ABSTRACT

The development of microbial fuel cell (MFC) concept was materialized to serve principally three purposes, first is to offer effective anaerobic treatment of different organic waste, second is for energy or by-products recovery from waste, and the last but not the least is to develop environment specific green technology. Electrogenic bacteria, which work as biocatalyst in an anodic chamber, play crucial role in enhancing power production of MFCs. The major bottleneck in application of MFC for wastewater treatment is the quick identification of bio-electrogenic activity of inoculum; hence, minimum startup time of about 8 days is required for MFC to check initial power production performance to ascertain electrogenic activity of inoculum. Therefore, for ensuring optimum performance of MFCs, emphasis should be given on development of technique for rapid identification of electrogenic activity in the anodic inoculum, so as to have assured start-up and enhance performance of the MFCs. Semiconductor quantum rods such as tungsten trioxide (WO_3) are inexpensive, easy to synthesize, biocompatible, possess photo- and electro-catalytic properties, and change its coloration to blue under an electrogenic environment; hence, these sensitive properties were used to determine the presence of electrogenic bacterial community.

Till now number of researches have been done using low-cost clayware MFCs for wastewater treatment and simultaneous electrical power recovery. Among them inexpensive clayware separator presented a viable option as a separator for MFCs. However, their negative impact on existing bacteria in anodic chamber due to oxygen crossover should be minimized by coating or filling of ceramic separator with suitable material having no toxic effect on bacterial population. For this purpose, *Brassica juncea* oil smearing on both sides of clayware separator showed 4.31 times higher power density than control MFC with significantly reduced internal resistance.

Electrogenic bacterial attachment on anode material is also the primary concern for improving electron flow towards anode for which a conductive and biocompatible carbonaceous material possessing high surface area is required. Hence, low-cost activated carbon produced from post brewing tea waste an environment-friendly and biocompatible anode catalyst was recommended to be used for fabricating anode for low-cost field scale MFCs. The current collector connected with electrodes also significantly affect the electron flow and power production of MFC. Higher conductivity, lesser resistivity, corrosion resistant and biocompatibility are the major factors to be kept in mind while selecting the perfect current collector for MFCs for which tungsten wire was found suitable. Similarly a wide variety of organic substrates have been successfully treated in MFCs till now including various types of wastewaters and several agricultural wastes for the power production; however, post brewing tea waste and household organic waste till now has not been explored as substrate. For treatment of above mentioned waste, a three chambered MFC configuration is proposed successfully, having dual cathodes to harvest in-house electricity from this waste and use of the digested waste from MFC as a bio-fertilizer is established.

Keywords: Bioelectrogenesis; Electrode catalyst; Microbial fuel cell; Power generation; Tungsten trioxide quantum rods; Wastewater treatment.