

ABSTRACT:

Zeolites for the Synthesis of Ketals from Ethyl Levulinate and Glycerol: Catalytic Screening and Kinetic Investigation

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The use of renewable sources offers significant environmental and health benefits by replacing fossil-derived products with sustainable chemicals obtained from biomass. Among these, ketals derived from levulinic acid and its derivatives have emerged as promising compounds with a wide range of potential applications. Catalysis plays a fundamental role in this process, with heterogeneous catalysts offering significant environmental and operational advantages, including reusability and easier recovery [1]. Ketal synthesis has been investigated using various catalysts; among these, zeolites stand out due to their excellent thermal and mechanical stability. The presence of both Brønsted and Lewis acid sites, combined with their porosity, makes them particularly attractive catalysts [2]. In this study, different zeolites were screened and extensively characterized to correlate their properties with their catalytic efficiency in the ketalization reaction. Among the investigated catalysts, H,Y-zeolite, which showed the highest activity, was selected for a kinetic investigation conducted in both batch and continuous reactors to evaluate the effect of operating conditions on the reaction rate. A mathematical model was developed and successfully described the experimental results, showing good agreement between experimental data and the simulated curves. Finally, the fluid-dynamic characterization of the continuous milli-reactor enabled the determination of the axial dispersion coefficient, providing insight into reactor behavior.

[1] F. Taddeo, R. Tesser, M. Di Serio, V. Russo, *Chem. Eng. Process.: Process Intensif.*, 197, 109712 (2024).

[2] F. Taddeo, M.E. Fortunato, R. Turco, A. Kowalczyk, M. Rutkowska, L. Chmielarz, V. Russo, M. Di Serio, *Appl. Catal. A: Gen.*, 707, 120521 (2025).