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ОЦЕНКА ЭФФЕКТИВНОСТИ ДАТЧИКОВ КОНТРОЛЯ ДВИЖЕНИЯ ПОЕЗДОВ НА ХОЛМИСТОЙ ЖЕЛЕЗНОДОРОЖНОЙ ЛИНИИ
EVALUATION OF THE EFFECTIVENESS OF TRAIN MOVEMENT CONTROL SENSORS ON A HILLY RAILWAY LINE

Abstract: The results of studies on the substantiation of the kinematic parameters of the movement of freight trains and diesel locomotives during the organization of the stopping process at the intermediate and final stations of the virtual hilly section of the railway are presented. The purpose of the study is to analyze the redistribution of these parameters and the rate of their fluctuations in the accepted range of changes in the mass of a freight train in the case of a decrease in speed and stops along the route of the rolling stock.

Keywords: research, result, freight train, diesel locomotive, railway, parameter, siding

Introduction

Modern transport systems are complex technical objects, which consist of a set of elements and are classified according to various technological features, and depending on the primary power plant are divided into aerospace vehicles, cars, diesel and electric locomotives, gas turbo locomotives and others. We present an overview of scientific research, dedicated to research effectiveness of use various transport systems (complexes) and their elements in operating conditions.

The authors' works [1, 2] present the results of studying the influence of general and component parameters on the characteristics of turbojet engines taking into account operating cycle performance under various optimal operating conditions and empirical evaluation of thermodynamic cycles of turbojet engines with a view to obtain quantitative indicators and characteristics of the processes of injection and combustion of fuel for stationary studies of engines.

The authors of [3, 4] investigate the issues of increasing the fatigue life and operational reliability of the blades and disk of a high-pressure turbine of turbojet engines by improving the surface protection and cooling them taking into account influence of load changes and average voltage on them.

Investigation of ways to reduce the consumption of fuel and energy resources for train traction are devoted to works [5, 6] in which it is proposed to save natural diesel fuel by diesel locomotives and electric energy by electric locomotives by optimizing the operating modes of power energy systems (installations) of diesel and electric traction locomotives.

According to the authors of works [7, 8, 9], it is recommended to improve (increase) the qualitative component of the current collection process by optimizing the current collection modes by normalizing the upper and lower limits of contact pressure and by using mechanical and electrical means of protection against the occurrence of any kind of resonant oscillations in the traction network.

However, in these researches, at all, the issues of the stopping process along the route of rolling stock on sections railways of varying complexity were not considered. In this connection, insufficiently worked out are the questions on justification of kinematic parameters the movement of a freight train during stops at intermediate and final stations of different, including high-speed railway sections.

Materials and methods

Therefore, the purpose of this study is to clarify the kinematic parameters along the path of movement, speed and travel time of freight trains, taking into account the time for acceleration – deceleration in the process of organizing their stop at an intermediate and the terminal station of a virtual hilly section the high-speed railway, where organizational and technological operating conditions are assumed to be similar to real ones.

The present studies were carried out in parallel with the works [1, 2] and therefore the basis of the developed algorithm for the implementation of the formulated research goal was the methods and methods of the theory of train traction [2, 3], the object and subject of research taking into account the initial data on the operation of freight locomotives on the railway section [4, 5].

Diesel 1A-5D49 differs from diesel 10D100 in its efficiency – at power in the norm of 2206 kW will be 208 g/kWh, hence, in the idle mode, the consumption of diesel fuel of a diesel engine 1A-5D49 of the third version is 14 kg/h. Parameters for a diesel engine 10D100 from the calculated ones will be respectively 226 g/kWh by 22.8 kg/h.

A virtual hilly railway section D – F is given (accepted), consisting of two hauls D – E and E – F, the straightened track profile of which is presented in Table 1.

Table 1.

Straightened track profile of a virtual hilly section D – E – F of the railway

№ element	1	2	3	4	5	6	7	8	9
	10	11	12	13	14	15	16	17	18
The steepness of the element i, ‰	-1.8	+3.8	+1.78	+6.8	-0.98	-10.8	-1.38	+1.8	+4.2
	0	-3,8	-2,22	0	+1,8	+3.8	+0.2	0	-
The length of the element S, m	1,900	4,200	2,200	6,800	1,900	1,900	1,300	1,200	1,100
	1,800	6,900	2,900	2,900	1,900	700	3,800	1,900	-

Differential equation of train movement for indicated driving modes has following form:
for the thrust mode:

$$\frac{dv}{dt} = \zeta\ (f_t - w_b) \quad (1)$$

for overrun (idling) mode:

$$\frac{dv}{dt} = \zeta\ (-w_b) \quad (2)$$

for the mode of braking (service):

$$\frac{dv}{dt} = \zeta\ (0.5b_b + w_{bid}) \quad (3)$$

b_b is average specific braking force, N/t;

$$b_b = 10000\vartheta_e \varphi_{be} \quad (4)$$

$$\zeta = \frac{\xi_L \bar{Q}_L + \xi_T Q_T}{\bar{Q}_L + Q_T}, \quad (5)$$

ξ_L is locomotive deceleration, m/s

ξ_T is deceleration of the train, m / s
$\bar{Q}_L$ is accounting mass of the locomotive, t [8].
Q_T is train mass, t

Table 2.

Travel time of a freight train by hauls without stops
and by intermediate station on deceleration – acceleration

intermediate stations	Distance, km	by hauls, min		
		train composition mass, t		
		Q_1=2,500	Q_2=3,000	Q_3=3,500
St. *D*	-	–	-	–
St. *E*	23.45	18.39	19.30	18.90
St. *F*	22.90	15.10	13.90	16.50
Section D–F	46.20	35.00	35.70	38.70

Table data 2 speak of the superiority of the non-stop process of movement of freight trains, which increases with an increase in the mass of the train and is characterized by an increase in the turnover of rolling stock, including traction.

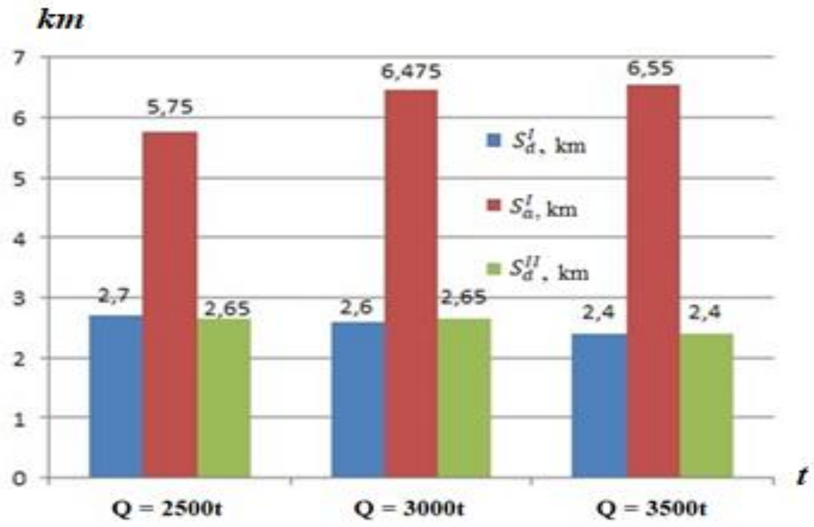

Fig. 1. The graphs of the path of movement of freight trains at the time
of braking and acceleration at the intermediate station and the arrival station

On fig. 1 respectively shows the numeral values and are given dynamics of the kinematic parameters of the stopping process – graphs for the distance that freight trains travel at the stations intermediate and final, and graphs of the speeds movement of freight trains as a result of the completion of acceleration and at the time of the start of braking at these stations.

Conclusions

In addition, the parameters speed and time of the movement of freight trains, as well as quantitative indicators of the energy efficiency of freight diesel locomotives of the UzTE16M3 series obtained by the authors can be are recommended in of the practice of work of the locomotive complex of the uzbek railways, which have real hilly sections, including high-speed ones, with the second type of track profile.

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