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Integrated On-site Treatment of Hospital Wastewater for the Removal of Emerging Micropollutants

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Abstract

Hospitals play a critical role in the maintenance of public health. However, hospital wastewater (HWW), which are generated from various hospital departments and support services, contains elevated concentrations of pharmaceutical compounds, pathogens, (multi-)resistant bacteria and their resistance genes, often exceeding the respective concentrations in municipal wastewater (Verburg et al. 2019). Although the management and discharge of the HWW differ among countries, in Europe, these effluents are transferred to the centralized Wastewater Treatment Plants (WWTPs) either directly or following on-site pre-treatment process using activated sludge process and disinfection (Verlicchi, 2018 from Arvaniti et al., 2023). The removal of emerging micropollutants, pathogens and resistant bacteria, is usually inadequate, as they are primarily designed to reduce the organic load. Consequently, the implementation of specialized on-site treatment systems, could provide an effective solution for mitigating the release of such contaminants into surface water bodies after wastewater treatment. In view of the abovementioned, the effectiveness of an on-site demonstration unit combining four technologies a) Anaerobic Moving Bed Biofilm Reactor, AnMBBR (biological), b) aerobic Membrane Biological Reactor (MBR), c) Advanced Oxidation Process (AOP) unit using UV radiation and addition of H2O2, and d) chlorine disinfection unit, was evaluated for the overall removal of the micropollutants identified in the recent EU Directive 2024/3019. Mean concentrations of target micropollutants (μg/L) were determined in hospital wastewater, the demonstration unit effluent, and municipal wastewater influent. Hospital wastewater showed the highest concentrations for Sulfamethoxazole (2.664 ± 5.279 μg/L) and Metoprolol (0.671 ± 0.269 μg/L), while most other pharmaceuticals ranged between 0.02–0.19 μg/L. Treatment with the AnMBBR–MBR unit reduced concentrations of most compounds, achieving the highest removal rates for Metoprolol (93%), Sulfamethoxazole (73%), and Clarithromycin (66%), although no significant reduction was observed for Amisulpride, Irbesartan, Candesartan, and Diclofenac. Compared to hospital wastewater, municipal influent generally exhibited lower pharmaceutical concentrations, confirming hospitals as important point sources of pharmaceuticals such as Sulfamethoxazole and Metoprolol (Äystö et al., 2023). In contrast, benzotriazoles (H-BTR and Mix 5-TTR + 4-TTR) were more abundant in municipal wastewater, suggesting predominantly urban diffuse sources. The results highlight the potential of combined on-site treatment technologies to improve the management of hospital

wastewater and reduce the release of hazardous micropollutants into the aquatic environment.

Keywords: pharmaceutical compounds, wastewater treatment, EU Directive 2024/3019, monitoring

References

Äystö, L., Vieno, N., Fjäder, P., Mehtonen, J., & Nystén, T. (2023). Hospitals and households as primary emission sources for risk-posing pharmaceuticals in municipal wastewater. Ecotoxicology and Environmental Safety, 262, 115149. https://doi.org/10.1016/j.ecoenv.2023.115149

Verburg, I., García-Cobos, S., Hernández Leal, L., Waar, K., Friedrich, A. W. & Schmitt, H. (2019). Abundance and antimicrobial resistance of three bacterial species along a complete wastewater pathway. Microorganisms, 7 (9). doi:10.3390/microorganisms7090312.

Verlicchi, P. (2018). Hospital Wastewaters: Characteristics, Management, Treatment and Envi ronmental Risks. The Handbook of Environmental Chemistry. Springer, Cham https://doi.org/10.1007/978-3-319-62178-4.

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