Ivantsov M.O., Drazhnikova A.V.
National Aviation University, Kyiv

Microbial fuel cell for biotechnological education

Modern biotechnology includes searching for alternative energy sources, one of which is the usage of microorganisms to obtain electricity [1]. There are many forms of microbial fuel cells (MFCs) different in their scale. This theme is also included in syllabuses of biotechnological disciplines of many universities around the world. A lot of commercial educational models of MFCs were created. However, these commercial devices require a high level of investment. University and high school educators from developing countries seek alternative ways of creating MFCs from low-cost materials for educational purposes.

This work describes the construction of a low-cost model of the MFC created on the basis of a principle scheme. The device consists of a cathode or aerobic chamber and anode or anaerobic chamber each of 140 mL working volume capacity, electrical wires, electrodes, electrical tape, resistor and the electron-permeable bridge ($l = 6.5$ cm; $d = 1.7$ cm). MFC chambers were made from parts of a plastic pump. The content of the anode chamber was a source of bacterial electrogenesis. River or lake mud may be used as a source of microorganisms consortium for anode chamber. However, it is also possible to add several amendments to the mud, such as cellulose or protein source, in order to increase the metabolic activity of a microbial consortium. As for the cathode chamber, it was filled with boiled water cooled to room temperature. An electron-permeable bridge was prepared by using 10% agar and 10% of sodium chloride in water. Both chambers were filled with corresponding contents, after that electrodes with electric wires, fixed on them, were immersed in chambers. The opening to the anaerobic chamber was isolated by electrical tape. MFC was assembled by connecting a salt bridge (blue tube) between the two plastic chambers (Fig. 1).

The voltage of the MFC was measured in mV every 24 hours using a multimeter. Results of voltage measurements are shown in table 1.

Табл. 1. Voltage measurements

Time period, h	24	48	72	96
Voltage, mV	0.3	0.6	0.5	0.2

Increase of voltage level during the first 48 hours of exposition may be explained by activity of mud bacteria in changed conditions. The reason for such a drastic voltage decrease after 96 hours may be the fact that the resistor was not unplugged, so it could freely spend energy that was generated by the MFC.

As a result, the educational model of MFC is proposed. The positive results of its application were obtained. Maximum measured voltage was 0.6 mV after the 48 hours of exposition. This voltage is enough to light

Рис. 1. The model of microbial fuel cell

up one low power LED.

Several advantages of this model can be identified:

- low-cost consumables and perishables;
- ability to make many copies of MFC for several student's subgroups;
- possibility to change configuration of MFC or contents of chambers to initiate more active electrogenesis (for example, ethanol or butyric acid fermentation may be demonstrated together with microbial electrogenesis).

1. *Idris S.A., Esat F.N., Rahim A.A.A., et al.* Electricity generation from the mud by using microbial fuel cell // MATEC web of conferences. — EDP Sciences, 2016. — Vol. 69. — 02001. — DOI: 10.1051/matecconf/2016692001