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https://orcid.org/0009-0000-6679-6847

NEW TECHNOLOGICAL SOLUTIONS BASED ON LOCAL RESOURCES IN THE DEVELOPMENT OF ANTI-CORROSION POLYMER-BITUMEN COATINGS

Isroilov Y.Y.
Master's student of the department
"Oil and gas work and their processing technology",
Karshi State Technical University,
Uzbekistan. Karshi city.
E-mail: yigitaliisroilov504@gmail.com

Abstract: This study is devoted to modern technological solutions for the development of anti-corrosion polymer-bitumen coatings based on local raw materials. It was found that the harmonious combination of polymer modifiers, oil residues and mineral additives in improving the physicochemical properties of bitumen has a significant impact on the structural stability, hydrophobicity and electrochemical protection of the coating. As part of the study, the structural properties of local bitumens were analyzed and the optimal parameters of the modification process - mixing speed, temperature regime and polymer concentration - were determined. Laboratory tests showed that the adhesion of polymer-bitumen composites to the metal surface increased, the penetration of ions that initiate corrosion decreased, and the mechanical stability of the coating increased. The results obtained confirm that the use of local resources is an important scientific and practical basis for diversifying the technology for the production of economically efficient, environmentally friendly and anti-corrosion coatings.

Keywords: polymer-bitumen composites; anti-corrosion coatings; local raw materials; bitumen modification; polymer modifiers; oil residues; structural stability; adhesion; hydrophobicity; corrosion process; electrochemical protection; technological parameters; protection of metal surfaces; environmental safety; composite materials.

Introduction:

The effective use of local raw materials is one of the important strategic directions in increasing the competitiveness of the production of construction and industrial materials. In particular, the integrated use of local grades of bitumen, oil residues, polymer modifiers and mineral additives in improving the technology of polymer-bitumen-based anti-corrosion coatings is at the center of scientific research. Studies conducted in recent years have proposed a number

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of new approaches to improving the dispersion of the polymer in bitumen-composite coatings, their oxidation stability, viscosity-gradient change and adhesion to metal surfaces. As reported in the literature, the use of thermoplastic polymers, rubbers, elastomers and organomineral modifiers significantly increases the hydrophobicity, dielectric properties and mechanical strength of the composite. A detailed study of the physicochemical structure of local bitumens shows that in most cases they are characterized by a tendency to harden at high temperatures and an increased level of brittleness in the cold. Therefore, researchers are developing various technological solutions based on polymer modification to increase the thermal stability of bitumen, reduce heat sensitivity, and enhance anti-corrosion efficiency. According to some scientific sources, the method of introducing the polymer into the bitumen composition, mixing speed, modification temperature, the presence of additional stabilizers, and the uniformity of the dispersed phase are the main factors determining the quality indicators of the final composite.

The methodology of scientific research in this area usually includes the following stages: physicochemical analysis of raw material samples; assessment of the degree of swelling and dispersion of the polymer in the bitumen composition; laboratory testing of the viscosity-temperature properties of the finished composite coating, its modulus of elasticity, thermoviscosity indicators, moisture resistance, ability to slow down the corrosion rate, and adhesion to metal surfaces. Experiments are also conducted to determine the coating's ability to work in real corrosive environments (saline soils, humid atmospheres, chemically active solutions, high-temperature conditions).

Preliminary results show that the structure of polymer-bitumen composites modified on the basis of domestic oil residues can be more stable than coatings based on other imported modifiers. This is primarily due to the high content of aromatic hydrocarbons, chemical compatibility with the polymer and the ability to form structural bonds. According to the results of the experiments, the introduction of the polymer into bitumen at an optimal concentration reduced the hardening temperature of the coating, increased the dielectric breakdown resistance and ensured its tight adhesion to the metal surface. At the same time, the addition of additional functional stabilizers also significantly improved the long-term service life of the coating.

Based on the experimental results obtained based on the theoretical models presented in the literature, it can be noted that the anti-corrosion mechanism in polymer-bitumen composites is carried out through two main processes: the first is the limitation of electrochemical reactions that initiate corrosion due to the strong adhesion of the polymer-bitumen layer with the metal; the second is the sharp reduction in the penetration of electrolyte solutions into the metal layer due to

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the hydrophobic structure. The resistance to corrosion is determined by the degree of bonding of polymer chains with the elastic phase in the bitumen matrix and the internal energy stability of the material system.

The results of the analysis show that the use of local raw materials not only increases economic efficiency, but also ensures environmental safety, increases the share of renewable resources in the coating production process, and allows for the adaptation of technological processes to local conditions. However, some limitations are also noted in the scientific debate: due to the structural differences of some local bitumens, the modification process does not always give the same result, and if the polymer introduction technology is not precisely controlled, uneven dispersion and a decrease in coating quality may occur.

In general, based on the synthesis of existing scientific developments, experimental analyses, and technological solutions, it can be said that the prospects for developing modern anti-corrosion polymer-bitumen coatings based on local resources are high, and scientifically based approaches to creating new composite materials in this area are increasingly expanding.

Conclusion:

Scientific analyses conducted on the development of anti-corrosion polymer-bitumen coatings based on local resources show that improving the structural properties of bitumen through polymer modification not only improves the mechanical and thermophysical parameters of the coating, but also significantly increases its anti-corrosion efficiency. The results of the study confirmed that local oil residues and organic additives have high chemical and physical compatibility with the polymer, which contributes to the formation of a stable dispersed phase, strong adhesion and hydrophobicity in the composite structure. Such modified materials significantly reduce the penetration of moisture and aggressive ions, limiting the onset of electrochemical processes on metal surfaces.

The created technological solutions, in particular, the optimization of the modification temperature, the precise selection of the mixing speed and polymer concentration, increased the structural stability of the composite and ensured a long-term service life of the coating. The advantages of working with local raw materials - cost-effectiveness, environmental safety and reduced dependence on imports - further strengthen the possibilities of widespread implementation of this technology in industry.

At the same time, it is emphasized in scientific discussions that due to the structural differences of some local bitumens, the stability of the modification process may not always give the same result. Therefore, in the future, it is necessary to conduct in-depth modeling of the

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rheological and chemical behavior of polymer-bitumen systems, optimize the selection of stabilizers, and conduct extensive testing in real corrosive environments. In general, the results of the study show that polymer-bitumen composites based on local resources have high practical potential as anti-corrosion coatings, and their use in industry and construction can significantly extend the service life of metal structures and increase technological safety. This direction will be of significant scientific and practical importance in the future in creating new composite materials, reducing production costs, and introducing environmentally sustainable technologies.

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