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A New Material for the Optimal Removal of Tetracycline from Wastewater

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Extended Abstract

Water is an essential building block, a nutrient of human life, needed for biochemical processes, regulating physiological functions in our body, daily activities, and industrial applications. It is the fundament of life itself. The public authority's task, mission, and responsibility of is to ensure water quality and protect existing water sources. Many laws and regulations have been introduced to achieve these goals. In the European Union, Directive 98/83/EC was in force, repealed on 12 January 2021, and replaced by Directive 2020/2184. This update aimed to provide high-quality tap water to all citizens of the EU. Key changes in the Directive include updated quality standards, stricter limits, and the identification of new pollutants. Emerging compounds, such as pharmaceutical residues, are specifically mentioned, highlighting the importance of establishing a monitoring and watchlist mechanism. It is stated that a report on the hazards of emerging compounds, including microplastics and pharmaceuticals, should be submitted to the European Parliament by January 12, 2029 [1,2]. As a result, we are tasked with researching the removal of pharmaceutical residues from wastewater. This necessity arises from the broad spectrum, high consumption rates, and resistance of these pollutants, which have become significant sources of emerging water contaminants [3]. Antibiotics commonly enter wastewater when flushed down toilets or through the discharge of treated wastewater into rivers and other water bodies. Notably, Appendix 1 of the Directive 2020/2184 does not specify standard methods, standards, or limits for antibiotics. Tetracycline (TC), an influential antibiotic introduced in 1948, is now the second most widely used antibiotic globally. Its importance in modern medicine is proved by its effectiveness in treating various microbial infections [4].

Adsorption has emerged as a promising bioremediation technique for the removal of antibiotics, such as tetracycline, from wastewater. However, there is a need for extensive research to identify effective and eco-friendly adsorbents capable of optimal, eco-friendly removal of tetracycline residues from aqueous solutions. These adsorbents range can be natural (activated carbon) and waste materials (brewery byproduct *S. cerevisiae*) [5].

Our research aims to further investigate the adsorption process of TC with eggshell as adsorbent, to identify the influential factors of the process. Optimizing these parameters is crucial for achieving maximum removal efficiency and minimizing the environmental impacts. To ensure comparability, we aim to apply and improve our previous research parameters [5] and to study the underlying mechanism of this process.

References

[1] M. Dettori, A. Arghittu, G. Deiana, P. Castiglia, A. Azara, "The revised European Directive 2020/2184 on the quality of water intended for human consumption. A step forward in risk assessment, consumer safety and informative communication", *Environ. Res.,* vol. 209, no. 112773, 2022.

[2] European Commission. Directive - 2020/2184 - EN - EUR-Lex. Official Journal of the European Union; 2020 [Online]. Available: https://eur-lex.europa.eu/eli/dir/2020/2184/oj/eng

[3] X. Li, N. Zhang, L. Yang, "Adsorption of ampicillin sodium on activated carbons with different surface chemistries", *IOP Conf. Ser. Earth Environ. Sci.,* vol. 467, no. 012184, 2020.

[4] M. Zahmatkesh, A. Najafpoor, B. Barikbin, Z. Bonyadi, "Adsorption of tetracycline on polyvinyl chloride microplastics in aqueous environments," *Sci. Rep.,* vol. 13, no. 17989, 2023.

[5] Sz. Tonk, Á. Kiss, E. Rápó, "Adsorption of Tetracycline on Untreated and Modified Surfaces of Waste Biosorbent," in *Proceedings of the 9th World Congress on Civil, Structural, and Environmental Engineering (CSEE 2024)*, 2024. DOI: 10.11159/iceptp24.198 .