UNIVERSITI TEKNOLOGI MARA

DESIGN AND FABRICATION OF SOLAR POWERED ALKALINE ELECTROLYSER

AHMAD ZAID BIN ZULKIFLI

DIPLOMA

Feb 2025

ABSTRACT

The production of hydrogen through electrolysis is a key component in the transition to sustainable energy sources. Current industrial hydrogen production methods rely heavily on fossil fuels, contributing to environmental degradation. This project focuses on designing and fabricating a smart solar-powered alkaline electrolyser to produce hydrogen using renewable solar energy. The primary objective is to create an efficient, cost-effective, and environmentally friendly system to address the increasing demand for clean hydrogen production. The project involves the design of the electrolyser using SolidWorks 2021, focusing on optimizing the arrangement and materials of the electrodes to enhance efficiency. Stainless steel electrodes with a surface area of 15 cm^2 each are used, spaced 14 cm apart within a 10-plate configuration. The system is powered by a 12V power supply, regulated through a solar panel with 19% efficiency and 30W output. The fabrication process includes lathe operations for cylindrical components, precise drilling for component alignment, and soldering for secure electrical connections. Safety measures are integrated into the design to mitigate risks associated with high electrical currents. The prototype successfully demonstrated the feasibility of integrating solar power with alkaline electrolysis for hydrogen production. The system operated effectively within the set parameters, utilizing solar energy to drive the electrolysis process. The hydrogen production rate was found to be efficient, with the system maintaining operational stability and safety throughout the testing phase. The use of renewable energy significantly reduced the operational costs and environmental impact compared to conventional hydrogen production methods. The results indicate that the smart solar-powered alkaline electrolyser is a viable solution for sustainable hydrogen production. The integration of solar energy not only makes the process greener but also reduces dependence on fossil fuels. However, further optimization is needed to enhance the overall efficiency and scalability of the system for industrial applications. Future work will focus on improving the design and exploring advanced materials for electrodes to increase the durability and performance of the electrolyser. The project underscores the potential of renewable energy in transforming hydrogen production, contributing to global efforts in reducing carbon emissions and fostering sustainable development.

ACKNOWLEDGEMENT

Above all, I want to express my sincere gratitude to God for giving me the courage, endurance, and resolve to start and finish this diploma journey. I feel incredibly fortunate to have had the chance to see this project through to completion, as it is the result of a great deal of effort and persistence.

I want to express my sincere gratitude to Dr. Abdul Hadi, my supervisor, for all of her help and advice during this project. Her knowledge, tolerance, and wise counsel were essential to my development, and her helpful criticism gave me a clearer sense of direction and purpose when I faced obstacles. Her steadfast dedication to helping me at every stage of this project has been a continual source of support. In addition to giving me technical knowledge, Dr. Abdul Hadi's mentoring helped me develop a greater respect for engineering. Despite her own hectic schedule, I truly appreciate the time and effort she put into my work.

My family has been my support during this journey, and for that I am incredibly grateful. Their unwavering support, understanding, and faith in my potential have inspired me to keep going when things get tough. They have been there for me at every turn, helping me remain rooted and goal-focused by giving me both practical advice and moral support. I sincerely appreciate all of their sacrifices, no matter how small, and without their unwavering love and support, I could not have made it this far.

Finally, I want to express my gratitude to my friends for supporting me along the way and lending me a sympathetic ear and hands when I needed it. Their encouragement kept me upbeat, which made the difficult times easier to handle and more significant.

I want to express my sincere gratitude to everyone who helped with this project, whether it was by offering advice, supporting me, or just having faith in me. Without all of you, this achievement would not have been possible, and I sincerely appreciate all the help I have gotten along the way.

TABLE OF CONTENTS

CHAPTER ONE
INTRODUCTION

1.1 Background of Study

At present, nearly 95% of industrial hydrogen is still produced from hydrocarbons, such as fossil fuels and biomass, which are neither clean nor renewable[1]. A fuel is a chemical substance that can be "burned" to produce useful energy. This burning process typically involves breaking the chemical bonds within the fuel and allowing the elements to react with oxygen, usually from the air. The primary component of natural gas from oil and gas fields is methane. Natural gas remains in use due to its availability, cost-effectiveness, and its status as a cleaner alternative to coal, which historically has been the dirtiest fossil fuel used for heating and electricity generation.[2]

Between 1980 and 2017, Malaysia's daily average was 43.26 thousand barrels, with minimum values of 3.25 thousand barrels in 1980 and maximum values of 104 thousand barrels in 2017. The most recent figure is 76.43 thousand barrels per day from 2021[3]. This situation worries us, as we rely on fossil fuel that will run out. We need to start using renewable energy as it can improve energy efficiency and implementing carbon capture and storage technologies can help reduce emissions from existing fossil fuel sources.

Water electrolysis is a simple procedure that uses a lot of resources and produces hydrogen without causing pollution when using renewable energy sources. Electrolysis is considered to be the cleanest way to generate hydrogen[4]. The use of alkaline electrolyser is now growing since it is cheaper and easier to obtain. By using renewable energy, solar power that can track the light, it will be more efficient.

By combining alkaline electrolyser and solar power, it can create an interesting system for renewable hydrogen production. A solar power is an apparatus that receive sunlight to optimize their daily usage, is the lowest cost option[5]. The use of solar energy is sustainable method and green process for alkaline electrolysis[6].