cathode was not recovered, even became worse comparing to the previous result (Figure 8). The cathode potential of 0.034 V was initially developed, and then decreased sharply down to - 0.131 V within about 21 hr. However, at this time, the anode potential decreased from - 0.402 V to -0.419V showing the increase of the anode performance. As a result, the significant decrease in cathode potential resulted in decreasing the cell voltage from 0.435V to 0.297V. The SCOD removal for 21 hours was only 2.4% (1004 to 980 mg/L) that was nearly 6 times less than that from the previous operation. The lower removal of the SCOD at this time could have been a result of less introduction of oxygen from the cathode chamber to the anode chamber (Liu et al., 2004; Min et al., 2005a). At the end of operation, the initial SCOD of 1004 $\pm$ 6 mg/L decreased to 940 $\pm$ 6 mg/L over about 52 hrs (SCOD removal= 6.4 %), but CE (27.9%) was increased about 4 times higher than that obtained in the previous run.

The above observation suggested that poor accessibility of oxygen to the cathode electrode decreased the performance of the cathode and the power generation, while possibly increasing CE due to low substrate oxidation by aerobic microorganisms in the MFC. Therefore, the performance of the cathode in the SMFC need to be further improved to generate high power and obtain better CE in the long period of operation, especially in the continuous mode.

Conclusion:

[0076] The SMFC containing air cathode chamber could successfully generate electricity from wastewater amended with only acetate. The maximum power generation was 204 mW/m^2 with current density of 595 mA/m^2 at a circuit resistance of 180Ω (SCOD of wastewater =1672 $\pm$ 6 mg/L). The power output showed a saturation-type relationship as a function of wastewater concentration (SCOD), with a half saturation coefficient of K_s = 244 mg/L and a maximum power density of P_{max} = 244 mW/m^2. The OCP of the anode electrode was -0.323V vs. SHE, which was a similar value to other studies. However, the cathode OCP of 0.393V (vs. SHE) was much less than the theoretical value (0.804 V, by 51% reduction), and smaller than the value (0.413V) from other type of air cathode MFC. The cathode potential showed the decrease of its performance as a function of time, and the performance was not recovered by removing the excess of water in the cathode chamber. These results suggested that the MFC can be used to generate power from the raw wastewater containing high substrate concentration, but need to improve the cathode chamber for higher and more stable power generation in the scale up field operation.

Claims

1. A microbial fuel cell, comprising

(i) an anode electrode,
(ii) a cathode chamber, said cathode chamber comprising an inlet through which an influent enters the cathode chamber, an outlet through which an effluent depart the cathode chamber, a cathode electrode and an electrolyte permeable membrane,

wherein both the anode electrode and the cathode chamber are to be submersed into an anaerobic environment to generate electrical energy.

2. A microbial fuel cell, according to claim 1, wherein at least 40% of the cathode chamber is surrounded by the anaerobic environment, such as at least 50%, e.g. at least 60%, such as at least 70%, e.g. at least 80%, such as at least 90%, e.g. 100%.

3. A microbial fuel cell, according to claim 2, wherein at the most 90% of the cathode chamber is surrounded by the anode electrode, such as at the most 80 %, eg. at the most 70%, such as at the most 60 %, eg. at the most 50%, such as at the most 40 %, eg. at the most 30%, such as at the most 20 %, eg. at the most 10%, such as in the range of 10-60%, eg. in the range of 20-80%, such as in the range of 30-70%, eg. in the range of 40-50%.

4. A microbial fuel cell, according to any of the preceding claims, wherein the distance between the anode electrode and the cathode chamber is 5 cm or less, such as 4 cm or less, e.g. 3 cm or less, such as 2 cm or less, e.g. 1 cm or less.

5. A combined electrode, comprising:

(i) an anode electrode,
(ii) a cathode chamber, said cathode chamber comprising an inlet through which an influent enters the cathode chamber, an outlet through which an effluent depart the cathode chamber, a cathode electrode and an electrolyte permeable membrane,

wherein both the anode electrode and the cathode chamber are to be submersed into an anaerobic environment to generate electrical energy and wherein the anode electrode is in direct contact with the cathode chamber

6. A combined electrode, according to any of the preceding claims, wherein the cathode chamber is partly surrounded by the anode electrode