EFFICIENCY EVALUATION OF 3VL80S ELECTRIC LOCOMOTIVES BY THE METHOD OF AVERAGING CALCULATED OF VALUES

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ABSTRACT

An assessment of the efficiency of the transportation work of three-section main (train) freight electric locomotives 3VL80S on a virtual hilly section of the railway when freight trains move without stops and with stops on intermediate separate points is presented. The foregoing is implemented by substantiating the energy indicators of the use of 3VL80S electric locomotives by averaging the calculated values, taking into account the kinematic parameters of the movement of freight trains. The results of the research are recommended for practical use by driver-instructors whose activities relate to the energy issues of the movement of freight trains on virtual and, identical to them, real hilly sections of railways, including Uzbek ones.

Keywords: freight train, electric locomotive, railroad, parameter, electric traction, calculated value, section, virtual.

At the department "Locomotives and locomotive economy" of the Tashkent State Transport University (TSTU), many years of research are being carried out to substantiate the indicators of fuel and energy efficiency of using the locomotive fleet of the Uzbek railway, some of which are indicated in works [1 - 3 and others].

The present research is a continuation of the work [4, 5], the purpose of which is to substantiate the indicators and evaluate the efficiency of the transportation work of electric locomotives by averaging method the calculated values in various conditions for the organization of railway transportation of goods on a virtual, hilly section of the railway.

The basis of the method of averaging the calculated values is the averaged values of the indicators of the transportation work of three-section main (train) freight electric locomotives 3VL80 on the studied section of the railway. These are the arithmetic mean values obtained as a result of the movement of freight trains without stops and with stops at intermediate stations in the range of changes in masses of compositions accepted by us from $Q_1 = 2500$ t to $Q_3 = 3500$ t, taking into account their differentiations by $\Delta Q = 500$ t value and a constant number of axles in the composition $m = 200$ axles.

In Table 1 shows the average values of the indicators of transportation work (use) of the mentioned 3VL80S electric locomotives for different variants of traction calculation [6], where the asterisk index * is the value of the cost of consumed electrical energy, into account of value added tax (VAT).

Table 1.

Indicators of the use of electric locomotives 3VL80S on a virtual hilly section of the railway

<table>
<thead>
<tr>
<th>Traction of calculation option</th>
<th>Conditions of transportation work</th>
<th>Train travel time, min</th>
<th>Electrical consumption energy</th>
<th>Cash costs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>composition mass ( Q_t ), t</td>
<td>number of axes ( m ), axes</td>
<td>technical speed of motion ( V_t ), km/h</td>
<td>in idling and braking mode, ( t_{id,b} )</td>
</tr>
<tr>
<td>1</td>
<td>2500</td>
<td>200</td>
<td>84.24</td>
<td>32.92</td>
</tr>
<tr>
<td>2</td>
<td>3000</td>
<td>200</td>
<td>81.57</td>
<td>34.05</td>
</tr>
<tr>
<td>3</td>
<td>3500</td>
<td>200</td>
<td>78.47</td>
<td>35.40</td>
</tr>
</tbody>
</table>

On fig. 1 shows the nature of the change in the average parameters of some of the main indicators of the transportation work (use) of three-section mainline (train) freight electric locomotives 3VL80S on a given hilly section of the railway. The average values of some parameters of the main indicators of the use of the studied freight electric locomotives 3VL80S in fig. 1 are changed: the value of the total \( A \) consumption of electrical energy is reduced by 10 times, the values of the technical speed \( V_t \) of movement are increased by 2 times. The value of specific of the cost \( C_e \) and \( C_e^* \) (including VAT) of electric energy is of increased, respectively, by 20 and 10 times.

![Figure 1: Dynamics of the average parameters of the main indicators of use of electric locomotives 3VL80S on a virtual hilly section of the railway](image)

The analytical expressions obtained by us (polynomial dependencies), designed to organize the calculation of the average parameters of some basic indicators of the transportation operation of 3VL80S electric locomotives on a hilly section of the railway track, are built using the standard Microsoft Excel Office program, in which the value of \( R^2 = 1.0 \) is a sufficient value for the approximation reliability (necessary condition of reliability - \( R^2 \geq 0.8 \)). Here the index asterisk * - is the value of the cost of consumed electrical energy, taking into account value added tax (VAT).
Technical speed of motion, km/h

\[ V_t = -0.215Q^2 + 2.025Q + 86.48 \quad R^2 = 1.0 \] (1)

Reduced (specific) cash costs including VAT, thousand soums/km

\[ c_s = -0.0695Q^2 + 0.7925Q_s + 4.004 \quad R^2 = 1.0 \] (9)

Full cash costs including VAT, thousand soums/km

\[ c_{s*} = -0.0465Q^2 + 0.7695Q_s + 4.947 \quad R^2 = 1.0 \] (10)

Reduced (specific) cash costs including VAT, thousand soums/km

\[ c_s = -0.0695Q^2 + 0.7925Q_s + 4.004 \quad R^2 = 1.0 \] (9)

Reduced (specific) cash costs including VAT, thousand soums/km

\[ c_{s*} = -0.0465Q^2 + 0.7695Q_s + 4.947 \quad R^2 = 1.0 \] (10)

Analysis of the results of the conducted research showed the following:

- the nature of the change in the averaged parameters of some basic indicators of the transportation work (use) of 3VL80 electric locomotives on a hilly railway section, depending on the mass of the freight train compound, is described by polynomial laws (dependencies);
- a decrease of the mass compound and the operating time of the power energy systems of 3VL80 electric locomotives in the traction mode leads to a decrease in the amount of electric energy consumed by them for traction of trains;
- an increase for every \( \Delta Q = 500 \) ton of mass compound from 2500 t to 3500 t leads to an increase in the cost of rail transportation of goods and a decrease in the specific consumption of electrical energy for train traction.

The regression equations obtained by us will be useful to locomotive instructor drivers and specialists of the locomotive depot operation shop, whose work is directly related to the transportation process of traction (main) electric rolling stock.

Reference:


