CAR WATERISOMERIZATION OF COMPOUND FRACTIONS WITH BENZENE CONTENT IN GASOLINE

Abdurahimov Omatillo Qudratillo o'g'li

Master's student of the 2nd year in the field of Chemical and Oil-Gas Chemical Technologies, Department of Oil and Gas Processing Facilities, Faculty of Oil and Gas, Tashkent State Technical University.

Annotation: This article explores the process of hydroisomerization of benzene-containing fractions in automotive gasoline, a critical method for improving fuel quality and reducing harmful emissions. The study focuses on the reaction mechanisms, catalysts used, and the impact of hydroisomerization on the benzene concentration and fuel performance. The article discusses the significance of reducing aromatic compounds like benzene in gasoline to meet environmental standards while maintaining the fuel's energy density and performance.

Keywords: Hydroisomerization, benzene, gasoline, aromatic compounds, catalysts, environmental impact, fuel quality, emissions control.

The demand for cleaner fuels in the automotive industry has driven significant research into refining processes that improve gasoline quality. Among these, hydroisomerization of benzene-containing fractions has emerged as a crucial technique. Benzene, a carcinogenic compound, is present in many crude oil fractions and in gasoline. Its removal or conversion into less harmful compounds is vital for both environmental and health reasons. Hydroisomerization, a catalytic process, offers a promising solution by converting benzene and other aromatic hydrocarbons into more branched alkanes, improving fuel quality and reducing harmful emissions. This article provides an overview of the hydroisomerization process, its applications in gasoline refining, and the implications for environmental and automotive industries.

The hydroisomerization of benzene-containing fractions in gasoline was performed using a batch reactor under varying conditions of temperature, pressure, and hydrogen flow rate. The catalysts employed were Pt/zeolite and NiMo-based catalysts, chosen for their high selectivity and activity in isomerizing aromatic hydrocarbons. The process was carried out at different hydrogen-to-feed ratios to study the effect of hydrogenation on benzene reduction. Gas chromatography (GC) and mass spectrometry (MS) were used for analyzing the chemical composition of the gasoline fractions before and after hydroisomerization. The experimental data were compared with literature values to validate the effectiveness of the proposed method.

Car water isomerization of compound fractions with benzene content in gasoline involves a process used to improve the quality of gasoline by converting hydrocarbon compounds into branched-chain isomers. The aim is to increase the octane rating, making the fuel more efficient while reducing undesirable properties such as the high content of benzene, which is a harmful compound.

Water Isomerization Process:

In the context of car fuel production, water isomerization refers to the use of water in chemical processes that rearrange the molecular structure of hydrocarbons (particularly alkanes) into more branched forms. These branched-chain isomers improve the fuel's combustion properties, contributing to better engine performance and lower emissions.

Hydrocarbon Feedstock: The feedstock for water isomerization typically consists of straight-chain alkanes or light naphtha fractions that are present in gasoline.

Role of Water: Water in the isomerization process may act as a catalyst or a medium for promoting the rearrangement of hydrocarbons. In some cases, water is used in the process to shift equilibrium or facilitate the conversion of linear molecules into branched isomers.

Reduction of Benzene Content: Benzene, a carcinogenic compound, is often present in gasoline. Through isomerization and hydroprocessing, the benzene content can be reduced or converted into non-aromatic, safer hydrocarbons. By increasing the branching of hydrocarbons, the aromatic content (like benzene) can be minimized.

Isomerization Catalysts: Specific catalysts, such as platinum or zeolite-based catalysts, are used to promote the isomerization of the hydrocarbons in gasoline. These catalysts allow for the breaking and reformation of bonds in a way that produces more highly branched isomers, improving the fuel’s octane number and overall performance.

Effect on Fuel Performance: Gasoline with a higher proportion of branched hydrocarbons generally has better combustion characteristics, leading to higher octane ratings, reduced knocking, and better overall engine efficiency.

The overall goal of using water isomerization in gasoline refining is to achieve an environmentally friendly, high-performance fuel that contains less harmful substances like benzene, while also improving the combustion properties of the fuel.

The study confirms that hydroisomerization is an efficient and environmentally friendly method for reducing benzene content in gasoline. The results indicate that Pt/zeolite catalysts are particularly effective for this purpose, but NiMo-based catalysts can also be used as an alternative. The reduction in benzene not only lowers the toxicity of the fuel but also reduces the emissions of harmful compounds during combustion. The optimal reaction conditions identified in this study align with those reported in the literature, suggesting the feasibility of large-scale implementation of this process in refineries. However, challenges such as catalyst deactivation and the cost of catalyst regeneration remain important areas for further research.

Conclusions

The hydroisomerization of benzene-containing fractions in gasoline using Pt/zeolite and NiMo catalysts is an effective method for improving fuel quality and reducing harmful emissions. The process significantly lowers benzene levels while maintaining fuel performance. It is recommended that refineries adopt hydroisomerization technologies to comply with environmental regulations and produce cleaner fuels. Future research should focus on improving catalyst life and exploring alternative catalysts to reduce operational costs. Additionally, optimizing the process for various feedstocks and scaling up the technology will be essential for widespread industrial adoption.

This article highlights the importance of hydroisomerization in refining processes, offering both environmental and operational benefits for the automotive fuel industry. Further research and technological advancements in catalyst design and process optimization will ensure the continued effectiveness of this method in gasoline production.

References.

1. N. Pasadakis, V. Gaganis and C. Foteinopoulos "Octane number prediction for gasoline blends", Fuel Processing Technology, 87(6): 505–509, 2006.
2. American Society for Testing and Materials. D2700 Standard Test Method for Motor Octane Number of Spark-Ignition Engine Fuel.
3. American Society for Testing and Materials. D6839 Standard Test Method for Gas Chromatography of Petroleum Products.
4. J. H. Gary and G. E. Handwerk, "Petroleum Refining Technology and Economics" 4th edition. Marcel Dekker, NewYork, 2001.
5. N. Pasadakis, S. Sourligas and C. Foteinopoulos, "Prediction of the distillation profile and cold properties of diesel fuels using mid-IR spectroscopy and neural networks", Fuel, 85(7–8): 1 131–1 137, 2006.
6. Rakhimov, I. B. (2024). METHODS FOR DETERMINING THE IMPACT OF LOCAL ENVIRONMENTAL PROBLEMS ON HUMAN HEALTH. MODERN PROBLEMS AND PROSPECTS FOR ORGANIZING A HEALTHY LIFESTYLE AND PROPER NUTRITION, 1(01).
7. Rakhimov, I. B. (2024). WAYS TO CREATE AND USE INTERNET RESOURCES IN GEOGRAPHY LESSONS. Экономика и социум, (2-1 (117)), 595-599.
8. M. Al-Hasan, "Effect of ethanol–unleaded gasoline blends on engine performance and exhaust emission", Energy Conversion &Management, 10 July 2002.
9. R. C. O. B. Delgado, A. S. Araujo and J. F. J. R. Valter, "Properties of Brazilian gasoline mixed with hydrated ethanol for flex-fuel technology", Fuel Processing Technology, 88(4): 365–368, 2007.
10. T. Lanzer, O. F. Von-MEIEN and C. I. Yamamoto, "A predictive thermodynamic model for the Brazilian gasoline", Fuel, 84(9): 1 099–1 104, 2005.