

УДК 622.625.28

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CALCULATION OF OPTIMAL AMPLITUDE OF OSCILLATIONS AND NUMBER OF PERIODS OF SINUSOID AT PULSATING BRAKE TORQUE USING «WOLFRAM MATHEMATICA» PROGRAM

The adhesion force of the locomotive wheels to the rails depends both on the state of the rail track and on the conditions of interaction of the wheel-rail friction pair [1]. The main parameter characterizing the adhesion force between wheels and rails is the adhesion coefficient [2].

In the work [3] provides a method for selecting a constant braking torque applied to the axle of the wheelset. In order to prevent clutch failure and wheel skidding, it is recommended to implement 80% of the maximum possible braking torque for mining electric locomotives.

In the work [4] provides examples of the useful application of vibration, which are based on phenomena associated with the characteristics of vibrations in nonlinear mechanical systems, and outlines a general approach to the study and use of vibration. In particular, attention is paid to the study of the sliding friction coefficient during vibration.

In the works [5, 6] recommendations are given for the analytical selection of the braking torque applied to the axis of the wheel pair of a mine locomotive in

order to achieve the most effective braking for various conditions of the rail track. Constructive conceptual solutions for the manufacture of a disc brake that creates a pulsating braking torque are proposed.

The braking torque created on the wheel by a wheel-block brake depends on the speed of the mine locomotive, the state of the rail track and the heating of the brake pad, which does not allow the possible adhesion coefficient to be fully realized. Disc brakes used in transport systems do not have this disadvantage. Research aimed at determining the rational parameters of the disc brake of a mine locomotive and studying the dynamics of the drive during braking will help improve traffic safety, increase the throughput of mine transport, and develop the mining engineering industry in Ukraine.

The purpose of this work is to establish parameters of the braking torque that ensure high braking characteristics of a mine locomotive by mathematical modeling of braking of a mine locomotive with a disc brake that creates a pulsating braking torque.

Forced vibrations of the elements of the wheel-motor unit (WMU) of a mine locomotive in the process of braking with a disc brake were studied by methods of differential calculus and mathematical modeling. The integration of the system of differential equations was performed using the Runge-Kutta method.

For the first time, a mathematical model of braking a mine locomotive with a disc brake has been developed, creating a pulsating braking torque on the axis of the wheel pair, depending on its angular coordinate, taking into account the nonlinear dependence of the adhesion coefficient on the relative slip, on the basis of which the effectiveness of a disc brake with a multi-sector disc is shown in comparison with a disc brake with a homogeneous disk under different conditions of the rail track.

A comparative analysis of the braking of a mine locomotive with a disc brake, which creates constant and pulsating sinusoidal braking torques with a different number of sinusoidal periods per revolution of the wheel pair on the axis of the wheel pair, has been carried out. It has been proven that the pulsating sinusoidal braking torque created on the axis of the wheelset, equal to the sum of the constant component and the oscillation amplitude of the variable component, multiplied by the sine of the product of the number of periods of the sinusoid per revolution of the wheelset by its angular coordinate, provides higher braking characteristics than constant braking moment. It has been shown that pulsating braking torque reduces the braking time and braking distance of a mine locomotive.

Using the «Wolfram Mathematica» program, it has been established that the greatest effect from the use of pulsating braking torque is achieved if the amplitude of oscillations is 10...15% of the average value of the braking torque, and the

number of sinusoid periods per revolution of the wheelset is in the range from 35 to 55.

Further studies of the dynamics of braking of a mine locomotive with a disc brake should be aimed at studying the influence on the braking distance and braking time of the values of the stiffness and damping coefficients of rubber-metal elements, as well as the values of the stiffness and damping coefficients of the axle shafts of the wheel-motor unit.

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