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Dual-response quadratic model for optimisation of electricity generation and chlorophenol degradation by electro-degradative Bacillus subtilis in microbial fuel cell system

Abstract

The interactions within microbial, chemical and electronic elements in microbial fuel cell (MFC) system can be crucial for its bio-electrochemical activities and overall performance. Therefore, this study explored polynomial models by response surface methodology (RSM) to better understand interactions among anode pH, cathode pH and inoculum size for optimising MFC system for generation of electricity and degradation of 2,4-dichlorophenol. A statistical central composite design by RSM was used to develop the quadratic model designs. The optimised parameters were determined and evaluated by statistical results and the best MFC systematic outcomes in terms of current generation and chlorophenol degradation. Statistical results revealed that the optimum current density of 106 mA/m^2 could be achieved at anode pH 7.5, cathode pH 6.3–6.6 and 21–28% for inoculum size. Anode–cathode pHs interaction was found to positively influence the current generation through extracellular electron transfer mechanism. The phenolic degradation was found to have lower response using these three parameter interactions. Only inoculum size-cathode pH interaction appeared to be significant where the optimum predicted phenolic degradation could be attained at pH 7.6 for cathode pH and 29.6% for inoculum size.

Keywords

2,4-dichlorophenol; Central composite design; Microbial fuel cell; Quadratic model; Response surface methodology