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Effect of Type of Inoculum and Application of $Ru_xMo_ySe_z$ on Microbial Fuel Cell Performance

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ABSTRACT

This research aimed at evaluating the effect of inoculum type and the application of $Ru_xMo_ySe_z$ as a cathode catalyst on the treatment and bioelectricity production of a microbial fuel cell fed with recalcitrant, municipal leachate. The device was an air-cathode, two-face microbial fuel cell fitted with graphite flakes as anodic material (*MFC-G*). The cathode was painted with $Ru_xMo_ySe_z$ at a dose of 0.5 mg/cm^2. The inocula assayed in our work were a plain sulphate-reducing inoculum (*In-SR*), an enrichment in Mn(IV)-reducing bacteria (*In-*$E_{Mn(IV)}$), and two enrichments in Fe(III)-reducing bacteria, namel, *In-*$E_{Fe(III)-S}$ and *In-*$E_{Fe(III)-SR}$.

Each face (I and II) of the *MFC-G* was characterized by separate (I and II), in series and parallel connection. We found that parallel connection of electrode faces lead to significantly lower values of the internal resistnace. In the batch operation where the cells were operated with the faces connected in parallel and loaded with an external resistance of 100 Ω, enrichment of the inocula had a significant, positive effect of cell performance. The average volumetric powers $P_{V\text{-}ave}$ observed were 4 376, 9 555, 11 249, and 13 303 mW/m^3 for the *In-SR*, *In-*$E_{Mn(IV)}$, *In-*$E_{Fe(III)-SR}$, and *In-*$E_{Fe(III)-S}$, respectively. The high $P_{V\text{-}ave}$ registered with the enriched inocula in our work could be attributed to the synergism of increased concentrations of exoelectrogenic bacteria as well as the high total anodic surface area by the use of granular graphite that could have facilitated the electron transport to the anode. The first issue was confirmed by molecular characterization of enriched inocula. In general, values of $P_{V\text{-}ave}$ obtained with the chalcogenide catalyst were 30-40% lower than those registered with Pt catalyst. Yet, the cost of the chalcogenide is 80% lower than that of platinum. We conclude that the application of inocula enriched in Fe(III) and Mn (IV)-reducing bacteria significantly improved the performance of cells that used $Ru_xMo_ySe_z$ as a cathodic catalyst for the ORR

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