PROJECT REPORT ON

A STUDY ON EFFECT OF DIFFERENT ELECTRON MEDIATORS ON MICROBIAL FUEL CELL TECHNOLOGY APPLIED TO BIOGAS PLANT

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ABSTRACT

Microbial fuel cells (MFCs) are a system that uses microbes to convert the chemical energy stored in the organic waste into electricity. One such biomass derived waste that has been effectively used at present for biogas production is cow dung. Cow dung slurry contains phylogenetically diverse group of bacteria, which could be tapped for the generation of electricity by applying MFC technology to the biogas plant. To facilitate the growth of bacteria on anode to form a biofilm and transfer the electrons directly to the electrode, it is specially coated with calcium alginate. The electrode is made up of copper sheets of 0.7 mm thickness and 6 X 6" dimension and zinc sheet of 6 X 2" dimension, hung in 20 liter capacity plastic canisters containing 6 liters of cow dung slurry in a proportion of 2 kg cow dung in 3 liters of water. The first design (tank 1) consisted of two canisters of 20 liter capacity bridged through a PVC pipe plugged with scrub. In this design one tank acts as anode chamber, which contained cow dung slurry and the other tank served as cathode, which contained plain water. The second design (tank 2) consisted of canister of 1 liter capacity and it resembled the second design except that the tanks were connected in series. Canister is tightly closed to create anaerobic environment and allowed to remain without disturbance for 21 days. Electrical measurements from homogenous (copper-copper or zinc-zinc) or heterogeneous electrodes (copper-zinc) were taken after 21 days on daily basis up to 10 days or to the nearest steady state value. To see the effect of electron mediators on generation of electricity, to the same tanks, salts of ammonium sulfate, sodium acetate, sodium formate and organic waste such as whey, fruits (without citrus fruit) and vegetable waste are added independently and electrical measurements are taken on daily basis up to 10 days.

To know the diversity of microbial community growing on the anode as biofilm, the biofilm is scrapped from the surface of anode and biochemical characterization of microbes was undertaken. Without the addition of electron mediators, the voltage generated by tank 1 uncoated copper anode- copper cathode electrode was 495 mV and coated copper anode-copper cathode electrode was 533 mV; zinc cathode and coated copper anode yielded 495 mV, but coated zinc anode-zinc cathode system yielded very low voltage of 59 mV; in tank 2 copper cathode-coated zinc anode yielded 965 mV, copper cathode-uncoated zinc anode yielded 907 mV. With electron mediator like fruit

and vegetable waste, tank 2 produced 1016 mV (copper cathode-coated zinc anode) 1077 mV (copper cathode-uncoated zinc anode); with ammonium sulfate as electron mediator yielded 1008 mV(copper cathode-coated zinc anode) to 1060 mV (copper cathode-uncoated zinc anode) and electron mediator sodium acetate yielded 1000 mV (copper cathode-uncoated zinc anode as well as in coated zinc anode). It can be concluded that by increasing the surface area of the electrode, higher electrical output can be obtained.