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# Dynamic Modeling of Hydrogen Production from Photo-Fermentation in Microbial Electrolysis Cell using Sago Waste

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**Abstract.** Hydrogen has a great potential as an alternative energy and produces zero emissions, but most of hydrogen is produced from non-renewable fossil fuels via reforming. Thus, biomass is a promising replacement to fossil fuels where hydrogen can be sourced from. In this project, sago waste is chosen as raw material in a microbial electrolysis cell (MEC) to produce hydrogen fuel. A mathematical model with the integration of MEC with photo-fermentation has been developed and modified by using sago effluent as a substrate in a batch process. The main parameter such as concentration of microbial community has been observed in this project as it gives a huge influence on the gas product of MEC. In conclusion, the develop model was to observe the behavior of the microbial electrolysis cell where a maximum of 3.8 L/day ( $t = 4$  days) of hydrogen production and 0.38A of MEC current were obtained.

## 1. Introduction

With rapid urbanization and industrialization, energy has become increasingly essential to human lives. For instance, energy is needed for various applications such as the manufacturing industry, electrical generation, and fuel for transportations. However, the major source of energy comes from non-renewable fossil fuels. As the world population continues to grow, the demand for energy is also expected to rise. This poses a challenge to the world as the number of fossil fuels available will begin to diminish and be bound to run out in the future. Furthermore, fossil fuels also bring negative impacts to the environment, releasing pollutants like nitrogen oxide (NO<sub>x</sub>), sulfur oxide (SO<sub>x</sub>), and volatile organic compounds (VOCs) which contribute to decrease air quality as well as global warming [1]. In recent years, renewable energy resources are gaining momentum in its development and have become popular because they are inexhaustible and clean. Nonetheless, there are still years to come before the world can depend on renewable energy entirely because renewable energy has not been utilized to their full potential and other limitations.

The development of renewable energy must be intensified to reduce the world's reliance on fossil fuels and eventually eliminate the usage of fossil fuels. A viable alternative to fossil fuels is hydrogen because it is widely available in nature, renewable and pollution-free. Unlike fossil fuels, hydrogen is environmentally friendly where it produces zero emissions. The only by-products from the combustion of hydrogen are steam and heat. The utilization of hydrogen as a fuel is imperative towards the goal of

