SOCIETY OF PHYSICS STUDENTS
An organization of the American Institute of Physics

SPS Chapter Research Award Proposal

Project Proposal Title	The Minute Differences in Production
Name of School	Missouri Southern State University
SPS Chapter Number	4398
Total Amount Requested	$2,000

Abstract

Missouri Southern State University will conduct research over the production of hydrogen using electrolysis. The research will be done in two phases; to conduct extensive research over previous experiments and to reproduce the most efficient results experimentally. We hope to others to take up an interest in hydrogen technologies.

Proposal Statement

Overview of Proposed Project

The project will be divided into two parts, part one includes preliminary research regarding the current methods of efficient hydrogen production. The final paper will be attached to the final report. The second phase will be to conduct our own experiment to identify the most efficient, cost effective, and scalable electrolysis process.
The project will inform the student body that there is a viable way to produce hydrogen in a 'green' way by using renewable energy as the source of electricity contrary to burning natural gas. Once constructed the project will let us control a magnetic field as well as the concentration of catalyst in the water solution to produce hydrogen efficiently. We will use fixed volume capture devices and use the time it takes to fill the device to show the efficiency of production.
This research project will promote interest in physics for all club members involved as well as the general student body. As other science-based majors have shared interests in the basic tenets of this project, members of the student body outside of the physics club have been included in implementation. This interdisciplinary appeal will demonstrate how physics serves as a fundamental tool in the development of greener industry production. All students interested in environmental health and chemical industry production could be reached and included in this project. Our success could spark interest in the application of physics in all those groups and generate new passionate members in SPS. Our results would be displayed in the hallways of our science building. Hopefully, with the success of our phase two experiments we will be able to apply for publication in the JURP which will further spark interest nationally.

Background for Proposed Project

Hydrogen production currently is mostly produced by the consumption of natural gas; "using a reaction with either steam (steam reforming), oxygen (partial oxidation), or both in sequence (autothermal reforming)." ("The Hydrogen Economy. Opportunities, Costs, Barriers, and R&D Needs") Electrolysis has always been an alternative to this. The issue with electrolysis lies in the energy barrier in place to split the very stable water molecule into usable hydrogen gas. The recombination process is still viable as there are now vehicles that are propelled by hydrogen fuel cells. These cars require small battery storage as most energy needed to propel the car is produced in the hydrogen fuel cell.

The research project is important as the production and storage of hydrogen will allow for an increase in our potential energy in our ever-expanding electrical grid. With the financial incentive from the federal government for individual citizens to go green there will be a tremendous amount of pressure on the existing electrical infrastructure that could lead to black outs, especially with a transition to renewable, non-uniform sources of energy. Currently renewable energy contributes to twelve percent of the energy consumption in the US. ("U.S. Energy Facts Explained") Many enemies of renewables cite the fact that peak production of electricity from these sources do not coincide with the demand for electricity. With our current battery capacity, and the detrimental effects of used batteries on the environment it would be counterintuitive to use batteries to store such vast amounts of energy. Our research will be beneficial to

the existing infrastructure as it will look at the efficiencies of an inexpensive catalyst with minimal environmental alterations.

Expected Results

The results expected are to quantify an efficiency based on the energy used and the amount of time it takes to produce a set amount of hydrogen by refining the catalyst added to the water solution as well as the temperature of the solution and the presence and orientation of the magnetic field.

Description of Proposed Research - Methods, Design, and Procedures

The researchers plan to procure the necessary materials, including the electrolyte, the nickel electrodes, and the tank for the water solution. The construction of the water containment chamber will be next. The chamber will be capable of handling a range of temperatures and magnetic orientations. Once the water containment chamber is built the project will be conducted with the supervision of our club advisors. The procedure will be to conduct electrolysis with no magnetic field and water at room temperature with no catalyst (sulfuric acid or potassium hydroxide). Once an adequate control is verified with repeated trials the first variable that will be altered is the concentration of the catalyst. We will conduct trials with an increased amount of catalyst until we have found the solution that makes the specified amount of hydrogen in the least amount of time. The time will be calculated through a program that uses a voltmeter as an on/off switch. The voltmeter will be places so that the nodes are in the aqueous solution until the desired amount of hydrogen is produced. Once the electrodes are in the gaseous environment they will not read a voltage triggering the program to stop the timer and turn off the electrical source. This will be done for both catalysts, potassium hydroxide and sulfuric acid. Once we have found the ideal catalyst and concentration we will implement water temperature changes, only ranging from room temp (20 C) to 80 C. After finding the ideal temperature w will factor in the magnetic field of varying strengths and orientations. Once testing is complete it will be reviewed by the advisors to guarantee proper protocol. Results will be made into a poster that will be displayed in the science department.

Plan for Carrying Out Proposed Project

Personnel – The research will be conducted and coordinated by Joshua Numata with assistance from Paige Lewis. Assistance in the construction of the project will be provided by our officers including Rebekah Sweyko, Ashley Stokes, and Madison Nagel, and our club members. Oversight of the project will be provided by Dr. Jency Sundararajan and Dr. Shayna Burchett.
Research Space – The experiment will be conducted in Reynolds Hall, the science building at Missouri Southern State University
The chemistry and physics departments will graciously be donating lab space for the storage and production of the experiment.

Project Timeline

December 3 Have all parts ordered for the construction of the project.
February 28 Have the project constructed
March 1 Begin testing the efficiency of electrolysis. Testing will be conducted with supervision by one of the advisors. Expected to be able to complete and record testing results twice a week.
April 1Complete the last of the testing to conclude the max efficiency in the given parameters.
May 15 Have calculations completed to represent efficiencies in a numerical method.
May 31 submit interim report for project.
June - July 2022 have the report reviewed by advisors to highlight flaws in procedure.
August 2022 Reconvene and address issues found by advisors.
September-October 2022 work on final report, produce a poster with our results.
November 2022 Submit final report.

Budget Justification

We will be using the full two-thousand-dollar award to fund the purchases of new equipment including the construction materials for the container, the electromagnets, the voltmeter, and the catalysts.

Bibliography

The Hydrogen Economy. Opportunities, Costs, Barriers, and R&D Needs. [Electronic Resource] : National Academies Press, 2004. *EBSCOhost*, search.ebscohost.com/login.aspx?direct=true&db=cat08449a&AN=mssu.b4408855&site=eds-live.