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Performance of planar and cylindrical carbon electrodes at sedimentary microbial fuel cells

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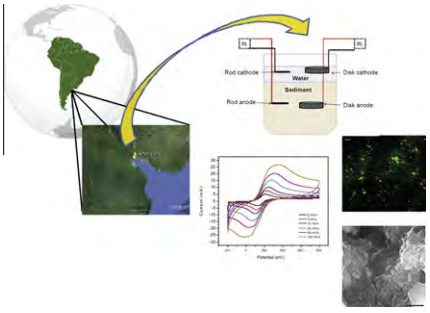
HIGHLIGHTS

- Mud obtained from zones surrounded by marshy vegetation performs better (current).
- Current production seemed to be controlled by diffusion processes.
- The addition of acetate decreased microbial diversity and increased biofilm development.
- An external carbon source (acetate) increased the power generation rate.

GRAPHICAL ABSTRACT



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ABSTRACT

This paper presents data obtained using an indigenous microbial community contained in anaerobic sediments (mud) collected from the shore of the Río de La Plata River (South America). After the sedimentary microbial fuel cells were assembled the evolution of current and power vs. time was studied. Two types of commercially available graphite materials were used as electrodes, which differ mainly in shape and size. In some experiments, an external carbon source (acetate) increased the power generation rate. The maximum power density observed in the aforementioned condition was 19.57 ± 0.35 and 8.72 ± 1.39 mW/m^2 using rod and graphite disk electrodes, respectively. The better performance of the rod electrodes can be explained, at least in part, by an enhanced rate of mass transport by radial diffusion. DGGE fingerprints were used to study the electrogenic community growing over the electrodes.

1. Introduction

In a microbial fuel cell (MFC) microorganisms are used to generate an electrical current. The bacteria oxidize organic matter while some of the electrons are transferred to the anode. An external circuit (which may or may not contain a load resistance) leads the electrons to the cathode producing an electrical current. At the cathode, oxygen is reduced into water. Reimers et al. (2001) were the first to develop the concept of sedimentary microbial fuel cell (SMFC), also known as benthic microbial fuel cell (BMFC), showing that the power generation can be sustained just by the oxidization of organic matter naturally present in sediments. In a SMFC, while an anode is embedded in an anaerobic sediment (marine or River sediment, rice paddy fields and other aquatic environments rich in organic matter) a cathode is exposed in the aqueous phase over the sediment usually saturated with oxygen (Bond et al., 2002;

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