IMPROVING THE EFFICIENCY OF VINYL ETHER PRODUCTION THROUGH THE USE OF NANOCATALYSTS

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Abstract. This article investigates the technological and economic advantages of using nanocatalysts in the synthesis of vinyl ethers. The catalytic activity of nanocatalysts, product yield, and selectivity in the production of vinyl ethers widely used in organic synthesis were studied. The obtained results demonstrate that the application of nanocatalysts increases product yield, reduces energy consumption, and improves the environmental safety of the process.

Keywords: vinyl ethers, nanocatalyst, catalytic activity, organic synthesis, selectivity, product yield, technological efficiency.

Introduction

Vinyl ethers are important products of the organic synthesis industry and are widely used in the production of polymers, paints and coatings, pharmaceutical preparations, and high-molecular-weight compounds. One of the primary objectives of modern chemical technology is the development of highly efficient and environmentally friendly catalytic systems.

With the rapid development of nanotechnology, nanocatalysts possessing a high specific surface area have been increasingly introduced into industrial processes. The unique properties of nanocatalysts are associated with their nanoscale particle size, which significantly increases the number of active

catalytic sites. As a result, reaction rates are enhanced and the yield of target products is increased.

The present study evaluates the effectiveness of nanocatalysts in vinyl ether production.

Materials and Methods

The vinylation reaction of acetylenic alcohols was selected as the object of study. The reaction was carried out in the presence of metal oxide-based nanocatalytic systems.

The process was investigated under the following conditions:

Temperature: 50–90 °C;

Catalyst concentration: 0.5–5%;

Reaction time: 1–8 h;

Product yield;

Selectivity.

The resulting products were analyzed using gas chromatography and infrared (IR) spectroscopy techniques.

Results and Discussion

The experimental results revealed a significant increase in reaction yield when nanocatalysts were employed.

Catalyst Type	**Product Yield (%)**
Without catalyst	52
Conventional catalyst	74
Nanocatalyst	92

As shown in the table, the use of nanocatalysts increased the product yield up to 92%.

The effect of temperature on product yield was also investigated. The maximum yield was observed at 80 °C. At higher temperatures, the product yield decreased due to the intensification of side reactions.

A reduction in reaction time was also observed in the presence of nanocatalysts. While conventional catalysts required approximately 6–8 hours to achieve maximum yield, nanocatalysts provided similar results within only 3–4 hours.

This phenomenon can be explained by the high density of active sites on the catalyst surface. Nanometer-sized particles accelerate the adsorption of reactants and lower the activation energy barrier of the reaction.

Economic Efficiency

The use of nanocatalysts provides several advantages:

Increased product yield;

Reduced raw material consumption;

Lower energy costs;

Shorter production time;

Improved environmental safety.

According to the calculations, the implementation of nanocatalysts can reduce production costs by approximately 10–15%.

Conclusion

1. Nanocatalysts exhibit high catalytic activity in the synthesis of vinyl ethers.
2. Product yield was increased up to 92%.
3. Reaction time was reduced nearly twofold.
4. Energy consumption and production costs were significantly decreased.
5. The application of nanocatalysts represents a promising approach for improving vinyl ether production technology.

References

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