UDC 681.5

MATHEMATICAL MODEL OF MECHANICAL PART OF ALLOCATE ELECTRIC ENGINE IN DIESEL TRAINS

D.M. HLAVCHEV[1*], V.D. DMITRIENKO[2], A.Y. ZAKOVOROTNIY[3]

[1] *MSc of the Department «Computer Engineering and Programming», NTU «KhPI», Kharkov, UKRAINE*
[2] *Doctor of Technical sciences, Professor of the Department «Computer Engineering and Programming», NTU «KhPI», Kharkov, UKRAINE*
[3] *Associate Professor, doctoral candidate, PhD, NTU «KhPI», Kharkov, UKRAINE*
[*] *email: dimaua2008@ukr.net*

During the propagation the global trend of fuel saving on railway transport, question about creation and implementation of systems based on the traction calculations is particularly acute. Research in this area has successfully conducted around the world, but there are large amounts of properties and variables that are still not take into consideration. For this reason, the addition of new operands in existing equations, as well as increasing the efficiency of their usage - an essential element for the development of the industry.

In addition, usually the diesel train is described as a material point, without account for the longitudinal, lateral and vertical oscillations of wagons that have a significant impact on the engine load, and as a result, the volume of fuel consumption. During mathematical description the mechanical part of a diesel train, accepted the next simplifications: the wagon has presented in the form of a concentrated mass; elasticity of the railway is not considered; the connection between the wagons represented as an elastic element without backlash and vibration absorbers; slippage between the rails and the wheels are missing [1]. Simplification is essential, however, even when such calculations, becomes noticeable influence of wagons vibrations, which are expressed in the form of a "jumps" on a graph of speed.

Was developed mathematical model of mechanical part of allocate electric engine in diesel trains, which take into consideration a parallel operation of two equivalent traction asynchronous electric engines, and elastic connections between wagons:

$$
\begin{aligned}
& dV_{v1}/dt = M_{dv1}/m_{mot1} - F_{v1v2} - F_{v1}; \\
& dV_{v3}/dt = M_{dv2}/m_{mot2} + F_{v2v3} - F_{v3}; \\
& dF_{v1v2}/dt = C_{v1v2}(V_{v1} - V_{v2}); \\
& dF_{v2v3}/dt = C_{v2v3}(V_{v2} - V_{v3}); \\
& dV_{v2}/dt = (1/m_{pas})(F_{v1v2} - F_{v2v3} - F_{v2}),
\end{aligned}
\tag{1}
$$

where V_{v1}, V_{v2} V_{v3} – speed of the first, second and third wagons accordingly; M_{dv1}, M_{dv2} – electromagnetic moments that develop the first and second equivalent motors respectively; m_{mot1}, m_{mot2} – respective masses of the motor wagons; m_{pas} – respective masses of the passengers wagons; F_{v1v2}, F_{v2v3} – the interaction forces between the first and second, second and third wagons of diesel train; F_{v1}, F_{v2} F_{v3} – the power of resistance of the first, second and third wagons respectively; C_{v1v2}, C_{v2v3} – elasticity coefficients between the first and second, second and third wagons.

In the model (1) electromagnetic moment of first (M_{dv1}) and second (M_{dv2}) engines obtained from two parallel working mathematical models actuators diesel train with equivalent asynchronous electric engines [2]. The results of modeling in Matlab and comparing with the real data confirmed the efficiency of the proposed model.

The developed mathematical model allows, on the one hand, get all the main processes occurring in the electric engine, and on the other hand, to monitor distribution of interaction forces between three wagons of diesel train.

The importance of this mathematical model is difficult to overestimate, because a large amount of modern rolling stock manufacturers, talking about the necessity of use the similar mathematical models as advanced tools that can improve the efficiency of train movement.

Taking into account the capabilities of modern simulation systems, this mathematical model can be regarded as an object of study the train behavior, depending of the type of weather conditions, railway profile, and other equally important factors.

Thus obtained new perspective direction for the study and implementation. The given data of modeling confirms the need for research in this area, and the simulation results indicate about possibilities for reducing fuel consumption, as well as, opportunities for modeling the behavior of the train at a particular section of the route.

List of references:

1. *Orlovskiy I.A.* Accounting elastic ties and distributed load during vector control asynchronous traction drive of diesel train / *I.A. Orlovskiy, A.N. Kuleshov* // Bulletin of the Dnipropetrovsk National University of Railway Transport of academician V. Lazaryan, 2007. – Vol. 19. – P. 209-213.

2. *V.D. Dmitrienko* The modeling and optimization processes of motion control of diesel trains / *V. D. Dmitrienko, A. Yu. Zakovorotnyiy.* – Kharkov: HTMT, 2013. – 248 p.