# DEVELOPMENT HYDROGEN GAS GENERATOR FOR DUAL FUEL ENGINE USING YULL BROWN METHOD

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# SUPERVISOR'S DECLARATION

I hereby declare that I have checked this project report and in my opinion this project is satisfactory in terms of scope and quality for the award of Diploma in Mechanical Engineering.

Signature	:
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# STUDENT' DELARATION

I hereby declare that the work in this report is my own expect for quotations and summaries which have been duly acknowledged. The report has not been accepted for any degree and is not concurrently submitted for award of other degree.

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#### ABSTRACK

This final year project is about fuel-saving device on gasoline that design to help the user on how to save the gasoline for car using hydrogen as a additional fuel to saving the uses of gasoline fuel which cannot be recycle and pollute the atmosphere. The objective of this project to design and experiment fuel-saving device. The device is a suitable for gasoline car. Electrolysis process is used to get the hydrogen channeled to the intake manifold. The hydrogen gas is device for the combustion in the engine of the car. It also as the device to help users in reducing uses of fuel for the car. The electrolysis process using battery water as the electrolyte. Finally, distance electrode rod (mm) versus fuel combustion (l/h) data record to be analyses.

#### ABSTRAK

Projek tahun akhir ini membentangkan mengenai alat penjimatan minyak yang direka cipta untuk menjimatkan minyak kereta berasaskan hidrogen sebagai sumber tambahan bahan api bagi mengurangkan penggunaan minyak petrol pada masa kini yang mana tidak boleh dikitar semula dan tidak mesra alam. Objektif projek ini adalah merekacipta dan menjalankan eksperimen mengenai alat penjimatan petrol. Alat yang di hasilkan sesuai digunakan pada kereta yang menggunakan petrol sebagai bahan api. Proses elektrolisis digunakan bagi mendapatkan hidrogen untuk disalurkan ke manifold kereta. Hidrogen adalah gas yang menjadi bahan bakar di dalam enjin. Ia juga untuk membantu penjimatan minyak ketika pembakaran enjin sedang berlaku. Air bateri digunakan untuk tujuan elektrolisis tersebut. Akhirnya, data jarak batang elektrod (mm) dengan penggunaan bahan api (l/h) di ambil bagi menganalisis kadar kebolehjimatan.

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# LIST OF SYMBOLS

MPa	Megapascals
Ø	Diameter
mm	Millimeter
ml	Milliliter

# LIST OF ABBREVIATION

HHO	Water		
Al	Aluminium		
NAHCO3	Sodium		

Bicarbonate

#### CHAPTER1

#### **INTRODUCTION**

#### **1.1 PROJECT SYNOPSIS**

Final year project is one subjects of this semester. This subject carries four hour credits. In this subject, a project needs to fulfill by the student. The current project is to fabricate, design and experimented Development hydrogen gas generator for dual fuel engine using Yull Brown method. Final year project are guided by the instructor, one student is required to accomplishing this project. The student must have hardworking and high discipline attitude. He/she must also willingly to learn and self-motivated. This project involves electrolysis experimented to produce hydrogen. This experiment testing were performed in engine performance laboratory to investigate the efficiency of the product.

#### **1.2 PROBLEM STATEMENT**

Today, the price of the petrol is increases. They have to buy the 1(one) liter petrol for RM1.90. It becomes problem for those who want to have a long journey. Due to this there is a heavy demand for the fuels, which is the basic for the many industry, factories and automobile. If this problem continues, consequently it will raised up their spending or budget for the fuel for the example budget for a fuel for this week.

#### **1.3 PROJECT OBJECTIVE**

The objective of this project are:

- To design and fabricate the fuel saving with electrolysis system by using the aluminium rod electrode base.
- To minimize the fuel usage by supplying the hydrogen gas produce.
- To investigate that the usage of the device can be decrease the usage of gasoline fuel or not.

#### 1.4 PROJECT SCOPE

The main scope of the project is to design and fabricate the fuel saving systemized with the electrolysis system by using aluminium rod electrode base on gasoline fuel car. The purpose of the project is to minimize the fuel usage by supplying the hydrogen gas produce by the aluminium rod which is done through the electrolysis process. Then channeled into the intake manifold to be used for combustion engine.

#### **1.5 PROJECT PLANNING**

According to Gantt chart from Table 1 (appendix 1), the project briefing started followed by the collecting literature review. These include a research project title and gathering some raw data from internet, book, and other source. The planning process is process is from week 1 until week 3.

After that this project was continued with identify scope, objective and problem statement from week 3 until week 4. Then, stared for sketching 4 type of fuel saving device concept and then indentifies the best concept based on concept generation and evaluation. Next, design the fuel saving device that was choosen using solid work software with actual dimension.

The fabrication process was started at week 9 after the pre presentation. This week also report writing started. The manufacturing process determined from the literature review. Evaluation stage has been implementing after the fabrication stage. The experiments were performed at engine laboratory to investigate the efficiency the product.

The final stage is writing the final report and prepare for the final presentation. The report writing guided by University Malaysia Pahang Thesis Writing guide and project supervisor. The entire task scheduled to take about fourteen weeks to overall.

## **1.6 CONTENTS**

- 1.6.1 CHAPTER 1- Introduction
- 1.6.2 CHAPTER 2- Literature Review
- 1.6.3 CHAPTER 3- Methodology
- **1.6.4** CHAPTER 4- Result and Discussion
- 1.6.5 CHAPTER 5- Conclusion and Recommendation

## **CHAPTER2**

#### LITERATURE REVIEW

#### 2.1 INTRODUCTION

There are many forms of fuel-saving device that area available in the market. Fuel-saving device on gasoline fuel car is a device that designed to minimize that use of gasoline fuel car. Nowadays, price for the fuel car is increased and the user need to pay the expensive fuel for a few liter. One liter of gasoline is RM1.90. It is a bit for user. From this problem, the device is designed to help the user and to manage this problem. Fuel saving device is a circuit that is produce hydrogen gas by using the battery water. The circuit is build to show by using electrolysis, the hydrogen gas can be produce and supplied into the manifold car.

## 2.2 WHAT YULL BROWN'S METHOD

Yull Brown developed a way to electrolyze water into HHO gas in an exact stoichiometric mix that allowed the substance to be used for welding. Ten years before Brown made his discoveries in Australia, William A. Rhodes, an American filed for international patents for a similar method of creating HHO gas (or oxyhydrogen or hydroxy as it is sometimes called) that would also be used in the welding industry.

But unlike Rhodes, Brown was a heavy promoter of what he called "Brown's Gas" and in honor of his work, many people still use this name today. Brown found that by electrolyzing water (H2O) into an exact mix of hydrogen and oxygen that HHO gas would be formed, which was highly flammable, but not combustible, when used properly.

Brown travelled around Australia, then the United States with what is called a traveling road show, promoting his device and gaining investors. Some of the controversy surrounding Yull Brown and Brown's gas comes from both his invention and his pedigree.

Those who have researched Brown take issue with his claims to have been an electrical engineer while in Bulgaria, saying he was rather at the more lowly position of electrician. Also, at issue was his claim to be a professor, saying that Brown and another gentleman started a paper university so that Brown could claim to have been a professor.

Also, at issue is whether or not Brown's gas worked as advertised in the welding industry. Many welding professionals initially could not get his invention to work properly. Over time, however, others such as William A. Rhodes and Denny Klein have been able to develop into commercial successes "water torches" that use oxyhydrogen.

Yull Brown has made several demonstration with Brown's gas welding torches were he will apply the flame and show the application for which it can be used. Brown was even known to burn his own skin to demonstrate that the flame was indeed real.

But, whether or not Yull Brown lived up to his own hype is not important. What is important is that he pioneered and advocated for HHO gas, which is not only being used in the welding industry, but also in the automotive industry.

In the past couple of years, garage inventors have been using Brown's gas as supplementary fuel in cars to increase gas mileage and reduce emissions. By carrying a small amount of water onboard, a vehicle can electrolyze H2O into Brown's gas, which is then fed into the intake system of the vehicle where it helps the fuel burn more cleanly and completely. The U. S. Department of Transportation recognizes Brown's gas (although they call it 'hydrogen injection') as a viable method to increase MPG's and lower tailpipe emissions.

The full impact of Yull Brown's life and contributions to this emerging industry is still yet to be understood. Some call Yull Brown a charlatan and others call him a visionary and pioneer.

Those who are using oxyhydrogen torches or HHO generators in their cars are the one's most thankful for Yull Brown the inventor.

## 2.3 WATER AS COMBUSTION FUEL

To understand how these water-fuel system work, it help to begin by realizing that ordinary water is actually a 'battery' containing vast amount of energy. Water is H2O- two part of hydrogen combined with one part oxygen. Every cubic foot of water contains about 1376cubic feet of hydrogen gas and 680 cubic feet of oxygen. The amount of energy in the water molecule is thus vast, and has absolutely nothing to do with the amount of energy it takes to break down that molecule.

## 2.4 INSTANT HYDROGEN GAS

The first process use water, sodium carbonate and an aluminium rod. The gas that result from this process is pure hydrogen, a fuel that without the need for external oxygen and gives of no pollution whatsoever. It is an aluminium to break down the water molecules that is of interest to us here. The sodium carbonate acts as the electrolyte here. When a piece of aluminium is dropped into al electrolyte mixture, hydrogen instantaneously begin to form at the amazing rate. Hydrogen gas produced here travels straight to the intake manifold. The combustion of hydrogen result is the rebonding of previously separated hydrogen and oxygen molecules, making the engine exhaust water vapor steam and nothing else meaning that no pollution at all.

#### 2.5 WHY USE HYDROGEN?

Hydrogen gas is a near perfect energy carrier and highly flammable. It will burn at concentrations as low as 4% of H<sub>2</sub> in air and when mixed with oxygen it will explode upon ignition. Hydrogen burn so efficiently when combined with oxygen that flame is almost invisible to the naked eye (flame in pale blue).

- H<sub>2</sub> used as rotor coolant a power station and large electrical generators because it has the highest thermal conductivity of any gas.
- Hydrogen has the highest combustion energy release per unit of weight of any other common occurring material and is used in rocked fuel because of this property.
- H<sub>2</sub> is used for oxy-welding (the cutting and melting of metals).
- It is totally non-polluting (small trace of water vapor is the exhaust).
- At later stage and even through some industries today is economically competitive with petroleum, Liquefied Petroleum Gas or diesel.
- Hydrogen is lightest element.
- About 75% of the universe's matter contains hydrogen.
- H<sub>2</sub> is non toxic at atmospheric pressure and temperatures.

#### 2.6 ELECTROLYSIS

This is another method converting water to fuel. It is called Electrolysis. This method breaks water down into Brown's gas that is also perfect fuel for gasoline engines. Brown's gas is a better fuel than hydrogen gas: the environment is experiencing tremendous problem at the moment, and one of the most serious of these is that we are losing our oxygen. The oxygen content of the air is becoming low that it threatens our very existence in some areas. The normal oxygen content of air is 21% by volume. But in some places it is only a very small fraction of that. If it reaches 5% people will begin to die. Eventually if something is not done this low oxygen situation will effect each and every one of us. Browns gas created through an electrolytic process. Actually may contribute oxygen to the air supply, rather than leaving it the same (as with fuel and pure hydrogen) or consuming it with fossil duels. It is for this reason that we feel it will be the future technology of choice for running our vehicles.

## 2.7 REVIEWS ON SELECTED MATERIAL

#### 2.7.1 Aluminium Rod

Aluminum is a chemical element in the periodic table that has the symbol Al an atomic number 13. It is a member of the chemical element called metals weak and has a silvery and ductile characteristics. Aluminium is found primarily in the ore bauxite and is known for oxidation resistance (by reason of the phenomenonpempasifan) and since keringanannya. Aluminium is used in many industries to produce various products and is a very important plant in the world economy. Structural components made of aluminium and alloy-alloy is important is the aerospace as well as in vehicles and building, where lightness, durability, and strength are needed.

Aluminium is a soft and lightweight metal with dull silvery appearance, due to presence of a layer of oxidation that forms thin when exposed the air. Aluminium is non toxic (in the form metal), non-magnetic, and do not produce switch. Pure aluminium has a tensile strength of 49 megapascals (MPa) and 700MPa when formed into an alloy. Aluminium has a density one third of the density of steel or copper: resistance due to the protective coating oxidants. Aluminium mirror finish has the highest kepantulan of all the metals in the 200-400nm region (ultaungu) and the 3000-10000 nm (far infrared), while in the 400-700nm range of vision is a little overcome by the silver, and in the range 700-3000 (near infrared) resolved by silver gold and copper. It is the second most malleable metal (after gold) and the sixth most ductile.

## 2.7.2 Plastic

A **plastic** material is any of a wide range of synthetic or semi-synthetic organic solids used in the manufacture of industrial products. Plastics are typically polymers of high molecular mass, and may contain other substances to improve performance and/or reduce costs. Monomers of plastic are either natural or synthetic organic compounds.

The word plastic is derived from the Greek (plastikos) meaning capable of being shaped or molded. It refers to their malleability, or plasticity during manufacture, that allows them to be cast, pressed, or extruded into a variety of shapes—such as films, fibers, plates, tubes, bottles, boxes, and much more. The physical properties of plastics are transparency, flexibility, elasticity, permeability, water resistant, electrical resistance and specific gravity.

## 2.7.3 Sodium Bicarbonate

Sodium bicarbonate or sodium hydrogen carbonate is the chemical compound with the formula NaHCO3. Sodium bicarbonate is a white solid that is crystalline but often appears as a fine powder. It has a slightly salty, alkaline taste resembling that of washing soda (sodium carbonate).

Since it has long been known and is widely used, the salt has many related names such as baking soda, bread soda, cooking soda, bicarbonate of soda. Colloquially, its name is shortened to sodium bicarb, bicarb soda, or simply bicarb.

## **CHAPTER 3**

#### METHODOLOGY

## 3.1 INTRODUCTION

This chapter includes about all the process to fabricate the fuel saving device from the beginning to the end of the project. There are three dimensional drawing using Solid Work and fabrication process.

#### 3.2 OVERALL RESEACH METHODOLOGY

Overall this project is following the flow chart from take the title from the supervisor, then the second task from taking the title is finding the related literature review for the project given. Then, sketch some design of the fuel saving device to be choose the best design using concept screening method. After that, draw the final design selected using Solid Work. After the fabrication is finish, device is test to the motorcycle engine to get best result. Finally, report documentation is writing do describe all the process since the beginning to the end of the project. Figure 3.1 shows the flow chart of the PTA project.

## Figure 3.1: flow chart



## 3.3 DESIGN

The design of the device must be compliance to several aspects. The design consideration must be done carefully so to the design can be fabricated and functioned well. The aspect that must to be considered in designing the device are:

- **3.3.1 Ergonomic factors :** The fuel saving device must be user friendly as easy to use and convenience.
- **3.3.2** Safety : The fuel saving device must the characteristic of electrical insulator since it is generated by the electricity source.

## 3.4 DRAWING

The drawing divide two categories which are:

- **3.4.1** Sketching: All the ideas for the device's fabrication are sketched first so that the idea selection can be made.
- **3.4.2** Solid modeling: the selected design or concept sketch are transfer to solid modeling by Solidwork software.

## 3.5 DESIGN SELECTION

From the exist ideas, only three sketch that had been chosen to be consideration as the final ideas which are:

# 3.5.1 FIRST CONCEPT



Figure 3.2: Concept A

## MATERIAL USED

- Plastic container 200mm x 150mm size.
- copper rod 140mm x ø10mm size.

## ADVANTAGES

- Easy to build.
- Gas production is high.
- portable

# DISVANTAGES

• No safety measure applied since the water can be direct being sucked into the engine.

## 3.5.2 SECOND CONCEPT



Figure 3.3: Concept B

## MATERIAL USED

- Plastic container 170mm x 150mm
- Aluminium rod 150mm x ø10mm

# ADVANTAGES

- Easy to use
- Simple design
- Portable
- More gas can produce

## DISVANTAGES

• Need more space to install

# 3.5.3 THIRD CONCEPT



Figure 3.4: Concept C

# MATERIAL USED

- Beaker 100mm x 60mm
- Aluminium rod 45mm x ø12mm

# ADVANTAGES

- Easy to use.
- Easy to build.
- Portable.

## DISVANTAGES

- Gas production is low due the size.
- No safety measure applied to protect the engine.

## 3.5.4 CONCEPT GENERATION AND EVALUATION

Three design for the fuel saving device were are develop then evaluated against the datum of the device using Pugh concept. Concept comparable is shown in **table 3.1** 

CRITERIA	CONCEPT		
	А	В	C
Easy to manufacture	+	+	+
Easy to use	+	+	+
Portability	+	+	+
Function	0	0	0
Safety	-	+	-
Efficiency	+	+	-
$\Sigma^+$	4	5	3
$\Sigma 0$	1	1	1
Σ-	1	0	2
Net score	3	5	1
Ranking	2	1	3

 Table 3.1 : Pugh's Selection Method

"0": same as "-" : worse than "+" : better than

Concept B was chosen because it is simple design. It is because the device is easy to build, easy to used, more than gas hydrogen can produce and portable.

#### 3.5.5 FINALIZE DESIGN



Figure 3.5: Final design

## 3.6 FABRICATION PROCESS

This process is about to fabricate the device using the material selected and make it based on the design by following the dimension stated. Many method can be used to fabricate the product like aluminium rod, plastic container and also many other method fabrication process is difference to the manufacturing process. Fabrication involves in making product only while manufacturing involves producing the product in a large batch.

## 3.7 PROCESS INVOLVES

In order to make the design comes to reality, fabrication process need to be done first. The fabricated process starts from dimensioning the material until it finish as desired product the process that involved in this project are:

3.7.1 Measuring: Material measure to desired a dimension as shown figure 3.6



Figure 3.6 : Measuring process

**3.7.2** Marking: all measured materials needed to be marked in order to give an accurate dimension as shown figure 3.7



Figure 3.7: Marking process



3.7.3 Sawing: Aluminium rod be deducted by using hacksaw as shown figure 3.8

Figure 3.8 : Sawing process



3.7.4 File: after sawing, aluminium rod filing with the file as shown figure 3.9

Figure 3.9 : File process



3.7.5 Joining: All material were measured combined together as shown figure 3.10

Figure 3.10 : Joining process

## CHAPTER4

## **RESULT AND DISCUSSION**

## 4.1 INTRODUCTION

The purpose of this chapter is to discuss the result after fabrication and experiment of the product. This chapter will also discuss about some the problem of the product and how to improve it.

## 4.2 FINAL PRODUCT

The final product is several view are shown in the figure below.



Figure 4.1: Design 2



Figure 4.2: Design 3

# 4.3 COMPLATE DEVICE AND CIRCUIT



Figure 4.3 : Diagram Device and Circuit

Figure 4.3 shows how to the installation of hydrogen gas at the vehicle. The steps are as follows:

- The water used for electrolysis is water battery (not ACCU ZUUR) or distilled water / Aquades / sea water.
- The chemicals be used to water as a catalyst mixture is: KOH (Potassium Hydroxide) / Ca (OH) 2 / baking soda.
- Pour the water in advance (the power supply / accu already installed) a new entry chemicals (KOH) little by little until there is the process of electrolysis.
- Positive and negative electrodes is near the each other not only affect / related.
- Use 2 bottles / tubes as picture diagram below, the two water filled tubes of distilled water 1 / 3 only (not too full).

## 4.4 EXPERIMENT TESTING





Figure 4.4 : Experiment testing of design 2



Figure 4.5: Experiment testing of design 3

The experiment was carried out using 100 cc motorcycle engine. At the beginning of the experiments are carried out, 325 ml of petrol has been used to find the time taken for the reduction of petrol 325ml. After the first experiments carried out, this experiment continues to use the products 2 and product 3 to bring the hydrogen gas. The experiment was carried out by using electrolysis to produce hydrogen gas.

To generated the hydrogen gas, sodium bicarbonate powder admitted into water battery. hydrogen gas is the gas of fuel in car engines. At the third product, the distance between the two bars of aluminum rods spaced at 40mm position. hydrogen gas can be produced is reduced from the experiments have been carried out on the product 2. After the experiments finish, the results are recorded. Results are shown in table 4.1.

## 4.5 RESULT

DESIGN	DISTANCE (mm)	TIME (min)	FUEL
			COMBUSTION (l/h)
1	0	136	0.143
2	30	170	0.144
3	40	155	0.125

 Table 4.1 : Result after experiment



Figure 4.6: Graph Distance (mm) against Fuel Combustion (l/h)

### 4.6 **DISCUSSION**

Based on the diagram 4.1,the first design was the experiment without using the hydrogen gas, the time taken to 325 ml of petrol is 136 minutes. This experiment carried out with the second and the third designs. When the experiment is carried out, hydrogen gas has been disbursed into the intake manifold. The result showed is the different between the three design. The time taken for the combustion of petrol for the design 2 is 170. Compared with design 1, design 2 could reduce fuel combustion by 25%.

The experiment continues with the third design, gas hydrogen was produced is reduced against the design 2. This is because caused the distance between the aluminium rid with the design 2. The experimental result for the design 3 was 155 minutes.

## **CHAPTER 5**

#### **CONCLUSION AND RECOMMENDATION**

#### 5.1 INTRODUCTION

The purpose of this chapter to give conclusion and recommendation of this project. It will also include the objective of this project whether it is fulfilled or not and gives suggestion to improve the project.

## 5.2 CONCLUSION

In conclusion, the hydrogen gas generated by electrolysis reduces the fuel 25% (refer to diagram 4.6). At the beginning, 325ml of petrol used for the experiment how to know the time taken for the reduction of petrol 325ml.

After the first experiments carried out, the experiment was continued by using electrolysis to generate hydrogen gas. Hydrogen gas was the fuel of the engine. With the channeled hydrogen gas, the time for combustion of the fuel is 177 minutes. The difference between the first experiment and the second experiment can be seen the time periods for reduction of fuel.

This result shows that hydrogen gas, function to be more fuel efficient and save fuel during combustion engine.

# 5.3 **RECOMMENDATION**

There are a few recommendation to improve the hydrogen gas generator for the future use:

- Adopt a small of a plastic container.
- Adopt a more compact aluminium rod

#### REFERENCES

2008 - 2011 Brownsgas.ws. All Rights Reserved (online). http://www.brownsgas.ws/yull-brown.htm

visitors since June 12, 2005 (online).

http://jnaudin.free.fr/wfc/index.htm

Omahe GendHul IreNg (online).

http://my.opera.com/suryagunawan/blog/hemat-bbm-dengan-electrolyzer?startidx=400

A Hydrogen Generator You Can Build November 14, 2010 (online).

http://fuel-efficient-vehicles.org/energy-news/?page\_id=927

California Fuel Cell Partnership3300 Industrial Blvd., Suite 1000, West (online).

http://www.ecoworld.com/energy-fuels/fuel-cells/hydrogen-fuel-cell-cars.html

Running a Gasoline Engine on Hydrogen Using Water by Drunvalo (online).

http://www.spiritofmaat.com/archive/watercar/h20car2.htm

2008 - 2011 Brownsgas.ws. All Rights Reserved (online). http://www.brownsgas.ws/brownsgas-fuelcells-compared.htm

U.S environment protection ageny (online).

http://www.fueleconomy.gov/feg/fuelcell.shtml

# APPENDIX

Weeks Tasks		1	2	3	4	5	6	7	8	9	10	11	12	<sup>13</sup> 3	3 <sup>14</sup>
Brainstorming	Plan														
	Actual														
Identify scope, objective and problem statement	Plan														
	Actual														
Product review	Plan														
	Actual														
Design concept sketching	Plan														
	Actual														
Finalize concept	Plan														
	Actual														
3D modelling	Plan														
	Actual														
Preliminary test	Plan														
	Actual														
Mid presentation	Plan														
	Actual														
Fabrication	Plan														
	Actual														
Testing and Improvement	Plan														
	Actual														
Final report preparation	Plan														
	Actual														
Final presentation preparation	Plan actual														

















