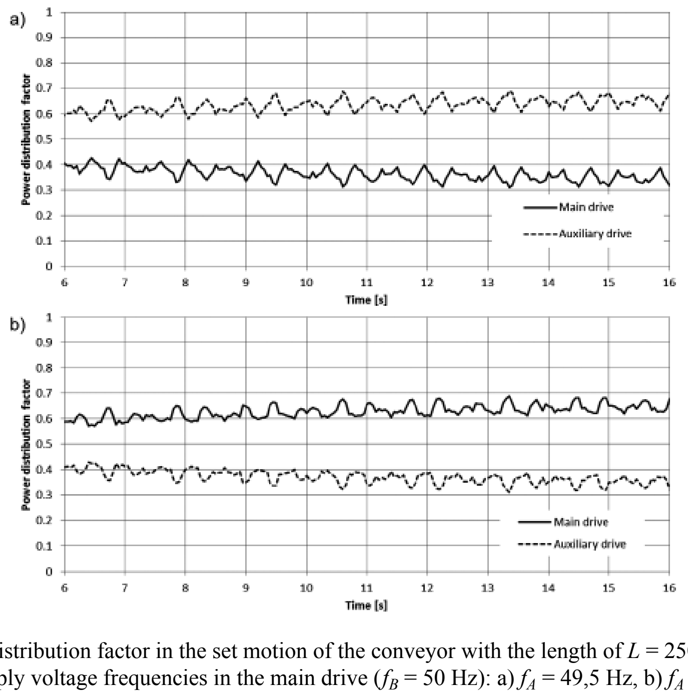

Fig. 6. Power distribution factor in the set motion of the conveyor with the length of L = 250 m for various motor supply voltage frequencies in the main drive (f_B = 50 Hz): a) f_A = 49,5 Hz, b) f_A = 50,5 Hz

frequency decreased by Δf_B = 0,5 Hz, the maximum value of the power distribution factor in the main drive $u_A^{\max}$ was reaching even 70 % in the set motion of the tested conveyor (Fig. 7). By increasing, however, the frequency of supply voltage of the asynchronous motor in the auxiliary drive f_B over the nominal value to 51,0 Hz, the main drive was underloaded and the auxiliary drive was overloaded at the same time. The maximum value of the power distribution factor in the auxiliary drive $u_B^{\max}$ exceeded 80%.

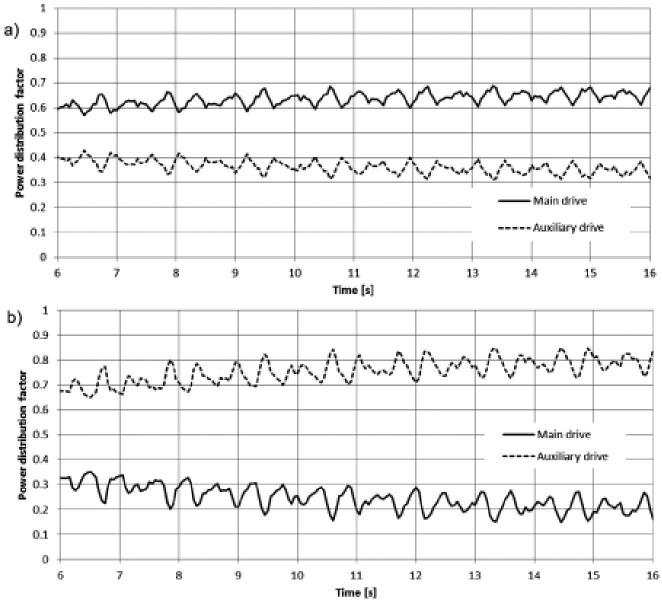

Fig. 7. Power distribution factor in the set motion of the conveyor with the length of L = 250 m for various motor supply voltage frequencies in the auxiliary drive (f_A = 50 Hz): a) f_B = 49,5 Hz, b) f_B = 51,0 Hz

Another reason for the non-uniform load of the main and auxiliary drive are different gear ratios of transmissions. The use of transmissions with different gear ratios in the conveyor drives situated in a bottom and top gates results usually from limited space available there. The users are hence mounting perpendicular transmission (in the main drive) and parallel transmission (in the auxiliary drive) in one face conveyor.

Computer simulations were performed for a face conveyor where the value of transmission gear ratio was changed in the main drive while maintaining a constant transmission gear ratio in the auxiliary drive equal to i_{RB} = 39,328. In the case where the gear ratio i_{RA} was the same as the transmission's gear ratio in the auxiliary drive, then both conveyor drives were loaded uniformly. An increase in the gear ratio value i_{RA} to 39,628 (Fig. 8a) and then to 39,928 (Fig. 8b) was a reason for the occurrence of higher and higher load non-uniformity of conveyor drives, and a higher load existed in the auxiliary drive. The maximum value of the power distribution factor in the auxiliary drive in the conveyor set motion $u_B^{\max}$ was, respectively, 64% and 76%.

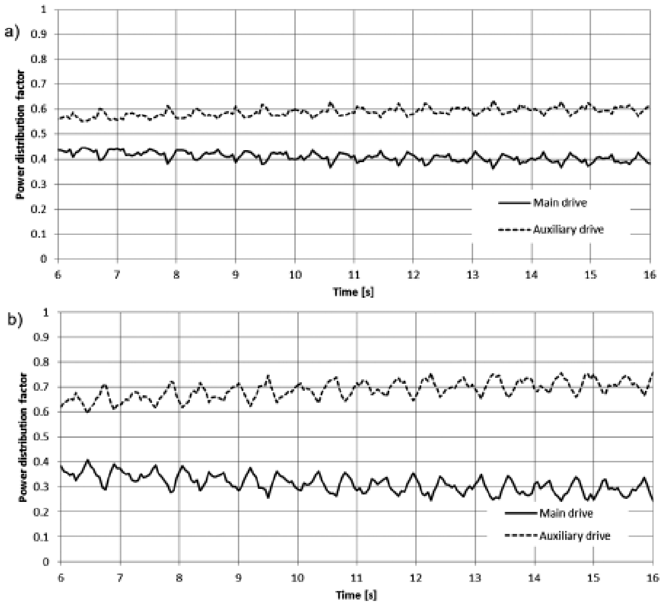

Fig. 8. Power distribution factor in the set motion of the conveyor with the length of L = 250 m for various gear ratios of the reducer in the main drive (i_{RB} = 39,328): a) i_{RA} = 39,628, b) i_{RA} = 39,928

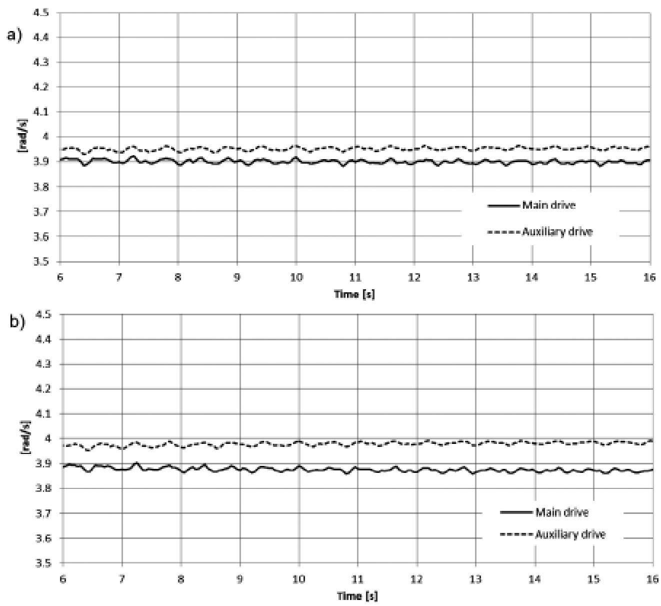

Fig. 9. Rotational speed of sprocket drums of the conveyor with the length of L = 200 m for different values of the pitches of the chain links interworking with the sprocket drum in the main drive: a) $(\Delta p/p)_A$ = 1,5%, b) $(\Delta p/p)_A$ = 3,0%

Shifts in the pitch of the chain located in the sprocket drum in the main and auxiliary drive were simulated in computer tests of influence of differentiation in the chain pitch on power distribution in a face conveyor with the length of 200 m. An assumption was made that the top strand will be loaded with mined rock at a rate of 200 kg/m. In the case where sprocket drums in the main and auxiliary drive interworked with chains with nominal pitches, then rotational speeds of the drums were the same and the both drives were loaded uniformly.

An increase in the chain pitch by $(\Delta p/p)_A = 1{,}5\%$, interworking with the sprocket drum in the main drive (while maintaining nominal chain pitch in the auxiliary drive), led to reduction in the rotational speed of the sprocket drum in the main drive (Fig. 9a) and substantial load increase for this drive (Fig. 10a). The maximum value of the power distribution factor in the main drive in the set conveyor motion was 75%. The difference of rotational speeds of sprocket drums in the main and auxiliary drive (Fig. 9b) increased for the relative elongation of the pitch of the chain located in the sprocket drum of the main drive $(\Delta p/p)_A = 3\%$. The value of the considered power distribution factor $u_A^{\max}$ equalled 98% (Fig. 10b).

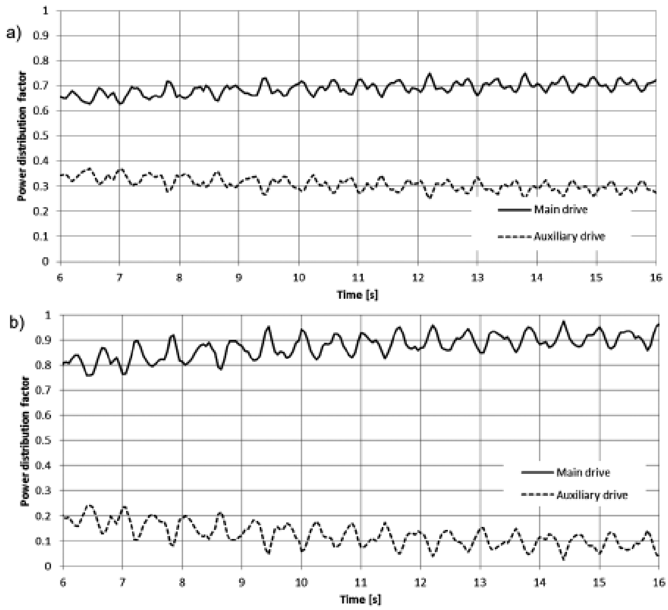

Fig. 10. Power distribution factors in the conveyor with the length of $L = 200$ m for different values of the pitches of the chain links interworking with the sprocket drum in the main drive: a) $(\Delta p/p)_A = 1{,}5\%$, b) $(\Delta p/p)_A = 3{,}0\%$

4. Summary

The created dynamic model of a face conveyor was equipped with asynchronous motors supplied from frequency inverters. This allows to simulate changes in the supply voltage frequency of drive motors such as to influence the value of rotational speed of sprocket drums in the main and auxiliary drive. The developed dynamic model of a face conveyor enables to simulate the phenomena influencing the load non-uniformity of drives.

The computer simulations carried out by means of the developed dynamic model show that the following dynamic phenomena exist in the set motion of the armoured face conveyor:

1. The drive whose motor has smaller slip consumes more power.
2. The drive whose motor has higher supply voltage frequency consumes more power.
3. The drive whose transmission has a higher gear ratio consumes less power.
4. The drive whose sprocket drum interworks with a chain with a larger chain pitch consumes more power.

The frequency of voltage supplying the drive motors is a parameter enabling to control power distribution in an armoured face conveyor. A correctly selected value of supply frequency for motors permits to decrease the non-uniformity of power distribution in the main drive and auxiliary drive of the conveyor. If this value is determined incorrectly, however, this may lead to the high load non-uniformity of the drives.

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