UDK 629.463.001.63

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KEY ASPECTS OF MODULATING AND PREVENTING CORROSION OF CARRIAGE ELEMENTS AT THE DESIGN STAGE

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Abstract *The results of corrosion modelling are the basis for the development of new standards and regulations in railcar building aimed at ensuring the safe operation of rolling stock. The paper shows the peculiarities of using 3D modelling to assess the corrosion effects on the destruction of car body elements. The proposed design of a railcar kingpin assembly with a corrosion-resistant element made of fibreglass composite materials*

Keywords: transport, railway transport, wagons, corrosion, kingpin beam.

Анотація. *Результати корозійного моделювання є основою для розробки нових стандартів і нормативних документів у вагонобудуванні, спрямованих на забезпечення безпечної експлуатації рухомого складу. У статті показано особливості використання 3D моделювання для оцінки впливу корозії на руйнування елементів кузова вагона. Запропонована конструкція шкворневого вузла вагона з корозійностійким елементом зі склопластикових композиційних матеріалів*

Ключові слова: транспорт, залізничний транспорт, вагони, корозія, шкворнева балка.

Introduction

Freight cars are a key link in the transport infrastructure, ensuring the transportation of various goods over long distances. Their reliable and safe operation is critically important for the stable functioning of the economy. One of the serious problems that negatively affects the service life and safety of freight cars is the corrosion of metal elements. Particular attention should be paid to non-load-bearing elements, which, although they do not carry the main load, play an important role in ensuring the integrity of the structure, the tightness of the body and the protection of the cargo from external influences [1].

Research results

The dependence of metal thickness on the service life of gondola cars was obtained by approximation with a linear model (uniform corrosion) (1-4) and a parabolic model (under oxidation) using the least squares method (LSM) [2].

$$L_{(kmp)} = b_0 - f \times t_i, \quad (1)$$

$$L_{(kmp)oks} = b_0 - f\sqrt{ti} \quad (2)$$

where b_0 is the initial thickness, f is the corrosion rate (mm/year), $L_{(kmp)}$─residual metal thickness of the gondola element, t is the life cycle period.

The coefficients b_0 and f are found by the Least Squares:

$$f = \frac{n\sum(t_i b_i) - \sum t_i \sum b_i}{n\sum t_i^2 - (\sum t_i)^2} \quad (3)$$

n-number of empirical data

$$b_0 = b + f \times ti \quad (4)$$

As a result of the analysis of metal thickness on the service life, regressive dependences of the dynamics of the thickness of the elements of the wagons were obtained. For the gondola wagon, the most universal components that are also in the designs of other wagons, depending on the type of cargo transported, are given:

-cargo technical and lump salt

vertical sheet of the pivot beam

$$L_{(kmp)} = -0.2963X + 8.055 \quad R2 = 0.9837$$

I-beam wall of the backbone beam

$$L_{(kmp)} = -0.2555X + 11.875 \quad R2 = 0.9091$$

For the car's pivot assembly, the process of installing a lining made of fiberglass composite material (or corrosion-resistant steel or other material) to protect against corrosion on the frame assemblies was modeled. (Fig. 1)

This studyproposed design improvements to combat corrosionaimed at introducing composite materials as a replacement for the used rolled metal and, as a result, reducing the cost of manufactured products, their competitiveness and improving operational characteristics.

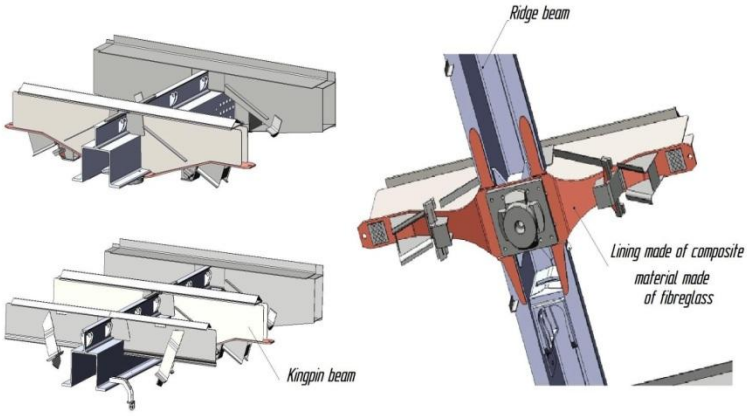

Fig. 1– Proposed design for counteracting corrosion of the car body pivot assembly

Conclusions

The results of corrosion modeling are the basis for the development of new standards and regulations in the field of railcar construction, aimed at ensuring the safe operation of rolling stock. The economic effect of the application of scientifically based methods of combating corrosion is manifested in reducing the costs of repair and maintenance of railcars, as well as in increasing their operational suitability.

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