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Decomposition of azo dyes in waste water and its power generation using air cathode microbial fuel cell

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The objective of this research is to develop an air biocathode microbial fuel cell (AB-MFC), with cultures of laccase producing white rot fungi *Ganoderma lucidum* (BCRC 36123) planted at the cathode. The developed AB-MFC was then applied to investigate the enhancement of the decomposition of azo dyes in waste water as well as its power generation. Results of the study showed: *Ganoderma lucidum* could utilize AO7 as a source of carbon to release laccase. AO7 concentration being 50 mg/L could be decolorized by 77% in 19 days and the laccase activity reached a maximum of 20.3±0.2 U/L. The system of planting *Ganoderma lucidum* at the cathode to release active laccase by repeatedly adding 180 mg/L AO7 as the sole source of carbon was capable of achieving a maximum open-circuit voltage of 821 mV, maximum closed-circuit voltage of 394 mV (external resistance of 1000 Ω), maximum power density of 13.38 mW/m2, maximum current density of 33 mA/m2 and highest decolorization of 82%, all of which were superior to the air cathode system or the white-rot fungi system with inactive laccase. Changes to voltage potential at the cathode of the AB-MFC system monitored using cyclic voltammetry scanning by a potentiostat revealed that planting laccase releasing *Ganoderma lucidum* at the cathode allowed the anode to receive electrons generated through microbial decomposition.

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Evaluation of performance of periodically fed zero discharge single chamber air cathode microbial fuel cell

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In this study, air-cathode microbial fuel cells were periodically refueled with different substrates (glucose, ethanol, sodium acetate and acetic acid) without replacing the electrolyte or discharging any solution. MFC performances and various electrolyte properties were monitored over 130 hours. Power loss of 68% and 48% were observed for glucose and ethanol-fed MFCs. The loss of power was mainly attributed to substantially increased internal resistances at relatively low electrolyte pH (~6), which was caused by production of fatty acids through fermentation and oxidation processes. On the other hand, rapid cathodic biofilm growth for glucose and ethanol-fed MFCs was found to cause higher electrolyte pH at the cathodic catalyst layer, leading to lower open circuit voltage (OCV) and power output. The stable performance of MFC fed with sodium acetate indicates that anodic electro-active species are more tolerant to alkaline pH and ionic strength changes. Our results revealed the preference of electro-active bacteria to non-fermentable substrate over fatty-acids producing substrates. The results demonstrated the importance of pH control and biomass removal from the cathode in waste water treatment by MFCs.

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