REMOVAL OF PERSISTENT MICROPOLLUTANTS FROM WASTEWATER BY HYBRID TREATMENT WITH LOW-ENERGY ELECTRONS AND OZONE

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ABSTRACT

Water is essential for life on earth. With the global population constantly increasing, the demand for a clean and copious water supply intensifies. However, of the 400 km³ of urban wastewater produced worldwide each year, only 20 % is treated, leaving 80 % to be discharged into the environment, making its way into the water cycle [1]. Even more problematic is the rising presence of micropollutants, substances that are able to evade traditional wastewater treatment methods. In the past three decades, micropollutants, specifically pharmaceuticals, have been discovered in nearly every environmental matrix across the globe, including surface water, groundwater, wastewater treatment plant effluent and influents, and sludge [2]. Even at very low concentrations, these pollutants have adverse toxic effects to humans as well as aquatic animals, and have shown to develop resistance traits in pathogenic microorganisms [3].
To combat this problem, Fraunhofer FEP is currently developing a hybrid process for wastewater treatment using 200 keV low-energy electrons and ozone. The treatment module, designed as a pretreatment stage to be implemented at point sources of contamination, as e.g. hospitals, aims to degrade persistent micropollutants into substances that can be effectively removed in downstream biological cleaning stages of conventional wastewater treatment plants. In the present work, five select pharmaceuticals in synthetic wastewater were treated and subjected to analysis by HPLC (high-performance liquid chromatography). Degradation better than 80 % was achieved for each substance at absorbed doses below 2.5 kGy, demonstrating the electron beam plus ozone hybrid treatment's success compared to known methods (such as activated carbon filtration or UV irradiation). An upscaling of the concept and expansion of its field of application is now planned, e.g., to the purification of wastewater from the chemical industry or agriculture, where the simultaneous inactivation of pathogens is of additional value.

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