Characterization of microbial electrolysis cell's bioanode performances through potentiostatic and potentiodynamic techniques

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Among the various sustainable hydrogen production technologies, Microbial Electrolysis Cells (MECs), offer significant advantages over conventional methods. Indeed, MECs use microorganisms to oxidize organic compounds at low energy, reducing the thermodynamic voltage required compared to water electrolysis (i.e. +0.187 V vs +1.23 V vs SHE for acetate oxidation). MECs can utilize organic waste and wastewater as substrates, improving the energy balance in water treatment processes. The present study reports the utilization of potentiodynamic and potentiostatic techniques for the electrochemical characterization of the biofilm activity of a bioanode under different operating conditions (i.e. synthetic vs real substrate). In this study Cyclic voltammetry (CV) was employed to characterize the electrocatalytic activity of the bioanode of a continuous MEC in which synthetic and real substrates have been used to convert waste organic substrates into hydrogen. CVs were recorded at 4 different scan rates, namely 5, 20, 40, and 60 mV/min three CV cycles were performed in each run (with vertex of Ei = +0.40 V and Ef = −0.40 V). Biofilm activity at different organic load rates with synthetic mixture a substrate and a real acidogenic fermentate has been monitored using cycle voltammetry's at different scan rates along with the application of potentiostatic polarization at different anodic potential obtaining the electricity/potential relationship under potentiostatic conditions. The data showed the applicability of these electrochemical techniques to monitor the anodic biofilm activity under different operating conditions, particularly the cyclic voltammetry highlight the presence of a clear oxidation peak around -0.15 V vs SHE when an OLR of 1gCOD/Ld was applied to the anodic chamber with synthetic substrates (Figure 1-a). On the other hand the characterization of biofilm activity during the bioanode operation with the real substrate highlights the presence of soluble oxidable compounds which affected the current production for applied anodic potentials higher than +0.3 V vs SHE (Figure 1-b).

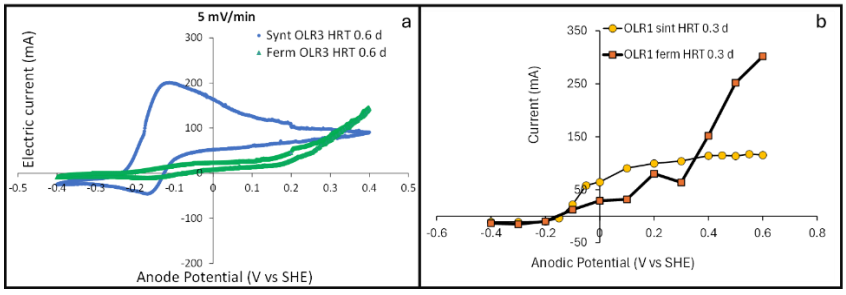

Figure 1. Cyclic voltammetry scan at 5 mV/min using synthetic and real substrate (a), kinetic characterization of biofilm activity under potentiostatic conditions with synthetic and real substrates.

Keywords: Green Hydrogen, Microbial electrolysis, wastewater treatment, dark fermentation