The beneficiation of algal biomass from a low-cost sewage treatment system as a feedstock in microbial fuel cells

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The challenge for both clean water and of renewable energy is perhaps most poignantly felt in communities in Africa living "off the grid". The challenge is as much health care as it is socio-economic. With increased urbanization in Africa, certain municipal wastewater treatment systems are also failing to provide adequately treated water. The Integrated Algal Ponding System (IAPS) which has been piloted at Rhodes University in South Africa provides a cost-effective and energy-efficient platform imminently suited to wastewater and sewage treatment for smaller communities. Apart from water treatment the system yields two additional byproducts: biogas and a biomass consisting of a natural consortium of different algal species. The latter is produced in abundance in the high-rate algae oxidation ponds, which form the tertiary phase of the sewage treatment process. As part of a broader set of related activities to derive energy more efficiently from organic sewage, the beneficiation of this algal consortium as a feedstock in microbial fuel cells for energy generation is examined (Figure 1).

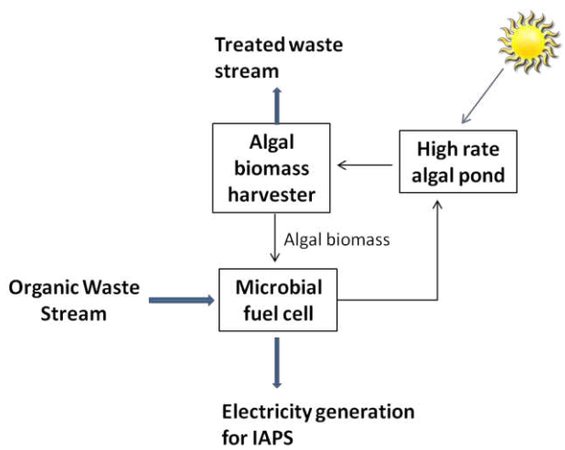

Figure 1. Linked energy production and waste-water treatment

The use of algae as a feedstock in microbial fuel cells (MFCs) has not been widely reported in the literature. Here we examine both commercial micro-algae and a natural algal consortium from the IAPS' sewage treatment as feedstocks for MFCs. The study explores certain key limiting factors including the effect of different algal pre-treatment methods for enhancing nutrient bioavailability and hence power density in a two-chambered H-type MFC setup. The MFC under investigation makes use of facultatively anaerobic Enterobacter cloacae as the anodic microbial catalysts.

The long-term performance of the micro-algae as a feedstock for MFC configurations is examined at carbon paper electrodes modified with different carbonaceous nanomaterials (CNM) (anode) and the synergistic coupling of CNM with iron (II) phthalocyanine (cathode)[1].

The long-term stability of the MFC using these competitive, non-platinized, electrode surfaces was assessed over a two month period utilizing micro-algae feedstocks. The presentation also provides a localized perspective on the feasibility of such systems in low cost and low resource settings as an energy generation system utilizing waste products.

References:

1. S.L. Edwards, R. Fogel, K. Mtambanengwe, C. Togo, R. Laubscher, J. L. Limson. Metallophthalocyanine/ carbon nanotube hybrids: extending applications to microbial fuel cells. Journal of Porphyrins and Phthalocyanines, 2012, 16, (7-8), 917-926.