Proceedings of the 10th World Congress on Civil, Structural, and Environmental Engineering (CSEE 2025)
Barcelona, Spain - April, 2025
Paper No. ICEPTP 182
DOI: 10.11159/iceptp25.182

Beneficial Nutrients Recovery from Biofuel Ash via Extraction with Organic Acids

Donata Drapanauskaitė[1], Kristina Bunevičienė[1], Karolina Barčauskaitė[1]
[1]Lithuanian Research Centre for Agriculture and Forestry
Instituto av. 1, Akademija, Kėdainiai distr., Lithuania
donata.drapanauskaite@lammc.lt; kristina.buneviciene@lammc.lt
karolina.barcauskaite@lammc.lt

Extended Abstract

The amount of generated solid waste is globally rising [1], and managing this waste properly, is essential due to its influence on our environment [2]. Careful consideration should be given to the nutrients in waste, which are lost if the waste is not recycled or otherwise utilized [3]. So, nutrient recovery from waste allows to reduce the use of natural resources [4].

The purpose of this study was to explore the effect of three different organic acids such as salicylic acid, citric acid, and oxalic acid, on the recovery of beneficial nutrients from biofuel ash. The leachates were compared with each other to evaluate the extraction efficiencies for beneficial nutrients. Also, the biofuel ash residues were analysed after leaching using SEM-EDS, and XRD. Thus, the main innovation of this study is to explore the potential for recovering all beneficial nutrients present in biofuel ash simultaneously by using organic acids, which naturally are released from plants/fungi/bacteria to the soil. Additionally, the study evaluates the leaching of heavy and trace metals in this process.

The findings of the study indicated that 0.1 M citric acid was the most efficient for plant nutrient recovery, with 82% of P recovered after 30 min, 82% of Ca, 77% of Mg, and 47% of K after 120 min. The leachates were not contaminated with heavy metals and the formation of calcium oxalates after extraction with 0.1 M oxalic acid was observed by SEM-EDS.

In conclusion, to achieve the highest recovery of all beneficial nutrients (P, K, Ca, Mg), different extraction times and different extraction agents are necessary.

References

[1] J.N. Jebaranjitham, J. Durairaj, S. Christyraj, A. Prasannan, K. Rajagopalan, K. Subbiahanadar, J. Kamalapriya, J. Samuel, "Current scenario of solid waste management techniques and challenges in Covid-19 - A review", *Heliyon*, vol. 8, no. 7, pp. e09855, 2022.

[2] K.S. Mulya, J. Zhou, Z.X. Phuang, D. Laner, K.S. Woon, "A systematic review of life cycle assessment of solid waste management: Methodological trends and prospects", *Sci. Total Environ.*, vol. 831, pp. 154903, 2022.

[3] D. Drapanauskaite, K. Buneviciene, M. Silva, A. Slepetiene, J. Baltrusaitis, "Phosphate removal from simulated wastewater using industrial calcium-containing solid waste". *J. Environ. Chem. Eng.,* vol. 9, no. 6, pp. 106575, 2021.

[4] K. Barčauskaite, Z. Braziene, D. Avižienyte, M. Silva, D. Drapanauskaite, K. Honer, K. Gvildiene, R. Slinksiene, K. Jancaitiene, R. Mazeika, G. Staugaitis, T. Dambrauskas, K. Baltakys, J. Baltrusaitis, "Mechanochemically synthesized gypsum and gypsum drywall waste cocrystals with urea for enhanced environmental sustainability fertilizers". *J. Environ. Chem. Eng.,* vol. 8, no. 4, pp. 103965, 2020.