FO-5 Agnieszka Rybarczyk

Innovative approach to removing pharmaceutical impurities using MOF-laccase systems

A. Rybarczyk, T. Jesionowski, J. Zdarta

Institute of Chemical Technology and Engineering, Faculty of Chemical Technology, Poznan University of Technology, Berdychowo 4, PL-60965 Poznan, Poland
agnieszka.rybarczyk@doctorate.put.poznan.pl

Growing concerns about contamination of surface waters with pharmaceuticals have spurred significant research and development efforts to find effective solutions. One promising approach involves the use of enzymes immobilized on solid supports to facilitate the removal of these contaminants [1]. Recently, metal-organic frameworks (MOFs) have attracted attention due to their unique structural properties, such as complex architecture and high porosity, making them ideal candidates for such applications. Incorporating enzymes into MOFs brings several benefits, including enhancing the thermal and chemical stability of the enzymes, thereby prolonging their activity and effectiveness under harsh environmental conditions [2]. In addition, such integration improves catalytic performance, allowing faster and more accurate degradation of pharmaceutical impurities. Moreover, the porous nature of MOF increases accessibility to the active sites on the enzymes, maximizing their effectiveness in degrading contaminants [3]. Laccase, meanwhile, known for its ability to degrade impurities, was chosen for immobilization on CuBDC MOF [4]. Optimal immobilization parameters were determined through thorough analysis, followed by a series of studies to assess enzyme loading, immobilization efficiency, retained activity, and kinetic properties. The biocatalytic system's reusability was examined, alongside investigations into the effects of temperature and pH on the immobilized laccase's catalytic behavior. Subsequently, the efficacy of the developed catalytic system was put to the test in the degradation of 17β-estradiol, a pivotal facet of the ongoing research endeavor. This comprehensive approach not only addresses the urgent need for efficient pharmaceutical pollutant removal but also underscores the promising potential of MOF-based enzyme technologies in tackling contemporary environmental challenges.

References

[1] D. Papagiannaki, M.H. Belay, N.P.F. Goncalves, E. Robotti, A. Bianco-Prevot, R. Binetti, P. Calza, *Chemical Engineering Journal Advances, 10 (2022), 100245*; DOI:10.1016/j.ceja.2022.100245.
[2] Y. Peng, J. Xu, J.Xu, J. Ma, Y. Bai, S. Cao, S. Zhang, H. Pang, *Advances in Colloid and Interface Science, 307 (2022), 102732*; DOI: 10.1016/j.cis.2022.102732.
[3] S.S. Nadar, L. Vaidya, V.K. Rathod, *International Journal of Biological Macromolecules, 149 (2020), 861-876*; DOI: 10.1016/j.ijbiomac.2020.01.240.
[4] W. Huang, W. Zhang, Y. Gan, J. Yang, S. Zhang, Critical Reviews in Environmental Science and Technology, 52 (2022), 1282-1324; DOI: 10.1080/10643389.2020.1854565.

Acknowledgments

The research was funded under National Science Center research project No. 2021/43/B/ST8/01854.