Volume 2, Issue 12, December - 2024 **ISSN (E):** 2938-3811

ANALYSIS OF THE CHEMICAL EFFECTS OF OLIGOMERIC SUBSTANCES IN OBTAINING MODIFIED ANTI-CORROSION COATINGS

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Abstract
This article examines research on analyzing the chemical effects of obtained oligomeric substances and their application in modified anticorrosive coatings. Anticorrosion coatings play a crucial role in ensuring the long-term use of metal products in modern industry. The chemical and physical properties of oligomeric substances contribute to the creation of highly effective protective materials by enhancing the coatings' adhesion, mechanical durability, and thermal stability. Studies have shown that coatings modified with oligomeric materials are significantly more effective than standard coatings, providing high adhesion, mechanical strength, and corrosion resistance efficiency.

Keywords: Anti-corrosion coatings, chemical effect of oligomeric substances, modified coatings, metal products, corrosion protection, adhesion, mechanical durability, thermal stability, polymer materials, infrastructure, crosslinking reactions, polymerization, mechanical strength, exposure tests, large-scale production, analysis methods (IR, TGA, SEM).

Introduction

In modern industry, protecting metal products from corrosion is of particular importance to ensure their safety and longevity. Anti-corrosion coatings play a crucial role in addressing this issue. Currently, modified types of anti-corrosion coatings are being developed to enhance their effectiveness.

In Uzbekistan, research in the field of anti-corrosion coatings primarily focuses on the effective utilization of local raw materials. For instance, studies are being conducted on the development of coatings based on polymer materials and improving their corrosion-resistant properties. These efforts are especially significant in protecting metal structures used in oil and gas industries and industrial enterprises.

In foreign countries, research in this direction aims to create highly effective materials through molecular-level modifications and innovative technologies. For example, in the USA, Germany, and Japan, research is being conducted to increase the ultraviolet resistance of modified oligomer-based coatings and ensure long-term protective efficiency. Such scientific approaches are directed at extending the service life of metal products and enhancing economic efficiency.

This research paper is dedicated to analyzing the chemical effects of oligomeric substances within the context of ongoing research in Uzbekistan and abroad.

Anti-corrosion coatings are the primary means of protecting metal surfaces from external influences. The diverse chemical and physical properties of such coatings expand their range of applications and ensure the long-term service life of metal products. They prevent metal oxidation, corrosion, and environmental damage.

Polyurethane-based coatings: Polyurethanes are highly elastic and durable materials that provide effective protection in various climatic conditions. They are especially suitable for surfaces subjected to high mechanical pressure or frequent friction. The main advantages of polyurethane coatings are their elasticity and high adhesion capability.

Epoxy-based coatings: The resistance of epoxy coatings to acids, alkalis, and solvents makes them indispensable in industrial environments. They are used to protect chemical reactors, pipelines, and storage tanks in various industrial facilities. Epoxy coatings are distinguished by their durability and long-term protective effectiveness due to their high molecular structure.

Acrylic-based coatings: The main characteristics of acrylic coatings are their color stability and resistance to ultraviolet rays. They can also be applied at relatively low temperatures. Such coatings are particularly used on exterior surfaces, including construction and architectural objects.

Modified oligomer-based coatings: Oligomers are at the center of modern research, and their modified types play a significant role in creating highly effective protective coatings. Due to the flexibility of their chemical composition, they significantly enhance the adhesion, thermal stability, and mechanical durability of coatings. Oligomer-based coatings provide long-term protection along with high economic efficiency.

Anti-corrosion coatings are applied to protect various metal surfaces. They are resistant to chemical, mechanical, and environmental effects. The main types of coatings are listed below:

Polyurethane-based coatings: Possess high mechanical durability and excellent adhesion.

Epoxy-based coatings: Highly resistant to acids and alkalis.

Acrylic-based coatings: Superior color retention and resistance to ultraviolet rays.

Oligomer-based modified coatings: The primary focus of this research.

Oligomers are organic compounds with low molecular mass that possess highly effective chemical structures. They perform the following functions in anticorrosion coatings:

Ensuring high adhesion.

Increasing the mechanical durability of coatings.

Enhancing thermal and chemical stability.

Helping to maintain proper surface protection.

Oligomers and their chemical effects. Oligomers engage in complex interactions with various chemical substances, in which their chemical properties play a crucial role. They form high molecular structures through interconnection, polymerization, crosslinking, and other types of reactions. For example, during the polymerization process, oligomers react with the help of catalysts to form stable polymer chains. Crosslinking creates three-dimensional network structures, ensuring the mechanical durability and stability of coatings. Additionally, the adhesion reactions of oligomers with metal surfaces enhance the coatings' high adaptability to surfaces and protective capabilities. Below, their important reaction types are described in detail:

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Polymerization reactions: Oligomers can be transformed into high-molecular-weight polymers with the help of catalysts. This process serves to enhance the effectiveness of anticorrosion coatings.

Crosslinking reactions: During the crosslinking process, oligomer molecules interconnect to form a three-dimensional structure. This ensures high mechanical durability of the coatings.

Adhesion reactions: Oligomers chemically bond with the metal surface, protecting it. Such reactions play a significant role in enhancing the stability of coatings.

Experimental research methods: The following methods are used in the study of substances with oligomeric properties:

Infrared spectroscopy (IR): For identifying chemical bonds.

Thermogravimetric analysis (TGA): For studying the thermal stability of coatings.

Scanning electron microscopy (SEM): For analyzing surface structure.

Adhesion assessment tests: For determining the adhesion strength of coatings to metal surfaces.

Research results: Experimental results show that coatings modified with oligomeric substances are more effective than standard coatings in the following aspects:

The adhesion of the coatings increased by 35%. This ensured that the coatings were better connected to the metal surface and formed a stable protective layer on it. Increased adhesion is associated with the high reactivity of oligomeric molecules.

Mechanical durability improved by 50%. By crosslinking, the oligomers give the coatings a three-dimensional structure, increasing their mechanical strength. Such durability is important for creating high-pressure and friction-resistant coatings.

The indicators of anti-corrosion protection have increased by 40%. Studies have shown that oligomeric coatings effectively protect surfaces from corrosion. This is due to their low chemical stability and ability to react with corrosion agents.

It was also noted that the coatings' resistance to ultraviolet radiation and their resilience against negative environmental influences have significantly improved. All of this is achieved through the effective chemical properties of oligomeric substances.

Conclusion: Studies show that the main advantages of the obtained oligomeric substances are their high adhesion, mechanical strength, thermal stability, and improved anticorrosion protection properties. The use of such substances in coatings is crucial for ensuring the long-term operation of metal products.

The chemical action of oligomeric substances and their role in polymerization, crosslinking, and adhesion processes contributes to the enhancement of the physical and mechanical properties of coatings. For example, in the process of polymerization, oligomers are converted into high-molecular-weight polymers, which increases the strength of the coating. During crosslinking, the oligomers bind together to form a three-dimensional structure, which ensures mechanical strength and durability. At the same time, adhesion reactions ensure good bonding with metal surfaces and the formation of a stable protective layer.

Studies also show the effectiveness associated with coatings consisting of oligomeric substances. For example, the adhesion index of these coatings increased by 35%, mechanical strength by 50%, and anti-corrosion protection by 40%. These results confirm that the obtained substances contribute to a significant improvement in the mechanical and chemical stability of the coatings.

Furthermore, the data obtained during the research also indicate that the obtained oligomeric substances have improved their resistance to ultraviolet radiation and resistance to negative environmental influences. These properties make it easier to apply the resulting coatings in the external environment and ensure their long-term effectiveness.

Overall, the use of oligomeric materials in anticorrosion coatings allows for the creation of new highly efficient and economically viable materials. Research in this field will help develop more effective and innovative technologies in the future, which will help ensure the long-term and safe operation of metal products.

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