

Discerning the effect of operating conditions on the improvement of up-flow constructed wetland-microbial fuel cell performance in treating mixed azo dyes wastewater and bioelectricity generation

Abstract

This study assessed the effect of implementing multiple circuit connections and operating parameters (hydraulic retention time (HRT), organic loading rate (OLR), and external resistance) on the improvement of up-flow constructed wetland-microbial fuel cell (UFCW-MFC) in treating the mixed azo dyes wastewater and bioelectricity generation. The multiple-circuits UFCW-MFC facilitated the organic substrate degradation, which improved the removal efficiency of dyes by 8% and COD by 7%, as well as power production by 6.5 times, compared to single-circuit UFCW-MFC. The prolonged HRT from 1 to 3 d extended the interaction time between the pollutants and microbes, which further enhanced the removal efficiency of dyes by 9% and COD by 6%. The decrease in power generation by 1.3 times could be ascribed to the lower OLR at a higher HRT (0.864–0.288 g COD/d when HRT extended from 1 to 3 d) as the utilization of electrons was prioritized for decolorization compared to bioelectricity generation. The increase in OLR (0.288 to 0.754 g COD/d) with the same HRT (3 d) exhibited an improvement of 4% in decolorization and 2.4 times in power generation. This could be attributed to more electron production from the higher COD removal. The lower external resistance benefited the UFCW-MFC performance, where the best performance was obtained at 200 Ω as it approached the internal resistance (150 Ω).

Keywords

Constructed wetland-microbial fuel cell; External resistance; Hydraulic retention time; Mixed azo dyes; Multiple circuit connections; Organic loading rate