Anode materials for sediment microbial fuel cells

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INTRODUCTION

Plant microbial fuel cells (P-MFCs), and more general sediment microbial fuel cells, make use of electricigenic metabolism of microorganisms in anoxic soils and sediments. Electricigenic microorganisms are able to respire organic carbon from the soil or sediment with an electrode as final electron acceptor [1]. In this work, the focus is on the anode buried in the sediment, the electron acceptor that makes biologically liberated electrons available for work. To test the applicability of various conductive carbon materials for the anode, microcosm sediment MFCs were used.

RESULTS & DISCUSSION

Various felt [a) commercial available, b)activated and c) carbonized], cloth [a) fine fiber, b) coarse fiber, both activated] and granular [a) commercial available 1-5 mm, b) 250-500 µm, activated and c) 250-500 µm, non-activated] materials were first subjected to an initial screening. This screening consisted of mixing 1 layer (felt/cloth) or 50% volume (granules) with sand, containing 20 mM of acetate as only carbon and electron source . Experiments were performed in duplicate. From this initial screening it could be concluded that the biggest granules (1-5 mm) had transferred the most coulombs within the timeframe of the experiment. All felt/cloth materials had roughly the same output in terms of transferred charge.

The second step consisted of mixing the best performing materials, a felt material and granules 1-5 mm in various ratios in the sand. Granular material (1-5 mm) had the best performance at a 67% mixing ratio, i.e. the performance was the same as a 100% mixing ratio. The commercial available felt did not show a clear differentiation between the various mixing ratio's. The current density of the felt material (30-50 mA/m^2 for 14-42 vol-% mixing) was much higher per % mixing compared to the granular material (50-70 mA/m^2 for 67-100 vol-% mixing).

These results indicate that interconnectivity between electron accepting materials in sediments plays a large role in determining current output. Although granular materials might be preferred in terms of handling and application, felt/cloth materials seem to have the better performance in terms of current output.

1. De Schamphelaire, L., et al., *Microbial fuel cells generating electricity from rhizodeposits of rice plants.* Environmental Science & Technology, 2008. **42**(8): p. 3053-3058.