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Economically Viable Design of A Single Chambered Microbial Fuel Cell For Gaining Larger Output

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***Abstract*— A novel design of Single Chambered Microbial Fuel Cell in Cloth Electrode Assembly is developed where we have introduced electrical circuitry to generate higher current density. The design is made with the carbon-graphite brushes, copper wire and a plastic box focusing on current output with economic viability of the design utilizing synthetic wastewater. Alteration is done mainly to the cathode surface area which has been constructed using graphite powder without Teflon coating. The highest production recorded is about 25 times (in case of power density) and 7.5 times (in case of current density) higher than that has been recorded using 4 carbon brushes attached to form a single anode in mediator less condition. These results conclude that:**

1) Scaling up for production of usable current and power economically, is possible through this way;

2) This can also decrease the huge variation of internal resistance;

3) Power Density increases although energy expense on transferring electrons decreases.

***Keywords*— Microbial Fuel Cell, Parallel Circuit, Multiple Anodes, Internal Resistance;**

I. INTRODUCTION

It has been a century ago when Prof M.C. Potter of Durham University has proposed the generation of electricity through biochemical degradation. However this idea was popularized around 1975 and further with the discovery of the electrogenic Geobacter *sp*. by Derek Lovely in 1987. Some well-known experiments relating to increase the output started in the last decade by improving electrode design like by coating the cathode with Ferric sulphate and anode with Manganese sulphate[1], coating anode with Pt[2] or utilizing carbon cloth as electrodes with Teflon coating only at air cathode [3]. But the first experiment with a stack of MFC was conducted using six individual MFC units made of robust cation exchange membrane and granular graphite anode and a hexacyanoferrate coated graphite rod as cathode [4]. Their work was followed by Wang and Han [5] where they introduced four MFC units inside a Plexiglas container using reticulated vitreous carbon anode and Pt/C coated air diffusive cathode.

The lowest internal resistance was observed as the MFCs were connected in parallel connection. Of all the above literatures cited above, involvement of PEM membrane was common except for **(3)** where they utilized J-cloth as an alternative for the high cost of this membrane. In later work it had been proved that the PEM gets deteriorated due to membrane fouling, resulting in decrease in performance of the cell [6]. And since the use of Pt/C coating is also very expensive, Logan and Pant et al developed an air cathode out of activated carbon bonded with PTFE, around a Ni mesh current collector, which is inexpensive than the previous[7]. The earlier approaches of scaling up an MFC were either connecting multiple MFCs in series for additive Voltage output[4,8] or increasing surface area of the electrodes[9,10]. The 2nd approach was more promising as long as the size of electrode surface does not affect the power density. Dewan et al performed analysis on the relation between the surface area of the anode as current-limiting electrode in a MFC and the power density generated by it. He generated the current limiting condition by utilizing cathode with surface area significantly higher than anode surface area. And he found out that the power density varies directly with the negative natural logarithm of the anode surface area, which validated that as long as surface area of a current limiting electrode increases, the maximum power density will decrease [11]. On the other hand by monitoring microbial adhesion and biofilm growth using electrochemical impedancemetry, Dheilly et al observed that internal resistance decrease with biofilm detachment [12]. From our 1st phase of experiment [13], it was observed that a single anode cannot contribute to higher current output. Since as reported and validated by Liu et al [14], Dekker et al [15], Rader and Logan [16] and Cusick et al [17] for scaling up an MFC by utilizing multiple pair of electrodes, it was planned to increase the total surface area of anode by inserting more than one anode (five anodes) in the anode chamber, connected in parallel circuit as current sources but sharing a single cathode. The objective was to increase power output by increasing current output with simultaneous decrease in the internal resistance range. And moreover substrate was fed hourly so as to make it a fed batch system.