Proceedings of the 9th International Scientific and Practical Conference «Science in the Environment of Rapid Changes»
(July 26-28, 2026).
Brussels, Belgium

No 303



# Application of Cobalt-modified Zeolite Catalysts in the Isomerization Reaction of n-hexane

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Isomerization of light paraffins is one of the important catalytic processes for obtaining gasoline components with high octane numbers in the oil refining and petrochemical industries. In modern times, the tightening of environmental requirements, the restriction of the use of aromatic hydrocarbons and oxygenated additives have further increased the importance of isomerization processes. The branched isomers obtained as a result of the isomerization of n-hexane - 2-methylpentane, 3-methylpentane, 2,2-dimethylbutane and 2,3-dimethylbutane - are widely used in modern gasoline production, as they have high octane numbers.

The efficiency of the isomerization process depends on the acidity properties of the catalyst, the pore structure, the activity of the metal component and the process parameters. In recent years, the high cost and limited resources of noble metals (Pt, Pd) have led researchers to develop new catalytic systems based on alternative transition metals. In this regard, cobalt-modified zeolite catalysts are of great interest in terms of high activity, thermal stability and economic efficiency.

Isomerization is the conversion of straight-chain paraffins into branched isomers as a result of a change in the carbon skeleton. During the reaction, the elemental composition of the molecule does not change, only the sequence of carbon atoms changes. This property allows the octane number of the fuel to increase significantly without reducing its energy value.

While n-hexane has a low octane number (about 25), its isomers, 2-methylpentane and 3-methylpentane, have octane numbers of 70-75, and dimethylbutane isomers have octane numbers of over 90. Therefore, the isomerization of n-hexane is considered a process of strategic importance in modern oil refining.

The isomerization reaction is mainly carried out on bifunctional catalysts. Such catalysts perform two main functions:

- metal centers provide the hydrogenation-dehydrogenation stage;
- acid centers cause the restructuring of the carbon skeleton.

Zeolites are crystalline aluminosilicate materials with a high specific surface area, a regular pore system, and strong Brønsted and Lewis acid centers. These properties make them one of the most promising carriers for isomerization processes.

Properties of cobalt-modified zeolite catalysts

Cobalt is a widespread, relatively inexpensive, and highly catalytically active element among transition metals. Cobalt particles deposited on the surface or pores of the zeolite enhance the hydrogenation function of the catalyst.

Cobalt can be incorporated into zeolites by various methods:

- ion exchange;
- impregnation;
- hydrothermal synthesis;
- precipitation.

Cobalt-modified zeolite catalysts are considered promising catalytic systems for the isomerization of n-hexane. As a result of the synergistic effect of the hydrogenation-dehydrogenation function of cobalt with the strong acid centers of the zeolite, high conversion rates and high selectivity to branched isomers are achieved. The lower cost of cobalt compared to noble metals also makes these catalysts economically attractive. Future studies aimed at optimizing the composition and pore structure of the catalyst will allow the development of more efficient and environmentally friendly technologies for the production of high-octane gasoline components.