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Evaluation of electricity generation using Microbial Fuel Cell technology for abattoir wastewater treatment

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2022
https://hdl.handle.net/10539/34388

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ABSTRACT

The main attraction to the Microbial Fuel Cell (MFC) system, is its ability to generate electricity whilst treating the wastewater. This technology continues to gain a lot of interest from researchers, with some applications proven to be successful on a small scale. Many industries in South Africa continues to struggle with the burden of disposal of wastewater, with the abattoir industry included that uses approximately 2900L of water per 1000kg live weight of animal killed, for smaller operations. The wastewater from such operations are deemed not suitable for disposal in municipal drainage system because of the contaminants in the water which poses risks associated with waterborne pathogens that can be hazardous for the general public. Therefore, the study was focused on testing the viability of generation of electricity from such wastewater and testing the ability to improve the quality of wastewater using this technology.

A double-chamber system, with carbon paper electrodes (without catalyst) was used. A Nafion 117 membrane was applied between the two chambers. The working volume for each chamber was 1L ($0.001m^3$) and the surface areas of both electrodes was $25cm^2$ ($0.0025m^2$). The experiment was conducted under ambient conditions and the pH was monitored and it remained approximately at 7.

The voltage readings were taken using a multimeter device and readings from the potentiostat.

The abattoir wastewater produced power density that ranged between 0.05294 and $0.30494W/m^3$, whist the use of different sized resistors indicated that the least resistor produced the maximum power density of $0.04W/m^3$. Also, with the polarization curves

developed, the power density of 0.0003mW/cm^2. Also, an improvement in the quality of wastewater was evident in some of the parameters with an achievement of COD removal efficiency of 38%, volatile fatty acid at 3% and nitrogen at 56%. Therefore, the MFC has demonstrated the ability to generate electricity from abattoir wastewater and has shown the ability to improve the quality of water.

Keywords

MFC, electricity, wastewater, abattoir, voltage, resistance, current, power density, COD