Analysis of data for quantitative assessment of reliability indicators of special self-propelled rolling stock

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Abstract: The article provides a forecast for the number of railcars, taking into account the development and maintenance personnel of railway transport, as well as an analysis of data for a quantitative assessment of reliability indicators. Taking into account the provisions and requirements, it is proposed to increase the development of work on the reconstruction and modernization of existing track facilities, including special self-propelled rolling stock.
Keywords: special self-propelled rolling stock, load-bearing structures, quantitative assessment analysis, failure of railcars

1. Introduction

According to the development strategy of the new Uzbekistan for the development of railway transport in 2022-2026, it is planned to improve railway transport and privatize ineffective routes in society [1].

Today, one of the pressing problems of economic development not only of railway transport, but also of other industries in all developing countries is the introduction of energy and resource-saving technologies and the identification of ways to use them effectively.

Electrification of railways is considered one of the priority areas of JSC "Uzbekistan Temir Yollari" due to the efficiency of electric traction compared to diesel.

The introduction of electric traction leads to the acceleration of transport processes. Electric traction makes it possible to increase the carrying capacity of railway lines by 2-2.5 times. Electric locomotives have virtually no power limitations, since they have centralized power and can withstand long-term overloads. An important feature of electric locomotives is the generation and return of electrical energy to the network during regenerative braking of the train. Modernization of rolling stock, including railcars, as well as the use of cost-effective methods will make it possible to reduce the overall cost of transportation as a whole. In this sense, the introduction of modern technologies and scientific developments to improve the dynamic performance of materials and structures of railway rolling stock plays an important role. Due to the end of their service life, by 2025 Uzbekistan Temir Yollari JSC will experience a massive failure of all operating railcar equipment. Therefore, an objective analysis of data for quantitative assessment of reliability indicators of special self-propelled rolling stock operated by the Uzbek Railways was presented in this article.

2. Methods and materials

The main activity of track facilities and equipment is a determining factor for the normal functioning of the railway infrastructure; financial investment flows for the development and modernization of self-propelled rolling stock facilities must correspond to its importance.

Special self-propelled rolling stock is organically integrated into the work to ensure the reliability of track facilities, safety and increase the speed of freight and passenger transportation.

As a recoverable object, each crew consists of components that are subject to replacement or restoration during planned types of repairs.

The main load-bearing part of the crew structure (body, frame), called the base, should serve, as a rule, until its full service life is exhausted.

In real operating conditions on different sections of railways, crews of the same type may be subject to significantly different loads when operating in different climatic zones and using different maintenance and repair technologies.

The consequences of metal corrosion can manifest themselves not only in a decrease in the load-bearing capacity of structures due to changes in the geometric dimensions of elements, but also in a decrease in the endurance limit of structures, both as a result of the appearance of stress concentrates in the form of cavities, and an adsorption decrease in strength, anodic dissolution of the metal and intergranular corrosion.

SSPS bodies and frames often have through-corrosion damage to the lower part, where moisture accumulates.

Currently, effective technologies for combating corrosion have been developed, the use of which can significantly increase the service life of basic crew parts.

The method of managing an individual resource includes a set of methods and techniques for influencing the managed object to achieve the goal of increasing the effective service life.

The calculation-expert-statistical method (RES-method) of individual resource management consists of three interconnected systems: monitoring, control and forecasting systems.[2]

The condition of railcars and motor vehicles operated in the divisions of Uzbekistan Temir Yollari JSC is 186 units, of which diesel assembly railcars of the ADM type (ADM-1) are 15 units and loading and transport motor vehicles of the MPT type (MPT-4) are 25 units. According to the

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Department of Machinery, Mechanisms and Railway Equipment of Uzbekistan Temir Yollari JSC, as of December 2014, of the available railcars (railcars) and motor locomotives MPT have served for more than 20 years (they need major overhauls with an extension of their useful life), 65% of special self-propelled rolling stock (SSPS). In addition, due to the end of their service life, by 2018 there will be a massive failure of all equipment in use for ADM type railcars (ADM-1) and MPT motor vehicles (MPT-4).[4],

According to the Department of Machinery, Mechanisms and Railway Equipment at UTY JSC, a significant number of fatigue cracks have currently been identified, although their repairs were carried out in accordance with instructions TsT 336. At the same time, even cracks that were welded, according to the rules of depot repairs, continue to develop and increase in size, weakening the most dangerous sections. It is obvious that the general stress state of the body frames, spring suspension and chassis of the railcars will significantly depend on the initial bending of the neutral axis and the constantly acting dynamic forces. These factors cause a reduction in the overall service life of railcars (railcars) and motor vehicles by 1.2-1.5 times.[5]

During their operation, solving the problems of comprehensive analysis of technical condition is of paramount importance, since the corresponding machines are serviceable and repairable. A malfunction of a track machine often leads to significant losses, since a violation of the repair schedule causes disruptions in the train schedule, which in the worst case affects traffic safety. Operating and maintenance personnel (engineers and electromechanics) are faced with the task of monitoring and maintaining the good condition of track machine devices, and in the event of failures, quickly identifying and eliminating them. Solving these problems is significantly complicated by the operating features of such devices: the seasonal and urgent nature of the work; long service life; widespread throughout the country; complex climatic and dynamic operating conditions [6].

At present, the SSPRS system and, in general, its organizational and technical facilities are not yet able to adequately and flexibly respond to the need for technical support and repairs, as a result of which the potential opportunities for ensuring continuous and safe traffic and economic benefits sometimes turn into an elementary source of the problem. Since it is known that 50-60% of unscheduled repairs are carried out due to unsatisfactory depot repairs, and more than 15% of the repair personnel are engaged in repairs of the SSPS. The funds spent on repairs and restoration of the SSPS during its service life are significantly more than its original cost. Therefore, research aimed at improving methods for improving design quality and operational reliability based on the use of technical diagnostics is important and timely.

Analysis of data from a quantitative assessment of reliability indicators carried out in the operational department of the JSC "Uzbekistan Temir Yollari" SSPRS, in the amount of 27 railcars of the ADM-1 type and other analogues, carried out in 2010-2020. shows that there are failures in electrical installations 58, hydraulic installations 46 and mechanical parts 34.

Failures of electrical installations of the SSPS are of varying degrees of operational loads Fig. 1.

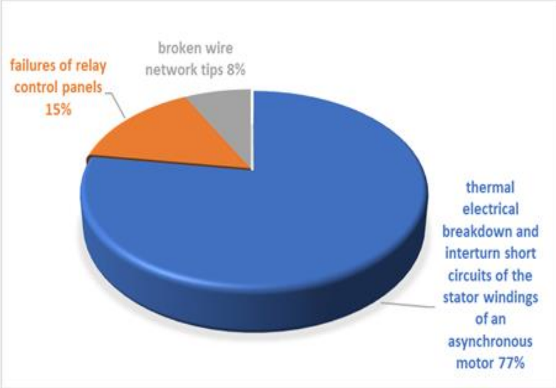

Fig. 1. Failures of electrical installations of self-propelled rolling stock.

Long-term experience in operating railcars and railcars shows that the causes of failures and loss of performance are the appearance of cracks in welds, deformation, of mechanical overloads, vibrations and fatigue effects 13%; operation of hydraulic cylinders in jerks, failure to maintain the components of the installation platform (IP) in the working position 11%; worm gear heating 5%; jamming of rollers in the slewing ring 3%; burnout and short circuit of the windings of executive electric motors as a result of overloads and electrodynamic influences and vibrations 15%; damage to the drive control system, malfunction of electrical equipment and wiring 6%, etc. [7].

Discussion of results and conclusions. The analysis revealed that failures in many cases arise due to an increase in operational loads on load-bearing structures, for electric motors and their contact control system; there were also defective elements due to an imperfect control system during the manufacturing process and low qualifications of maintenance personnel [8].

Taking into account the above provisions and requirements, it is necessary to increase the development of work on the reconstruction and modernization of existing track facilities, including the SSPRS, by identifying the following key points:

− the need for accelerated renewal of growth and modernization of the entire system of fixed assets of the SSPRS;

− the need to extend the technical and technological gap in the main equipment of the SSPRS from the advanced foreign countries of the world;

− the need for comprehensive systematic work to improve technical and electrical safety when performing repair work under voltage of the contact network;

− it is necessary to provide a set of works to modernize the SSPRS in terms of energy and resource saving.

3. Conclusion

The implementation of the strategic development of railway transport in the CIS countries necessitates the rapid development and innovative methods of the entire track infrastructure and in particular the SSPRS with the harmonious development of electric rolling stock.

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