Design of a single chamber air cathode microbial fuel cell using a stainless steel spiral anode and 3D printing techniques for continuous flow dye decolourisation

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A poster presented atthe 4th European Meeting of the International Society for Microbial Electrochemistry and Technology, Newcastle University, Newcastle upon Tyne, 12 - 14 Sep 2018.

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Microbial fuel cells (MFC) offer a novel solution in wastewater treatment systems. Their capacity for COD removal and concomitant electricity generation are highly attractive properties for reducing costs & environmental impacts in industry. MFCs require expensive membranes & catalysts such as Nafion and platinum respectively to achieve increased power output, but the cost of these materials is prohibitive for real world applications.

An air breathing, 1 litre-scale spiral anode MFC was designed (Fig. 1) to provide a high electrode surface area to reactor volume ratio using commonly and cheaply available materials such as stainless steel and activated carbon. Non-platinum group metal catalysts (FeAAPyr family) were integrated into a PVDF cathode fabricated using single step phase inversion to improve rate of the oxygen reduction reaction. Anode surface area was maximized by concertina folding and spiral arrangement and its surface was modified using sulphuric acid, heat treatment & carbon black adsorption to provide a more biocompatible surface for biofilms.

The performance characteristics of the designed MFC are currently being investigated. Decolourisation of Acid orange-7 azo dye & COD removal were initially investigated in recirculating batch mode followed by continuous flow configuration with a hydraulic retention time of 36 hours. Optimisation of hydraulic retention times, cathode construction & anode surface modification will present a feasible system for the scale up of microbial fuel cells for industrial use, maximizing COD removal & electricity production.

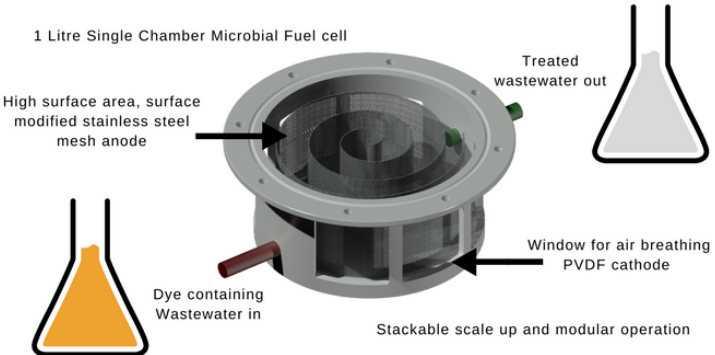

Figure 1.