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EXCEL-OHW-UTILIZATION OF HUMAN WASTE TO MAKE NEW RENEWABLE ELECTRICAL ENERGY BASED ON MOBILE APPLICATION IN ISOLATED VILLAGE TO ACHIEVE SDGs 2030

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ABSTRACT

This paper aims to describe the working principle applied to EXCEL-OHW to produce electrical energy and its efficiency level, considering that electrical energy generally comes from non-renewable fossils energy sources. Non-renewable energy utilization has drastically increased leads authors to explore new, innovative, and easy to get alternative energy. *Microbial Fuel Cell* (MFC) is a new alternative energy resource technology that utilizes bacterial interactions found in nature. The authors introduce new MFC innovation, mobile-based applications of EXCEL-OHW device. This device generates electrical energy from human waste as a substrate that is converted into electrical energy by electron and proton activity by bacteria in MFC technology. This device controls temperature, voltage, and can be automatically turned on and off. A graphical interface is developed to facilitate the users. This device produced 12 V DC voltage to 220 V 500 W AC voltage with 95% efficiency and minimize the electrical energy crisis and fulfill the needs of local society especially in low electrical energy source and isolated areas, such as Desa Jatisari Malang, Indonesia. This technology can be the solution to the energy crisis in order to achieve SDGs by the year 2030.

Keywords: mobile application, human waste, microbial fuel cell (MFC)

1. INTRODUCTION

Energy availability is a crucial requirement for human life. In the recent era, the demand for alternative energy, especially electrical energy, has increased drastically. According to Indonesia's Agency for Study and Application of Technology (BPPT) in 2017, the demand for electricity in the industrial and household sectors was 37% with a total of 2,584 TWh. Interestingly, the number of people who have not had access to electricity has even reached 87.69 million people. One of the technologies that can be a new alternative energy source is the *Microbial Fuel Cell* (MFC). Unfortunately, the application and development of Microbial Fuel Cell technology in Indonesia are still minimal. The utilization of human waste in Indonesia is still minimum, for example in Jatisari Village, Malang. The implementation of this technology support the Sustainable Development Goals (SDGs) number 7.

2. MATERIAL AND METHOD

2.1 Material

2.1.1 Microbial Fuel Cell (MFC)

Microbial Fuel Cell or MFC is an electrical energy generating system that utilizes bacterial interactions found in nature. Bacteria in organic medium convert organic material into electrical energy. The property of bacteria that can degrade the organic medium (enrichment media) in MFC produces electron and proton ions. These ions produce the difference in electric potential so that energy can be generated.

2.1.2 Human Waste

Human waste is waste from the human body that goes through the digestive process so that it becomes waste from food scraps. Certain bacteria that generate electricity, namely electroactive bacteria, can channel electrons outside of their bodies through their cell membranes. The most important characteristic of bacteria to generate electricity is that bacteria must emit electrons. Dr. Falk Harnisch, a researcher at the Helmholtz-Zentrum für Leipzig environmental research center, explains "*Bacteria are everywhere, also in our digestive system, and in feces. If not, of course, it cannot be found in the toilet*" (Sudha, 2009).

2.1.3 Mobile Application

Application is a program that is ready to use which is made to carry out a function for application service users as well as the use of other applications that can be used by a target to be addressed. The definition of application according to Indonesia Dictionary is that, "*Application is the application of system design to process data using rules or provisions of certain programming languages".*

2.2 Methods

2.2.1 Tools Used

The tool used in the manufacture of EXCEL-OHW is a dual-chamber with compartment (anode-cathode) and electrodes are installed in each compartment, storage chamber, boost converter, IC 4047, 100 Ohm resistor, IRFZ44 MOSFET transistor, a variable resistor (potentiometer), 0.22 microfarad diode, step-up transformer, cable, solder tin, nuts, bolts, Nafion Proton Exchange Membrane (PEM), battery, circuit board (PCB), solder, round loop, straight loop, 3-liter measuring cup, infusion set, and reaction tube.

2.2.2 Variable Used

The variables used in this study are the dependent variable and the independent variable. The independent variable in this study is the Microbial Fuel Cell, while the dependent variable used is human waste.

3. FINDINGS AND ARGUMENTS

3.1 How MFC Works in Generating Electrical Energy

3.1.1 Microbial *Fuel Cells* Energy Conversion

The raw material of human waste that is flowed from a waste storage place of about 3 liters is inserted into the chamber, then the energy conversion process occurs due to a chemical process at the electrodes which then binds the electrons, causing a potential difference at the two ends of the electrode. If no voltage appears, the chamber and the human waste content will be checked. The electrode oxidation ability will also be checked to find out whether the two electrodes can produce a voltage or not. The voltage generated from this MFC is a DC voltage, and sufficient AC voltage is required to supply electrical energy to an electronic device to activate every electronic component on the device. The output voltage generated by MFC reaches 12 V and this value is sufficient to be inverted to AC voltage by using DC to AC inverter with input power 500 W. (*Flowchart* is on **appendix 4**).

3.1.2 Mobile Application Working System

The mobile application system consists of the integration of Wemos D1 Mini and Relay (switch) as a circuit breaker connected to one of the MFC cell connections, both from the anode and cathode sides. The first step is to connect the device with the application service provider server. Once connected, the new system can be operated with a visual application. This system will be visualized using a mobile-based application equipped with a button to activate or disconnect the switch. Besides, in the application, a system will also be developed to monitor the amount of voltage at the MFC output and the amount of current that will flow to the DC to AC inverter and can monitor the remaining human waste in the EXCEL-OHW. The final application can be seen at bit.ly/**AplikasiEXCEL-OHW**.

3.2 Testing Experiment Electrical Energy from Human Waste (EXCEL-OHW)

Device testing was performed after designing the EXCEL-OHW. So that the test results are obtained. From the test result, it was studied that conversion of DC voltage to AC using an inverter shown an efficiency value of up to 95%.The next step is product evaluation. This stage was done by comparing the conditions before and after using EXCEL-OHW.

4. CONCLUSION

EXCEL-OHW, a technology that produces renewable electrical energy based on a mobile application by utilizing human waste as a driving material, is much more effective and efficient for remote rural communities with an electrical energy crisis, one of which is the residents of Jatisari Village, Malang, which is one of the isolated villages in Indonesia.

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Sekian, terima kasih.

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