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STUDY OF PROTECTIVE COMPOSITE COATINGS FOR HIGH-SPEED MOBILE COMPOSITION OF RAILWAY TRANSPORT OF THE REPUBLIC OF UZBEKISTAN

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Abstract
This article proposes the formation of composite polymeric oxide coatings on steel grade 09G2S using the method of plasma-electric oxidation in order to increase the adhesion properties of the metal of the running parts of highspeed rolling stock while driving at low temperatures.

Keywords: running gear of high-speed rolling stock, icing, protective flytrafluoroethylene-oxide coatings, galvanization, electrolyte, adhesion.

Introduction

High-speed trains, when moving in low temperatures, are often accompanied by icing of their running parts, which can lead to accidents and catastrophic situations. Icing does not occur if the skin has a positive temperature or drops of water with a temperature above 0 °C fall on its surface. Ice formation is assessed by the degree of icing, which is understood as the thickness of the overgrown ice. The effectiveness of ice removal work is affected by the freezing strength of ice with the surface, which depends on the cohesion of the adhesion forces between ice particles and adhesion – the adhesion forces of ice with the surface. The amount of cohesion is determined by the composition of the water from which ice is formed, and the number намораживанияof ice freezing cycles, and adhesion is determined by the interaction of ice with the surface. In the autumn-winter period, it is extremely important to know the period of possible icing. The icing period is limited to the upper and lower limits. The upper limit indicates the beginning of icing and is determined by the atmospheric temperature of 0 °C, with a relative humidity of at least 95 %. Reducing the air temperature from 0°C to -18 °C causes icing. At temperatures below -18 °C, the water content decreases significantly due to the crystallization of supercooled droplets. According to this icing is possible in the temperature range from 0° C to -18 °C (80-85 % of icing cases). Methods of de-icing are divided into mechanical, physico-chemical and thermal. Mechanical is the direct removal of ice by hand or the use of various mechanical systems. In practice, in order to reduce the adhesion of ice to the surface, various coatings, special lacquers and paints, or separately applied substances (for example, based on fats or paraffins) can be used.

Coatings were formed on the 09G2S alloy in galvanostatic mode at a current density of 0.05 A/ cm2 for 20 minutes. The "initial" coating was formed in the base electrolyte (0.05 mol/l$Na_2SiO_3 \times 5H_2O$ + 0.05 mol /l NaOH), the "Emulsion" coating was formed in the base electrolyte +100 ml/l siloxane acrylate emulsion. Complex aqueous electrolytes of the suspension-emulsion were prepared in two stages. First, a given amount of siloxane-acrylate emulsion (100 ml/l) was mixed with a corresponding amount of differently dispersed (the particle size of the main fraction is about 1 μm) PTFE powder (20 g/l, 40 g/l, 60 g/l). The mixture was thoroughly mixed with a magnetic or mechanical stirrer for at least 10 minutes, which ensured that the particles of PTFE powder were wetted with a siloxane-acrylate emulsion. The second step was mixing the resulting mixture with the base electrolyte (0.05 mol/lNa_2SiO_3 * $5H_2O$ + 0.05 mol /l NaOH). The finished electrolyte was a complex aqueous suspension-an emulsion with a dispersed phase formed by microcapsules in which insoluble solid particles of PTFE located in the" shell " of a siloxane-acrylate emulsion are homogeneously distributed in an aqueous dispersion medium. From the above data, it can be seen that the coating formed in the base electrolyte, the coating obtained in the electrolyte with the addition of an emulsion, and the coatings containing PTFE in their composition have approximately the same ice adhesion strength of ~840 kPa.

The electrochemical cell for plasma-electrolyticися oxidation consisted of a glass beaker (1) with a volume of 800 ml, which was filled with electrolyte (2), and a tubular coil (4) made of stainless steel. The coil was connected to the negative pole of the current source, so that it served as a cathode, while the sample (3) on which the coating was formed was connected to the positive pole of the current source.

The thickness of the coatings was measured with an eddy current thickness gauge VT-201. The eddy current control method is based on the analysis of the interaction of an external (relative to the test sample) electromagnetic field with the electromagnetic field of eddy currents induced by an exciting coil in an electrically conductive control object (the test sample) by this field. ТолщиномерThe VT-201 thickness gauge allows measuring coating thicknesses from 2 to 1100 microns. The limit of the permissible absolute basic error does not exceed (0.03 d + 1.0) microns (where d is the value of the measured thickness) when the device is used correctly. Thickness measurements were performed at randomly selected 10 locations on each side of the sample. Along with changes in the thickness, composition, and hydrophobicity of the surface, an increase in the concentration of PTFE powder in the electrolyte leads to noticeable changes in the surfaceof the formed coating.

Additional introduction of PTFE powder into the electrolyte initially leads, at powder concentrations of 10-30 g/l, to the enlargement of surface formations and at concentrations of 50 g/l or more – to the formation of a cellular fused structure. Tests of ice adhesion to the surface were evaluated on a laboratory-assembled installation simulating the separation of a frozen water drop from the surface (Figure 5). The installation was assembled on the basis of a metal rail, on which two racks are mounted: one is equipped with electronic scales that work on tension; the second is equipped with video equipment that allows recording the readings issued by the scales. The principle of operation of the unit is as follows: the unit is placed without equipment and scales in the freezer at a temperature of minus 18 °C, a sample is fixed on the rail, on which a drop of distilled water is placed and an indenter is lowered into it, strictly vertically using tweezers fixed to the rackиндентор. After 20 minutes, after the drop has solidified, carefully remove the tweezers that held the indenter (the indenter is now fixed with ice in the frozen drop), install the scales on the rack and connect them to the indenter.

Conclusions

1. A method for forming composite polymer oxide coatings on steel grade 09G2S by plasma-electric oxidation is proposed.
2. This method allows you to protect metal from ice formation on the surface of the running parts of high-speed rolling stock at low temperatures that prevent freezing of the components of the rubbing parts of the brake and load-bearing elements of the train.

References

1. Турсунов, Н. К., Авдеева, А. Н., Мамаев, Ш. И., & Нигматова, Д. И. (2022). Метрология и стандартизация: роль и место дисциплины в подготовке специалистов железнодорожного транспорта республики узбекистан. *Academic research in educational sciences*, *3*(TSTU Conference 1), 140-145.
2. Нурметов, Х. И., Турсунов, Н. К., Кенжаев, С. Н., & Рахимов, У. Т. (2021). ПЕРСПЕКТИВНЫЕ МАТЕРИАЛЫ ДЛЯ МЕХАНИЗМОВ АВТОМОБИЛЬНЫХ АГРЕГАТОВ. Scientific progress, 2(2), 1473-1479.
3. Tursunov, N. K., Semin, A. E., & Sanokulov, E. A. (2016). Study of desulfurization process of structural steel using solid slag mixtures and rare earth metals. *Chernye metally*, *4*, 32-7.
4. Турсунов, Н. К., Тоиров, О. Т., Железняков, А. А., & Комиссаров, В. В. (2021). Снижение дефектности крупных литых деталей подвижного состава железнодорожного транспорта за счет выполнения мощных упрочняющих рёбер.
5. Турсунов, Н. К., Санокулов, Э. А., & Семин, А. Е. (2016). Исследование процесса десульфурации конструкционной стали с использованием твердых шлаковых смесей и РЗМ. *Черные металлы*, (4), 32-37.
6. Tursunov, N. K., Semin, A. E., & Sanokulov, E. A. (2017). Study of dephosphoration and desulphurization processes in the smelting of 20GL steel in the induction crucible furnace with consequent ladle treatment using rare earth metals. *Chernye Metally*, *1*, 33-40.
7. Toirov, O. T., Tursunov, N. Q., Nigmatova, D. I., & Qo'chqorov, L. A. (2022). USING OF EXOTHERMIC INSERTS IN THE LARGE STEEL CASTINGS PRODUCTION OF A PARTICULARLY. *Web of Scientist: International Scientific Research Journal*, *3*(1), 250-256.
8. Турсунов, Н. К., & Тоиров, О. Т. (2021). Снижение дефектности рам по трещинам за счёт применения конструкции литниковой системы.

9. Тоиров, О. Т., Турсунов, Н. К., Кучкоров, Л. А., & Рахимов, У. Т. (2021). Исследование причин образования трещины в одной из половин стеклоформы после её окончательного изготовления. *Scientific progress*, *2*(2), 1485-1487.
10. Tursunov, N. K., Semin, A. E., & Sanokulov, E. A. (2017). Research of dephosphorization and desulfurization processes in smelting of 20GL steel in an induction crucible furnace with further processing in a ladle using rare earth metals. *Chern. Met.*, *1*, 33-40.
11. Тен, Э. Б., & Тоиров, О. Т. (2021). Оптимизация литниковой системы для отливки. *Литейное производство*, (10), 17-19.
12. Тен, Э. Б., & Тоиров, О. Т. (2020). Оптимизация литиковой системы для отливки «Рама боковая» с помощью компьютерного моделирования. In *Прогрессивные литейные технологии* (pp. 57-63).
13. Азимов, Ё. Х., Рахимов, У. Т., Турсунов, Н. К., & Тоиров, О. Т. (2022). Исследование влияние катионов солей на реологический статус геллановой камеди до гелеобразования. *Oriental renaissance: Innovative, educational, natural and social sciences*, *2*(Special Issue 4-2), 1010-1017.
14. Тоиров, О. Т. У., Турсунов, Н. К., & Кучкоров, Л. А. У. (2022). Совершенствование технологии внепечной обработки стали с целью повышения ее механических свойств. *Universum: технические науки*, (4-2 (97)), 65-68.
15. Riskulov, A. A., Yuldasheva, G. B., Kh, N., & Toirov, O. T. (2022). DERIVATION PROCESSES OF FLUORINE-CONTAINING WEAR INHIBITORS OF METAL-POLYMER SYSTEMS. *Web of Scientist: International Scientific Research Journal*, *3*(5), 1652-1660.
16. Рахимов, У. Т., Турсунов, Н. К., Кучкоров, Л. А., & Кенжаев, С. Н. (2021). Изучение влияния цинка Zn на размер зерна и коррозионную стойкость сплавов системы Mg-Nd-Y-Zr. *Scientific progress*, *2*(2), 1488-1490.
17. Нурметов, Х. И., Турсунов, Н. К., Туракулов, М. Р., & Рахимов, У. Т. (2021). УСОВЕРШЕНСТВОВАНИЕ МАТЕРИАЛА КОНСТРУКЦИИ КОРПУСА АВТОМОБИЛЬНОЙ ТОРМОЗНОЙ КАМЕРЫ. Scientific progress, 2(2), 1480-1484.
18. Тоиров, О. Т., Кучкоров, Л. А., & Валиева, Д. Ш. (2021). ВЛИЯНИЕ РЕЖИМА ТЕРМИЧЕСКОЙ ОБРАБОТКИ НА МИКРОСТРУКТУРУ СТАЛИ ГАДФИЛЬДА. Scientific progress, 2(2), 1202-1205.

19. Турсунов, Н. К., Уразбаев, Т. Т., & Турсунов, Т. М. (2022). Методика расчета комплексного раскисления стали марки 20гл с алюминием и кальцием. Universum: технические науки, (2-2 (95)), 20-25.
20. Avdeeva, A. N. (2020). Disputed kinds of influence in the process of learning at the university.
21. Riskulov, A. A., Yuldasheva, G. B., & Toirov, O. T. (2022). FEATURES OF FLUOROCOMPOSITES OBTAINING FOR WEARING PARTS OF MACHINE-BUILDING PURPOSE. *Web of Scientist: International Scientific Research Journal*, *3*(5), 1670-1679.
22. Risqulov, A. A., Sharifxodjayeva, X. A., Tursunov, N. Q., & Nurmetov, X. I. (2022). Transport sohasi uchun mutaxassislarni tayyorlashda materialshunoslik yo ‘nalishining o ‘rni va ahamiyati. Academic research in educational sciences, 3(TSTU Conference 1), 107-112.
23. Riskulov, A. A., Yuldasheva, G. B., Kh, N., & Toirov, O. T. (2022). DERIVATION PROCESSES OF FLUORINE-CONTAINING WEAR INHIBITORS OF METAL-POLYMER SYSTEMS. Web of Scientist: International Scientific Research Journal, 3(5), 1652-1660.
24. Файзибаев, Ш. С., Авдеева, А. Н., Мамаев, Ш. И., Турсунов, Ш. Э., & Нигматова, Д. И. (2022). АНАЛИЗ ЭКСПЛУАТАЦИОННОЙ НАДЕЖНОСТИ ТЯГОВЫХ ЭЛЕКТРИЧЕСКИХ ДВИГАТЕЛЕЙ ЛОКОМОТИВОВ ОА “УЗБЕКИСТОН ТЕМИР ЙУЛЛАРИ”. *Universum: технические науки*, (4-5 (97)), 30-35.
25. Алимухамедов, Ш. П., Рахимов, Р. В., Инагамов, С. Г., Мамаев, Ш. И., & Кодиров, Н. С. (2022). Математическое моделирование передаточного механизма потележечной тормозной системы грузовых вагонов. *Universum: технические науки*, (2-3 (95)), 8-14.