Abstract

Microbial fuel cell is a green technology that can convert chemical energy stored in organic matter into electrical energy in an eco-friendly manner. In this study, two types of microbial fuel cells were used, viz. sediment microbial fuel cell (SMFC) and constructed wetland microbial fuel cell (CW-MFC). SMFC was developed for the purpose of bioelectricity production and CW-MFCs for the secondary treatment of domestic wastewater along with potential benefit of power generation. Objectives of this study also included enrichment of anode-respiring bacteria at anode as well as identification of this microbial community. CW-MFCs configuration included gravel used as wetland matrix (CW-MFC-I), and sediment used as wetland matrix (CW-MFC-II). Sediment and lake water samples were collected from Uchhali Lake, Khushab, Pakistan and wastewater sample for use in CW-MFCs was acquired from Water and Sanitation Authority (WASA), Lahore, Pakistan. Electrochemical parameters (voltage & current) and physicochemical parameters (pH, electrical conductivity etc.) were monitored regularly. In case of CW-MFCs, chemical oxygen demand (COD) removal was also determined as a measure of wastewater treatment performance. Spike experiment of SMFC resulted in highest open circuit voltage of 732mV and highest closed-circuit voltage of 520mV. Highest current and power density were calculated to be 11.38 mA/m^2 and 1.68 mW/m^2 respectively. Electrical conductivity (EC) of lake water decreased from 23mS/cm to 12.77 mS/cm and salinity decreased from 6.4 ppt to 5.32 ppt after SMFC operation. The decrease in EC as well as salinity of SMFC suggests its use as desalination unit. Anodic biofilm contained *Proteobacteria* as the most abundant phylum followed by *chloroflexi*. CW-MFC-I and II produced a highest closed-circuit voltage of 343mV and 367mV respectively. Maximum open circuit voltage value from these cells was noted to be 664mV and 702mV respectively. Electrical current values for CW-MFC-II were also higher than CW-MFC-I, i.e., 372 mA and 365 mA respectively. CW-MFC-I performed better at water treatment since it reduced chemical oxygen demand by 90% as compared to CW-MFC-II which resulted in 86.86% removal of COD. Total dissolved solids in CW-MFC-I decreased by 59.7% while in CW-MFC-II, TDS level increased instead of decreasing because of salts in lake water. Overall, MFCs proved to be valuable tool for bioenergy generation as well as wastewater treatment. Treated saline water form CW-MFC-II can serve as an excellent substrate to the desalination microbial fuel cells which in return will produce more bioelectricity. SMFCs can be coupled with solar cells in order to have enhanced collective output. Combining MFCs with solar cells is another perspective that if focused can yield positive results.