

UNIVERSITI TEKNOLOGI MARA

**BIOELECTRICITY GENERATION
THROUGH PALM OIL MILL
EFFLUENT TREATMENT USING
MIXED CULTURE
EXOECTROGENS IN
MICROBIAL FUEL CELL (MFC)**

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PhD

May 2020

AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree of qualification.

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ABSTRACT

MFC technologies represent the newest approach for generating electricity (bio-electricity generation) from biomass using bacteria. Bio-electricity generations by MFCs have gained considerable attention due to its integration with wastewater treatment. This study consist of 4 main stages which are bacteria isolation, bacteria identification, optimization of MFC and optimized MFC electrochemical operation. In bacteria isolation stage, MFC device were used to obtain exoelectrogens from POME mixture in a form of biofilm. Bath sonication were used to detach bacterial cells (biofilm) from the anode. The isolation process were separated into 3 different pH values that represent pH value ranges in fermentative pathway's phases which is acidogenic (pH 5.5 ± 0.2), acetogenic (pH 6.8 ± 0.2) and methanogenic (pH 8.0 ± 0.2). Bacteria were successfully isolated and acetogenic was the best isolation condition for bacteria to metabolize. In bacteria identification, metagenomics accomplished identified all the exoelectrogens mixed culture from 4 different sources of POME samples. 181 bacteria species were detected. For sample from TSB broth (S1) and BHI broth (S2), the most dominance bacteria species are *Proteus* and *Sporanaerobactor*. TSB MFC (S3) and BHI MFC (S4), the most dominance bacteria species is *Alcaligenes*. In optimization of MFC, the works were separated into two parts. The first part analyze variable of bacteria's broth, pH controller and external resistor, and the second part were temperature, electrode material and fermentation time. In the first part, DOE experimental result shows that the best interaction between these 3 factors is (-+-) interaction which is the interaction between TSB broth, $\text{Ca}(\text{OH})_2$ as pH controller and resistant of 200Ω , with the effect value of 24.56. In second part, (+++) is the best interaction which are the temperature of 37°C , carbon cloth and fermentation's time of 120 hours. Finally, the new MFC configuration were set into a final stage of electrochemical analysis evaluation to examine its improvements after successfully being optimized. The MFC configuration modification is a huge success by comparing it with previous study MFC studies. The power density produced in this study is 311.19 mW/m^2 with the current density of 919.73 mA/m^2 . The new MFC configuration managed to treat the POME wastewater up to 82.42 %.

ACKNOWLEDGEMENT

In the name of **Allah s.w.t, The Most Gracious and The Most Merciful**. Alhamdulillah, all praise to Allah, because of Him always giving me strength and patience to complete my work. Also, thank you Allah for all His guidances, prosperity, opportunity, and forgiveness become my motivation to move on, by seeking His only one straight and true path of eternal happiness.

May Allah give His blessings to my UiTM supervisor, **Dr. Oskar Hasdinor Hassan**, and my MPOB supervisor, **Dr. Andrew Yap Kian Chung**, because of their willing to accept me as their post-graduate student and giving me words of advices, careness and welfare until the end of this work. May Allah pleases with my UiTM co-supervisor, **Dr. Sharifah Aminah Syed Mohamad**, and my MPOB co-supervisor, **Dr. Hj. Zulkifli Abdul Rahman** because of their thoughts, ideas and opinions to give some directions in this work.

May Allah give His blessings towards my mother, **Ummi** and my father, **Abah** for all their supports and understandings. They are my motivation to go to the university and keep studying until completion. Also pray wellness to my brothers and younger sisters **Balong, Mahfudz, Intan, Jannah** and **Kauthar** who always cheer me up as their brother, hoping that their brother success in his study.

May Allah bless iMADE lab, the sacred place of research works, the managers, **Dr. Muhd Zu Azhan Yahya** and **Assoc. Prof. Dr. Ab Malik Marwan Ali** to accept me as one of the lab's student. Pray of all goodness and best wishes to my senior and teacher, **Sir Hak**, as he became my teacher, introduce me about this work and give some guidance to do this work. Endless thanks to all labmates, **Atikah, Syafiqah, Dr. Fariz, Kak Masni, Dr. Kamil, Kak Shereen, Dr. Ijat, Kak Amy, Kak Maziid, Kak Diana Hashim, Kak Diana Ramli, Kak Zulaikha, Kak Aniza, Kak Mashitah, Kak Linda, Dr Nazli, Dr. Hafiz, Dr. Hazrie, Dr. Wafi, Dr. Fairuz, Syazwan**, and all seniors and newcomers. Thank you to make this work more exciting. May Allah bless you all and pay your all good deeds.

Special salutation and respect to my iMADE labmates and college mates from California State Polytechnic University Pomona, USA. They are **Dr. Aidil, Ika and Dr. Haikal**. Not to forget my off campus friends **Fazrin, Zac, Hani, Bal, Kecik, Liyana, Ainil, Yana, Abid, Hanis, Cellen, Checan, Esan and Farvin**. A special thanks to my beloved wife, **Nadiatul Asma'a**, who never stop cheering and providing an endless moral support. May Allah bless you. I will always cherish the laughs and tears we shared together. My cheeky and most wonderful daughter **Nisa' Zakeerah AlKhair** who has my endless and non-conditional love.

Thank you to **UiTM Shah Alam, Malaysian Palm Oil Board (MPOB), FELCRA, Ministry of Science, Technology and Innovation (MOSTI) and Ministry of Higher Education (MOHE)** for supporting me in doing my study.

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