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ALGAL –ASSISTED MICROBIAL FUEL CELL AS AN OXYGEN SUPPLIER FOR BIOELECTRICITY GENERATION

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Abstract

This paper describes the potential of algal biomass (*Chlorella vulgaris)* as photosynthetic cathodes for eliminating the need of a mechanical air supply and the use of often expensive noble metal cathode catalysts, thus improving sustainability and cost effectiveness of MFC system. During polarizations, MFC power density using algal biomass was 0.4mW/m², whereas the MFC with mechanic aeration showed a value of 0.2mW/m². The cyclic voltammetry(CV) analysis of oxygen reduction revealed that the cathode potential was proportional to the oxygen amount available in the cathode surface electrode. In the case of algal aeration, the peak reduction value of -2.18A/m² was two times higher than in mechanical aeration -1.85A/m². The electricity production reached 70 mA/m² and was stimulated immediately by the oxygen produced by algae up to value of 20 mg/L.

Methods

Algae and media

Chlorella vulgaris was chosen due to its fastest growing. *C. vulgaris* grown in BG11 medium in sterilized Erlenmeyer flask. *C. vulgaris* was used as bio-cathode. Anaerobic activated sludge from plant of Beni-Messous WWTP(Algiers) was used in anodic compartment.

MFC design

A dual-chamber reactors MFC was used as reactor. The reactor has been fabricated in the laboratory using plastic jars. The cylindrical and rectangular jars were used as the anode and cathode chambers, respectively. The volume of anode and cathode chambers was 0.8 and 2L, respectively. the two chambers were connected with a proton exchange membrane (PEM). The plain graphite plates (5 x 2cm) were used as electrodes for both anode and cathode.

Experimental Procedure

1: Cathodic compartment
2: Anodic compartment
3: Resistance
4: PEM membrane

Results and discussions

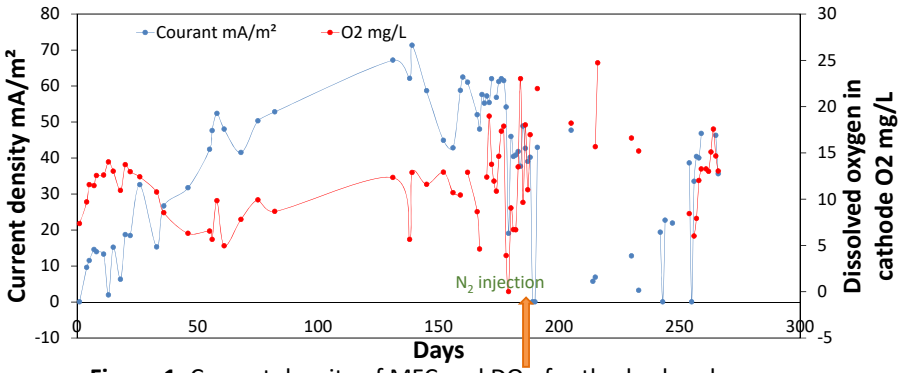

Figure 1. Current density of MFC and DO of cathode chamber

Discussions of results

Fig1 shows two curves as a function of time: the oxygen production in the cathode compartment and the current density produced in MFC, their trend was similar for each cycle during almost 12 months of operation. A current density of 70mA/m² with maximum voltage of 150mV was reached from MFC/Algal. The N_2 injection in cathodic compartment shows an abrupt fall of the current reaching 19 mA/m² and 0 of dissolved oxygen (DO) which indicates the implication of the O_2 produced by the microalgae in the current generation.

The algal aeration in the cathode chamber shows better performance compared to the mechanical aeration. The MFC with algal aeration generates a maximum power density of 0.4mA/m while the maximum power density achieved with the MFC with mechanical aeration was 0.2mA/m² .

Conclusions

A modified MFC with microalgal was constructed by introducing *C. vulgaris* to the cathode chamber used to generate oxygen in situ. The CV and DO measurements showed that oxygen indicates that the reduction peak with microalgal was two times higher than mechanical aeration. Microalgae can replace the conventional mechanical aeration method which could be a more sustainable alternative in both economic and environmental terms.