Applying a continuous electrooxidation reactor for the removal of bulk organic matter in biologically treated landfill leachate: influence of operational conditions and online surrogate monitoring

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Biologically treated landfill leachate contains (bio-)recalcitrant organic matter that should be removed before discharge (Gripa et al., 2023). In this study, continuous electrooxidation (EO) treatment was applied to treat this landfill leachate as polishing step. A co-axial tubular electrolytic cell was applied as EO reactor (Fig. 1). The effect of different operational settings including current density, residence time and pH on the removal of bulk organic matter and specifically fluorophores was investigated. Furthermore, the changes in the composition and molecular weight of organic matter during EO treatment were also assessed.

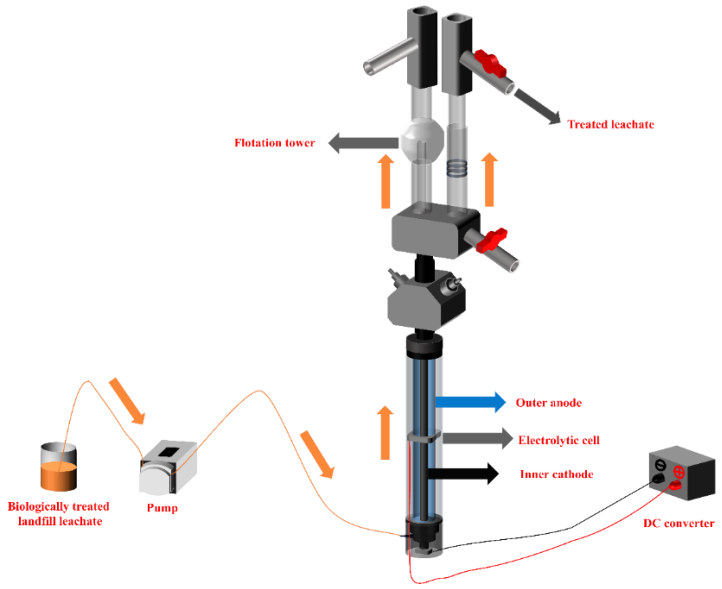

Fig. 1. Schematic overview of the lay-out of the co-axial tubular electrolytic cell for continuous EO treatment that was applied for landfill leachate treatment in this research.

As shown in Fig. 2, increasing the residence time in electrolytic cell and current density can significantly enhance the removal of organic matter by this reactor. This improvement can be attributed to the extended interaction time between pollutants and active substances, as well as the increased generation and concentration of these active substances (Guo et al., 2022; İskurt et al., 2022). A slight enhancement in organic matter removal was observed at low pH compared to high pH. This can be attributed to the increased presence of active chlorine species under acidic conditions (Murrieta et al., 2023). The tubular continuous EO reactor achieved removal efficiency of 52% for COD, 59% for UV_{254} and 98% for UV_{400} from biologically treated landfill leachate under the following conditions: a residence time of 2.8 minute, a current density of 150 A/m², and a pH of 8.5, with an energy consumption of 11.4 kWh/m³.

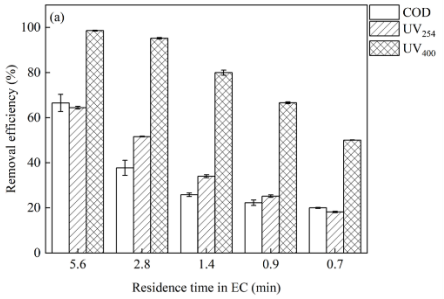

Fig. 2. Recalcitrant organic matter removal from landfill leachate by EO as function of residence time

In order to identify surrogates suitable for the online real-time control of the EO treatment of biologically treated landfill leachate, a correlation between charge loading (the product of residence and current density), spectral surrogate measurements (including UV-vis and fluorescence) and COD removal efficiency was established. For example, in Figure 3, the correlations between charge loading, COD removal efficiency and energy consumption were presented (R^2>0.95).

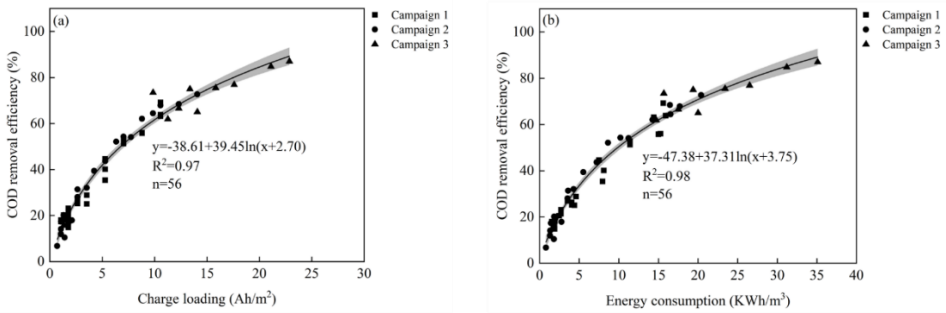

Fig. 3. Correlation between COD removal efficiency and (a) charge loading or (b) energy consumption (confidence level=95%) during EO treatment of landfill leachate

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