OPTIMIZATION OF POWER FROM FOOD WASTE USING MEMBRANE-LESS MICROBIAL FUEL CELL

by

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Sekian, terima kasih.

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This dissertation is composed of my original work and contains no material previously published or written by another person except where due reference has been made in the text. The content of my dissertation is the result of work I have carried out since the commencement of my research project and does not include a substantial part of work that has been submitted to qualify for the award of any other degree or diploma in any university or other tertiary institution.

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June 2020

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LIST OF SYMBOLS

	Caption
° C	Celsius
kg/m^3	kilogram per metre cube
mg	milligram
NaOH	Sodium hydroxide
$NaClO_2$	Sodium chlorite
c/kW.h	Cent per kilo Watt hour
mg / L	Milligram per litre
mW / m^2	milliwatt per meter cube
g	gram
M	Molar
HNO_3	Nitric acid
NAD^+	nicotinamide adenine dinucleotide
$FADH_2$	Flavin adenine dinucleotide
CO_2	Carbon dioxide
H_2O_2	Hydrogen peroxide
V	Volt
I	Current
R	Resistance
P	Power

LIST OF ABBREVIATIONS

Abbreviation	Definition
MFC	Microbial fuel cell
ML-MFC	Membrane less - microbial fuel cell
COD	Chemical oxygen demand
SDE	Substrate degradation efficiency
OFAT	One-factor-at-a-time
RE	Renewable energy
NRE	Non renewable energy
cm	Centimetre
MW	Microgram
mm	Millimetre
Abs	Absorbance
EJ	Exojoule
mV	milivolte
ATP	adenosine triphosphate
ppm	Parts per million
hr	Hour
mL	millilitres

Abstrak

Bahan bakar fosil telah menyokong perindustrian dan pertumbuhan ekonomi negara-negara selama berabad-abad yang lalu dan jelas bahawa tidak dapat bertahan dalam jangka waktu yang lebih lama. Dalam kajian ini, Microbial Fuel cell (MFC) berpotensi untuk menghasilkan tenaga elektrik dan pada masa yang sama dapat mengurangkan banyak sisa makanan (1,64 kg / hari, sekitar 8 tan / tahun) yang dibuang di tempat sampah. MFC yang dikendalikan secara elektrokimia menggabungkan bakteria elektrogenik (EB) yang bertindak sebagai biopemangkin untuk menghasilkan elektrik. Prestasi MFC menggunakan sisa makanan dinilai menggunakan kaedah satu-faktor-pada-satu-saat (OFAT). Kajian ini fokus pada pengoptimuman pH untuk menghasilkan penjanaan tenaga yang lebih baik. Untuk menentukan elektrik yang dihasilkan, keluk polarisasi digunakan untuk menilai prestasi MFC. Permintaan oksigen kimia (COD) sisa makanan juga dipelajari. Pengoptimuman keadaan pH di MFC di bawah pH antara 5 hingga 9. Hasil kajian menunjukkan bahawa pH 8 adalah pH yang paling sesuai untuk strain *Bacillus* yang dipilih untuk eksperimen ini. Dengan voltan yang dihasilkan 807 mV, biojisim tertinggi 35.46 mg / L, dan ketumpatan kuasa menghasilkan 373.3 mW / m_2. Kesimpulannya, keadaan persekitaran pH di MFC akan mempengaruhi kecekapan pengeluaran tenaga. Peningkatan dalam EB juga meningkatkan voltan dalam ML-MFC, membuktikan bahawa jumlah EB dan voltan EB dikaitkan dengan pertumbuhan EB.

Abstract

Fossil fuels have supported the industrialization and economic growth of countries during the past centuries and it is clear that they cannot indefinitely sustain in a longer time. In this study, Microbial Fuel cell (MFC) had potential solution to generate electricity power and at the same time could reduce the abundant of food waste (1.64 kg/daily, around 8 tonnes/year) which dumped in the landfill. The MFC operated electrochemically incorporate electrogenic bacteria (EB) acted as a biocatalyst in order to produce electricity. The performance of the MFC using food waste is evaluated using one-factor-at-a-time (OFAT) method. the optimization performance of the MFC using food waste was evaluated using method of one factor at one time (OFAT) and it was focused to pH for power generation. To determine the generated electricity the polarization curve was used to evaluate the performance of MFC. The chemical oxygen demand (COD) of food waste is studied. Optimization of pH condition in MFC under certain pH ranging from 5 to 9, with other condition. Results shows that pH 8 is the most suitable pH for *Bacillus* strain that was chosen for this experiment. With voltage generated resulted 807 mV, highest biomass produced 35.46 mg/L, and power density produced 373.3 mW/m2. In conclusion, pH environment condition in MFC will affect the efficiency of performance for energy production. The increase in EB biomass also increased the voltage in the ML-MFC, proving that EB biomass and voltage were associated with growth.