proceedings

Abstract

Catalytic Pyrolysis of Waste Biomass †

Grigore Pșenovschi [1,2], Mihaela Cîlțea-Udrescu [1,2], Andreea-Luiza Mîrț [1,2,*], Constantin Neamțu [1] and Gabriel Vasilievici [1]

[1] National Institute for Research & Development in Chemistry and Petrochemistry—ICECHIM Bucharest, 202 Spl. Independentei, 6th District, 060021 Bucharest, Romania; gregorypshenovschi@gmail.com (G.P.); mihaela.ciltea@icechim.ro (M.C.-U.); titi.neamtu@icechim.ro (C.N.); gvasilievici@icechim.ro (G.V.)
[2] Doctoral School, National University of Science and Technology Politehnica of Bucharest, Splaiul Independenței No. 313, 060042 Bucharest, Romania
* Correspondence: luiza.mirt@icechim.ro
† Presented at the 19th International Symposium "Priorities of Chemistry for a Sustainable Development", Bucharest, Romania, 11–13 October 2023.

Keywords: pyrolysis; biomass; catalyst; bio-oil; lignocellulose

The pyrolysis process converts lignocellulose organic materials into gases, liquids (bio-oil), and solids (biochar). This technology has great potential to be used effectively to convert waste and biomass into usable energy sources, thereby reducing dependence on fossil fuels and helping to reduce greenhouse gas emissions [1].

This study investigates the impact of dolomite and zeolite on the pyrolysis process of lignocellulose biomass. The addition of these catalysts to the biomass was found to enhance the yield and quality of the bio-oil produced [2]. The dolomite was investigated to promote the thermal decomposition of the biomass and increase the bio-oil yield, while the zeolite was found to catalyze the cracking and upgrading of the bio-oil. These findings suggest that the use of dolomite and zeolite in the pyrolysis process can significantly improve the efficiency and sustainability of biomass conversion to biofuels [3]. Furthermore, this study investigated the effects of different concentrations of dolomite and zeolite on the pyrolysis process.

The oak sawdust in combination with dolomite $CaMg(CO_3)_2$ and/or zeolite was fed into the reactor; then, the reactor was assembled. Before starting pyrolysis, the plant was purged with nitrogen from the cylinder at a flow rate of 5 L/h for 7 min to remove oxygen from the plant. Heating was set to 450 °C. Temperature parameters were monitored in relation to time.

The optimal concentration of dolomite was 5%, while the optimal concentration of zeolite was 2%. Higher concentrations of these catalysts proved to have diminishing returns on the yield and quality of the bio-oil produced. The results showed that the bio-oil produced with the addition of these minerals had a higher heating value, lower acidity, and lower water content, indicating a higher quality fuel product.

The results of this study demonstrate the potential benefits of using dolomite and zeolite synergy effect in the pyrolysis process of lignocellulose biomass. These minerals can increase the yield and quality of bio-oil produced, as well as improve the overall efficiency and sustainability of biomass conversion to biofuels.

Author Contributions: Conceptualization, G.P. and A.-L.M.; methodology, G.P.; software, C.N.; validation, G.V. and C.N.; formal analysis, M.C.-U.; investigation, G.P.; resources, G.V.; data curation, C.N.; writing—original draft preparation, A.-L.M.; writing—review and editing, G.P. and G.V.; visualization, A.-L.M.; supervision, G.V.; project administration, M.C.-U.; funding acquisition, G.V. All authors have read and agreed to the published version of the manuscript.

Funding: This work was funded by Subsidiary contract 384/2021 of project POC-A1-A1.2.3-G-2015—P_40-352—"Sequential processes of closing the side streams from bio-economy and innovative

check for updates

Citation: Pșenovschi, G.; Cîlțea-Udrescu, M.; Mîrț, A.-L.; Neamțu, C.; Vasilievici, G. Catalytic Pyrolysis of Waste Biomass. *Proceedings* **2023**, *90*, 46. https://doi.org/10.3390/proceedings2023090046

Academic Editors: Mihaela Doni, Florin Oancea and Radu Claudiu Fierăscu

Published: 29 February 2024

(bio)products resulting from it" (SECVENT) 384/2021 funded by cohesion funds of the European Union; and the PN 23.06 Core Program—ChemNewDeal within the National Plan for Research, Development and Innovation 2022–2027, developed with the support of Ministry of Research, Innovation, and Digitization, project no. PN 23.06.02.01 (InteGral).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Acknowledgments: This work was carried out through the PN 23.06 Core Program—ChemNewDeal within the National Plan for Research, Development and Innovation 2022–2027, developed with the support of the Ministry of Research, Innovation, and Digitization, project no. PN 23.06.02.01. Also, this research was funded by the Ministry of Research, Innovation and Digitization through Program 1—Development of the national research-development system, Subprogram 1.2—Institutional performance—Projects to finance excellence in RDI, Contract no. 15PFE/2021.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Ellabban, O.; Abu-Rub, H.; Blaabjerg, F. Renewable energy resources: Current status, future prospects and their enabling technology. *Renew. Sustain. Energy Rev.* **2014**, *39*, 748–764. [CrossRef]
2. Chen, X.; Che, Q.; Li, S.; Liu, Z.; Yang, H.; Chen, Y.; Wang, X.; Shao, J.; Chen, H. Recent developments in lignocellulosic biomass catalytic fast pyrolysis: Strategies for the optimization of bio-oil quality and yield. *Fuel Process. Technol.* **2019**, *196*, 106180. [CrossRef]
3. Rabiu, S.; Auta, M.; Kovo, A. An upgraded bio-oil produced from sugarcane bagasse via the use of HZSM-5 zeolite catalyst. *Egypt. J. Pet.* **2018**, *27*, 589–594. [CrossRef]