

Development Hydrogen Gas Generator for Dual Fuel Engine Using  
Capacitor Water Fuel Cell Method

NIK AHMAD FAIRUZ BIN NIK ADLAN

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University Malaysia Pahang

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## **ABSTRACT**

This report shows the design and fabrication of the fuel-saving plate-electrode device on gasoline fuel engine. The objective of the report is to develop the procedures to design and fabricate the fuel-saving plate-electrode base device on gasoline fuel engine. Design generation is showed and solid three dimensional structures modeling of the test rig was developed with the solid work software. Material selection and the reason behind the selection are shown based on criteria predetermined. Based on the selection, plastic and steel are selected. This project is difficult to make because it is hard to find the references and information of similar project. As the conclusion, this project has achieved its goal through the successful of the product making.

## **ABSTRAK**

Laporan ini menunjukkan rekaan dan pembuatan alat penjimat minyak menggunakan kepingan besi sebagai elektrod untuk enjin yang menggunakan gasoline sebagai bahan bakar. Objektif laporan ini adalah untuk menghasilkan prosedur-prosedur dalam pembuatan alat penjimat minyak menggunakan kepingan besi sebagai elektrod untuk enjin yang menggunakan gasoline sebagai bahan bakar. Generasi rekaan ditunjukkan dan struktur model tiga dimensi alat penjimat minyak dibangunkan melalui perisian solid work. Pemilihan bahan dan sebab-sebab pemilihan ditunjukkan berdasarkan bahan yang telah dipilih. Plastik dan besi telah dipilih untuk pembangunan projek ini. Penghasilan projek ini sukar kerana rujukan dan maklumat tentang projek ini sukar ditemui dan terhad. Sebagai kesimpulan, misi projek ini telah tercapai melalui penghasilan alat penjimat minyak yang telah dilakukan.

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## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 PROJECT INTRODUCTION**

This project involves in designing and fabricating the fuel saving device. The basic system used to generate the device was the electrolysis. Basically, the working session could be divided into three stages, which were the concept review and development, designing, and fabrication. The device was invented by using the fasteners like plate aluminum and cork (rubber cover) that were used to build the structure of electrode for the electrolysis system. Then, the pair of electrodes were hanged inside of a plastic container that act as the container of the electrolyte for the electrolysis process. Apart from plastic containers, aluminum plate size and plate spacing aluminum important role in the electrolysis. Electrical connection was also required for generating the device in order to run the electrolysis. Lastly, a small plastic container was used in order to accumulate the gas that was produced by the electrolysis process before being flowed into the intake manifold.

## **1.2 PROBLEM STATEMENT**

Nowadays, most people find it is difficult when the fuel for their vehicle runs out before the allocated time. If this problem continues, consequently it will rise up their spending or budget for the fuel for example budget for the fuel for a week. It also can affect to the individual's working quality and efficiency. For example, getting scolded by the boss because of getting late to work caused by the running out of the fuel. Moreover, people stated that in the past, the fuel was hard to runs out within a period of time, although the spending remains the same as present. Meaning that the price is still the same, but the volume is decrease due to the global economy rate.

## **1.3 PROJECT OBJECTIVE**

The objectives of this project are:

- To design and fabricate a fuel saving device systemized with the electrolysis system by using the plate electrode base.
- To investigate the usage of the device whether can decrease the usage of gasoline fuel or not.

## **1.4 PROJECT SCOPE**

The specific scope of this project is to design and fabricate a fuel saving device. Its purpose is to minimize the fuel usage on a vehicle by supplying the hydrogen gas produced by the device which is done through the electrolysis process, then channeled into the intake manifold to be used for the combustion of the engine.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 INTRODUCTION**

There are many forms of fuel saving device that are available in the market. Some are invented in the form of gadget, and some are in the form of additional substances for the fuel that used for the internal combustion of engine. Back of the time, there was a Canadian inventor, Charles Nelson Pogue, who had invented the 200 mpg carburetor, used as a fuel saving gadget for vehicles. But, the invention was claimed difficult to justify because the invention did not undergo any testing or demonstration that proved the carburetor loud save up the fuel usage. Nowadays, people had invented the fuel saving device in many ways especially in the form of fuel additives. Materials such as tin, magnesium and platinum compound are used for the additives. Generally, these usages of additives purposely to improve the energy density of the fuel by virtue of the material added. But some of the other additives also can cause harmful for the internal plastic parts in the fuel system such acetone. For my project, the device is invented in the form of gadget. The body of the device is mainly about plastic. The electrode is built by using the fasteners that made of steel that have the characteristic of the electrical conductivity. And the system of my device is also based on the electrolysis system in order to generate the device for producing the hydrogen gas that later used for the combustion.

## 2.2 TYPE OF FUEL SAVING DEVICE



**Figure 2.1:** Voltage Stabilizer.

The product name is voltage stabilizer. The function of this product is for fuel saving for vehicle that using petrol. This product is easy to use because the connection from terminal to car socket (cigarette-lighter socket).

### **Advantages**

- Very accurate output voltage regulation.
- Wide choice of kVA rating, voltage and configuration.
- Easily applicable to outdoor application.
- High tolerance to system faults and overload.
- High tolerance to power factor and frequency deviations.
- Good line isolation.
- Relatively inexpensive.

## Disadvantages

- Mechanical drive components, brushes and contactors require regular maintenance  
And/or replacement
- Frequent overloads can damage brushes.
- Speed of voltage correction correct may not be fast enough for electronic loads.



**Figure 2.2:** Gas Saving Gadget.



**Figure 2.3:** Prozone.





**Figure 2.4:** Tezkar Fuel Saver.



**Figure 2.5:** Hydro-Octane Booster.

This product has two ways which is outlet and inlet. The source of oil tank was connected to the inlet of this product and the pipe from this product was connected to the carburetor.

## **Advantages**

- Relatively concentrated and you can travel many hundred km with one full tank of petrol.
- It is highly available.
- It is fairly cheap.
- It is not difficult to make - it just has to be distilled and no waste is produced.
- It is easy to carry around.
- It is fairly safe to store.

## **Disadvantages**

- The supply of petrol is decreasing and we will one day run out of it.
- Because of the high demand and decreasing supply, the price of petrol is increasing.
- It greatly affects the environment as carbon is produced when petrol is burned.
- Petrol can be much better used to create other products like plastics and chemicals.
- Wars and international disputes have formed from petrol.



**Figure 2.6:** Nox Gen Fuel Saving Device.



**Figure 2.7:** Force Flow Turbine Fuel.



**Figure 2.8:** Fuel EX Fuel saver.



**Figure 2.9:** Air Compressor Fuel Saver.

ECO-Power Compressor is simple technology designed to improve fuel economy. Developed based on the scientific principle of magnetic .This amazing revolutionary device enhances the molecular structure of the fuel resulting in a better and more complete combustion. As the fuel passes through the highly focused charges, the molecular bonds and spins are enhanced, re-arranged and aligned. These molecule structural changes result in a more complete combustion.

**Product Name** : HKS Secondary Fuel Saving Accelerator/HKS Micro Air Compress Fuel Saver/Hks power compressor with meter for all car, high quality.

**Item Code** : 43200848

**Category** : Air-Compressors

**Port** : Ningbo

**Type** : Turbo

## **Advantages**

Saves fuel up to 5% to 35%.

- Easy to fix (no modification on original engine)
- Cheaper price
- Compatible to all cars
- Maximizes energy
- Saves fuel up to 5% to 35%
- Improves spark plug life.
- Improves torque
- Increases car engine power 15% to 35%
- Environment friendly
- Smother running engine, by promoting a more complete combustion.
- The Combustion of the air and fuel mixture is more complete compare with the engine without micro compressor.
- No need any supported accessories (can function well independently).
- All the components inside the micro compressor function 100% mechanically.
- Won't make any noise to your engine.
- Won't cause any side effect to your engine.
- Small size component (compatible with all kind of engine).
- Light, not bulky & easy for handing.
- Product Weight: 1kg.

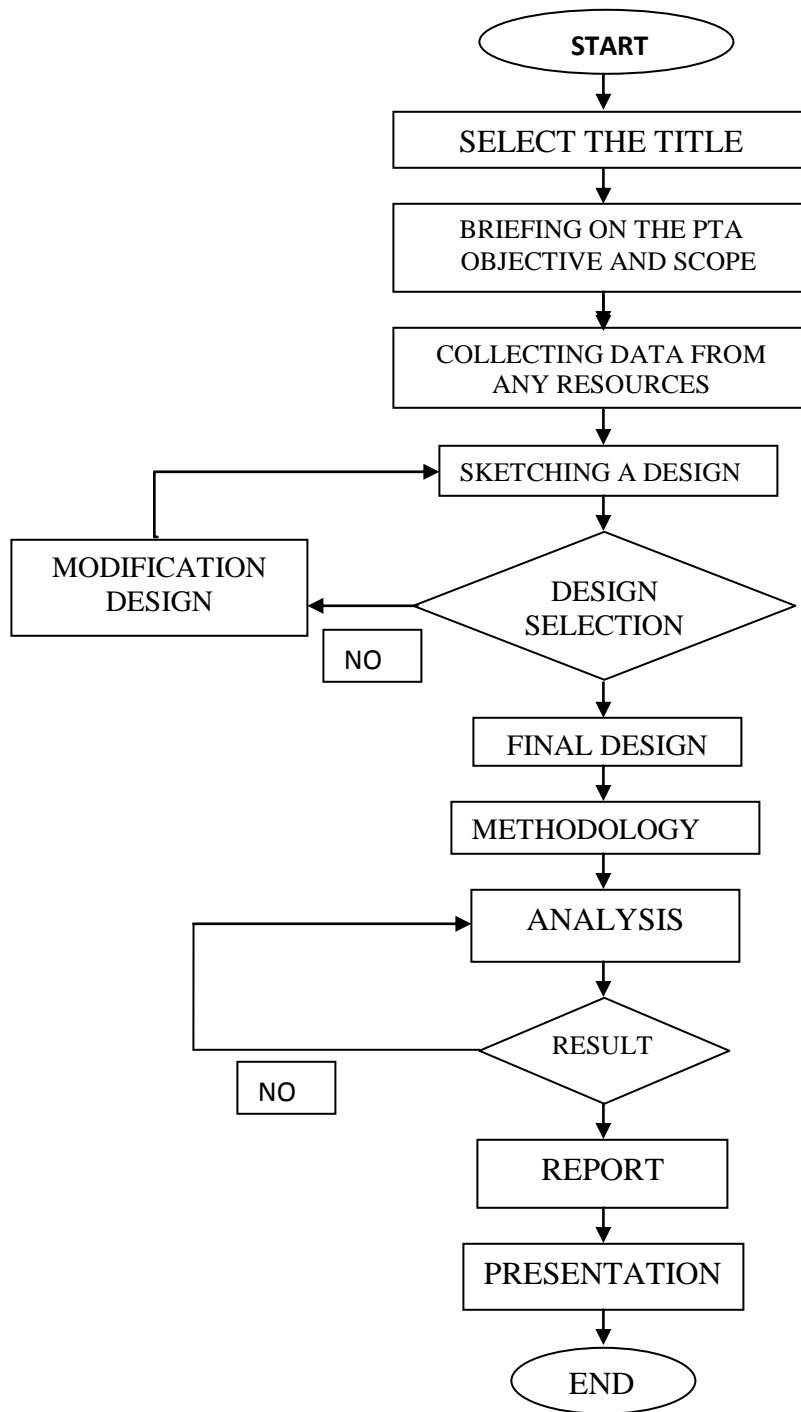
## **CHAPTER 3**

### **METHODOLOGY**

#### **3.1 INTRODUCTION**

For the diagram in **Figure 3.1** below, the project is started with the literature review and research about the title. This consists of the review of the concept of the fuel saving device, type of the fuel saving device, and the features of the fuel saving devices used in various fields. These tasks have been done through the research based on internet, books, and other sources. After gathering all the relevant information's, the project undergoes the designation process. In this step, the knowledge gathered are used to make several sketches or designs that may be fit for this project. After that, design consideration have been made in order to chose the best design so later on it can be built-up. The selected design's sketch is then transferred into the solid modeling generated by the solid work program. The materials and the measurements needed for the device were listed down and calculated in order to give an ergonomic shape of the device. After listing up the materials needed, acquisition step take place. There are only few materials that are needed to be bought such as wires, tubes and other additional accessories for the production of the product. The next step is the fabrication process. The design and the drawing are used as the references in order to build the device.

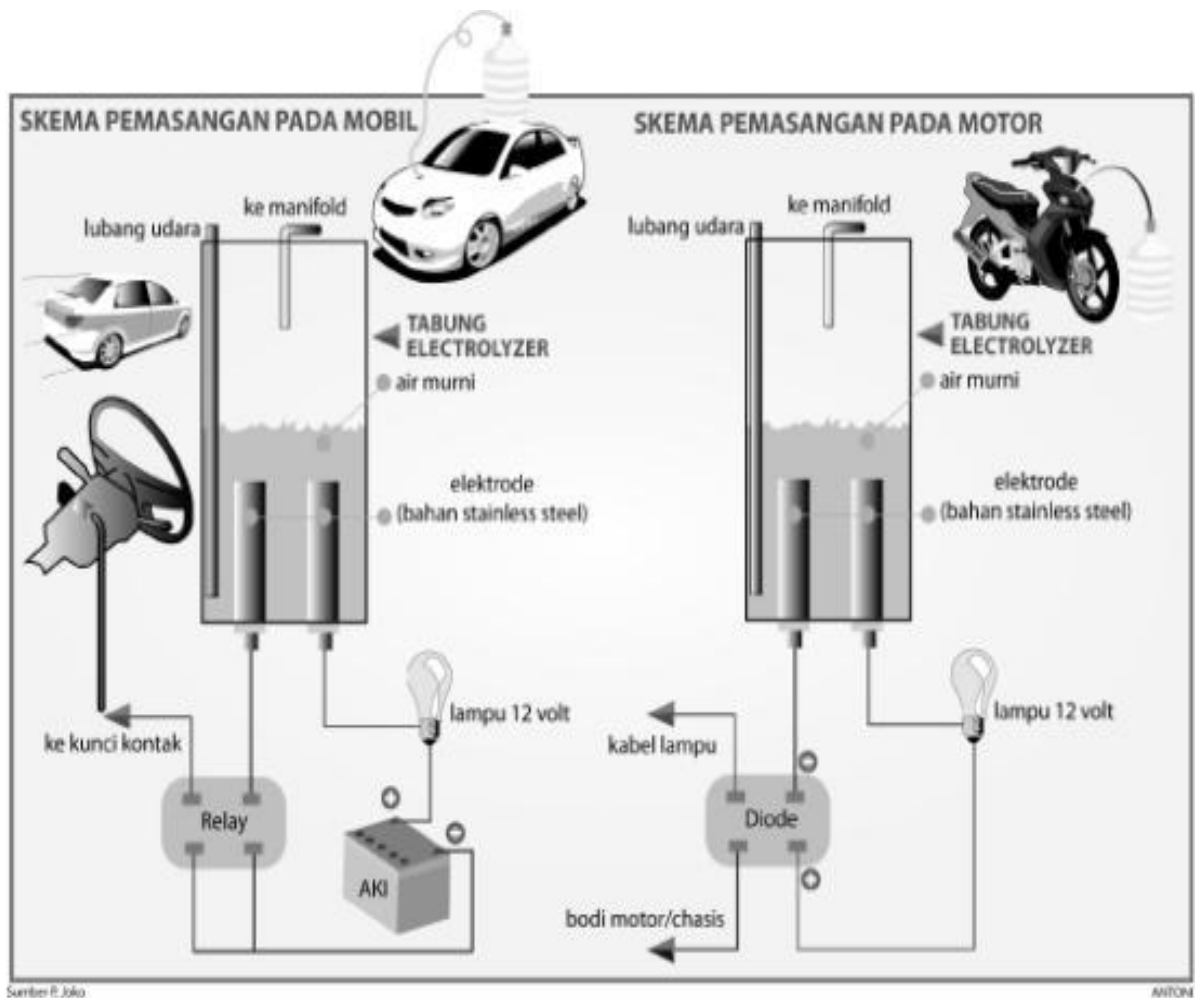
The fabrication process that involved in this project are drilling, assembling and fastening. After each of these processes is finished, the product undergoes the inspection session so that the product obeys the design and drawing that have been made earlier.



**Figure 3.1:** Flow Chart

The product is then being tested in order to get the result as stated in the project objective. During the testing session, if any problem occurs such as malfunction and others, the device will step back to the previous process where all the mistakes and errors will be fixed.

After fixing up the errors, the testing session will be done again in order to get the expected result. If the testing goes well, then it will proceed to the last stage, the discussion. In the discussions data, the draft report and all the related things are gathered and handed over to the supervisor to be checked in order to ensure that there is no mistake done for both the project and report.



**Figure 3.2** Example of electrolysis



The **figure 3.2** show analysis of both types of vehicle that using gasoline fuel. Which carry out electrolysis process to produce bubble to be distributed into intake manifold of vehicle.

### **3.2 DESIGN**

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

#### **3.2.1 Ergonomic factors:**

The fuel saving device must be user friendly such as easy to use and convenience.

#### **3.2.2 Safety:**

The fuel saving device must have the characteristic of electrical insulator since it is generated by the electricity source.

#### **3.2.3 Size of the plate electrode:**

The larger the surface of the plate electrode, the higher the rate of electrolysis. So, the gas production is also high.

### **3.3 DRAWING**

The drawing is divided into two categories which are :

#### **3.3.1 Sketching:**

All ideas for the device fabrication are sketched first so that the idea selection can be made.

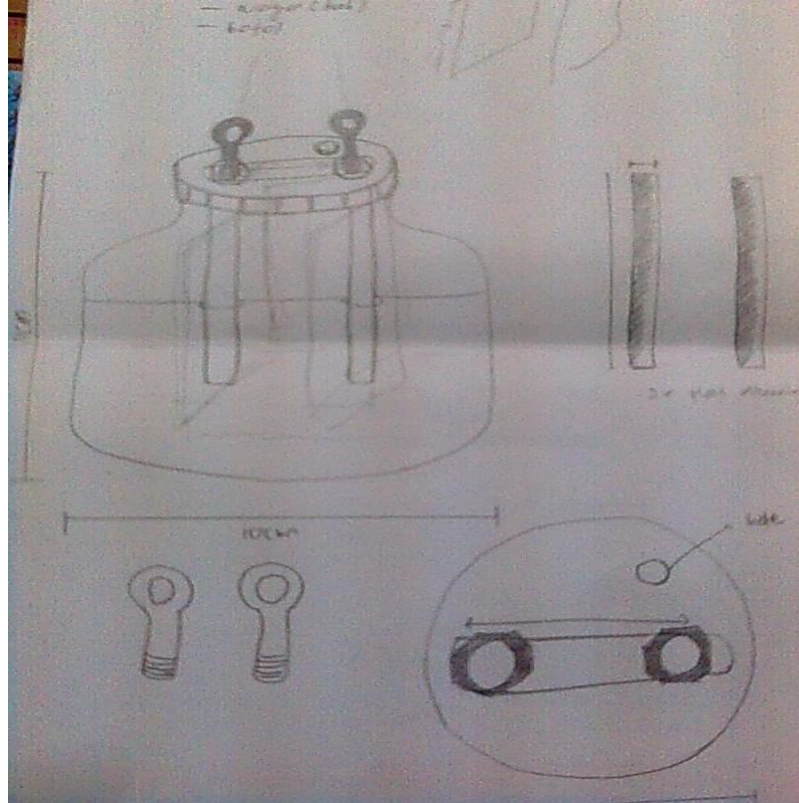
#### **3.3.2 Solid modeling:**

The selected designs or sketched concepts are transferred to solid modeling using Solid work software.

### **3.4 SKETCHING DRAWING SELECTION**

From the existed ideas, only three sketches that has been chosen to be considered as the final ideas which are:

### 3.4.1 First Design



**Figure 3.3:** Concept A

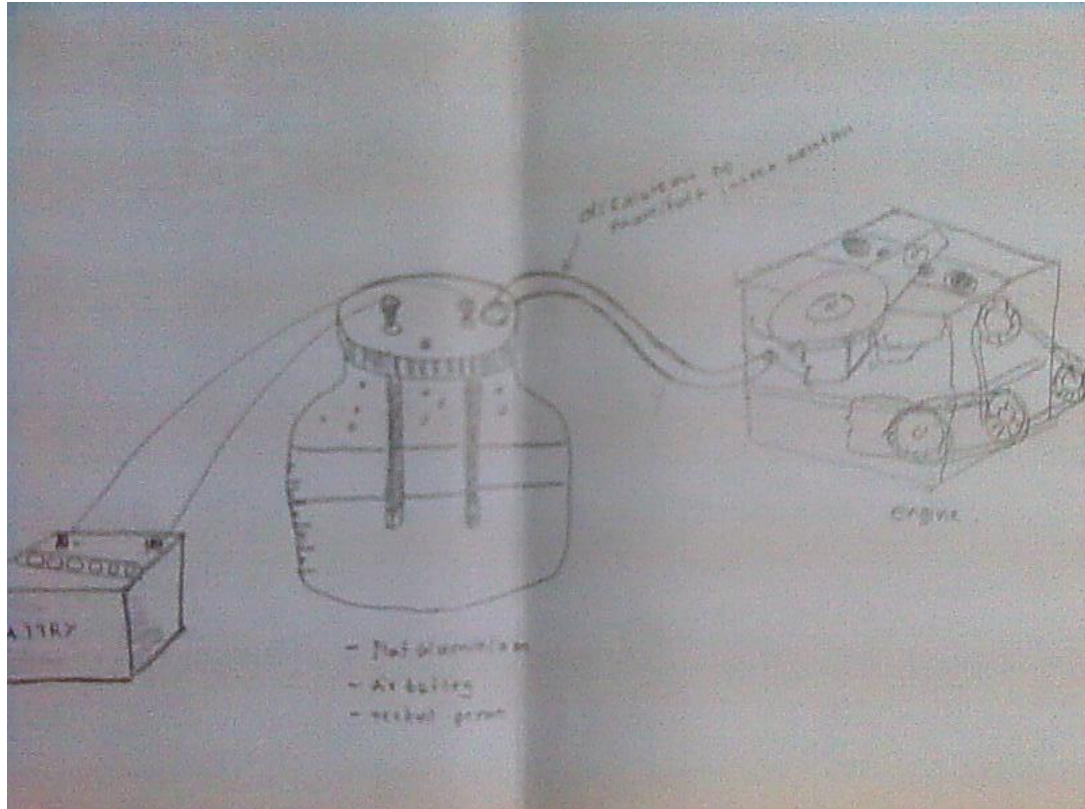
#### **Advantage**

- Can be built up easily
- Easy to use
- Portable

#### **Disadvantage**

- Gas production is low due to the size of the plate
- No safety measure applied to protect the engine since the water can be directly sucked the into engine.

### 3.4.2 Second Design



**Figure 3.4:** Concept B

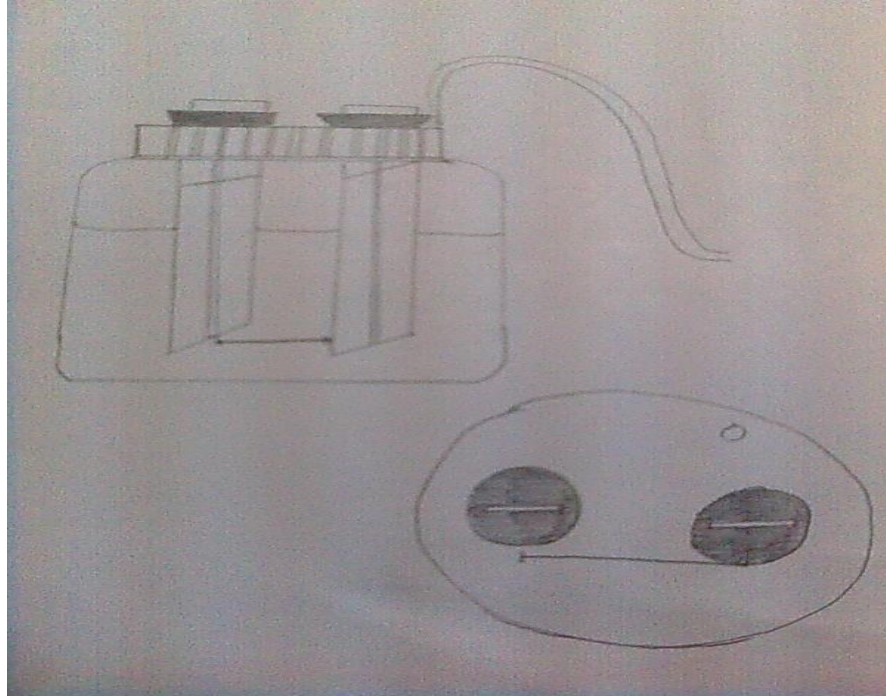
#### **Advantage**

- Easy to build
- Easy to use
- Gas production is high than before due to the larger area of the electrode plate.

#### **Disadvantage**

- No safety measure applied since the water can directly being sucked into the engine.

### 3.4.3 Third Design



**Figure 3.5:** Concept C

#### **Advantage**

- Easy to use
- Portable
- Easy to build
- Gas production is higher due to the size of the plate.
- Safety measure applied
- Light and easy to shapes.

#### **Disadvantage**

- Need more space to install

### 3.5 CONCEPT GENERATION AND EVALUATION

Four concepts for the fuel saving device are developed and evaluated against the datum of the device using the Pugh concept selection. The comparison between each concepts are shown in **Table 3.1**.

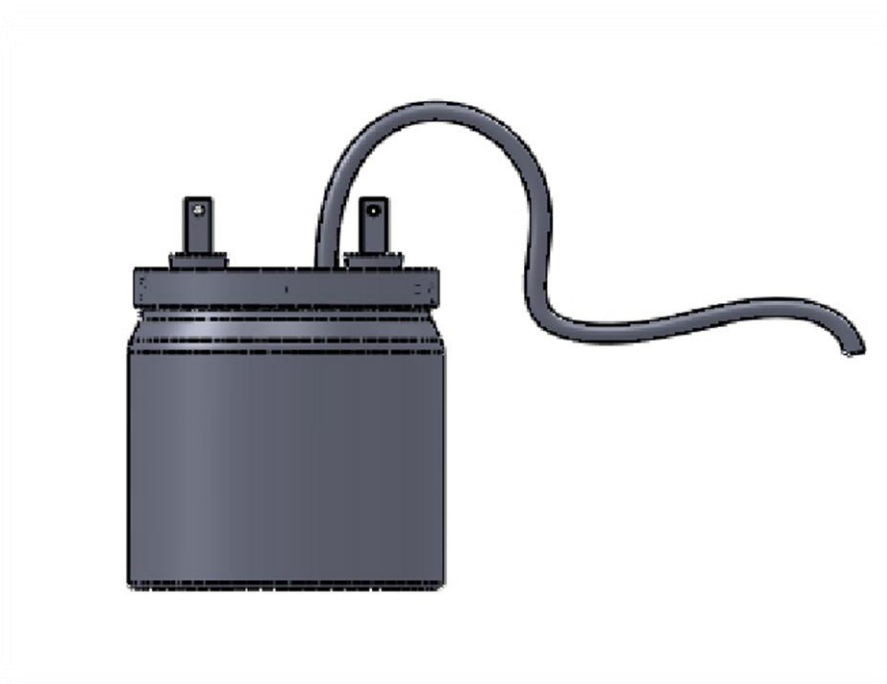
Selection Criteria	Concept			
	X(Datum)	A	B	C
Easy to manufacturing	0	+	+	+
Easy to use	0	+	+	+
Portability	0	+	+	+
Function	0	0	0	0
Efficiency	0	-	+	+
Safety	0	-	-	+
$\Sigma+$	6	3	4	5
$\Sigma 0$	0	1	1	1
$\Sigma-$	0	2	1	0
Net score	0	1	3	5
Ranking	4	3	2	1

**“0”**: Same as **“-”**: Worse than **“+”**: Better than

**Table 3.1:** Pugh’s Selection Method

According to the Table 3.1, Concept C is chosen because it is simple yet convenient. It is because the device is portable, easy to use, easy to manufacture, and also can function effectively. Besides that, the Concept C is equipped with a small container which helps in collecting the gas effectively and then channeled into the manifold without the water because the container also acts as the filter. Thus, it is a safety feature that is used for the device to prevent the engine from damage.

### 3.5.1 FINALIZE DESIGN



**Figure 3.6** Final Design

I choose the third design as my final design because according to the concept screening example Pugh selection method it was suitable design for my project to comply with the scope and objective.

### **3.6 FUNCTION**

The main function of the device is to decrease the fuel usage on a vehicle. This can be done by the device that operates the electrolysis system which then produces hydrogen gas. Then, it will be channeled into the intake manifold and get along with the gasoline and used for the combustion of the engine. Thus, this can reduce the amount of gasoline that enters into the combustion chamber by supplying along it with the hydrogen gas produce by the device. Meaning that amount of fuel that inserted into the engine after attaching the device is lower than before we attaching the device.

### **3.7 JOINING METHOD**

Joining method that is used in this project is fasteners. This joining method is used when build-up the electrode for the electrolysis system.

### **3.8 FASTENERS**

Generally, fastener is a hardware tool that mechanically joins two or more objects together.



### 3.8.1 Cork.



**Figure**

**3.7**

Among its valued properties are its lightness, impermeability to liquids, and resistance to wear, rot and temperature extremes and its renowned compressibility. Being elastic, cork is also more tolerant than other materials of changes to temperature and pressure.

### 3.8.2 Plate aluminum



**Figure 3.8**

Physically, chemically and mechanically aluminum is a metal like steel, brass, copper, zinc, lead or titanium. It can be melted, cast, formed and machined much like these metals and it conducts electric current. In fact often the same equipment and fabrication methods are used as for steel.

### **3.8.2.1 Light Weight**

Aluminum is a very light metal with a specific weight of 2.7 g/cm<sup>3</sup>, about a third that of steel. For example, the use of aluminum in vehicles reduces dead-weight and energy consumption while increasing load capacity. Its strength can be adapted to the application required by modifying the composition of its alloys.

### **3.8.2.2 Corrosion Resistance**

Aluminum naturally generates a protective oxide coating and is highly corrosion resistant. Different types of surface treatment such as anodizing, painting or lacquering can further improve this property. It is particularly useful for applications where protection and conservation are required.

### **3.8.2.3 Electrical and Thermal Conductivity**

Aluminum is an excellent heat and electricity conductor and in relation to its weight is almost twice as good a conductor as copper. This has made aluminum the most commonly used material in major power transmission lines.

### **3.8.2.4 Reflectivity**

Aluminum is a good reflector of visible light as well as heat, and that together with its low weight, makes it an ideal material for reflectors in, for example, light fittings or rescue blankets.

### **3.8.2.5 Ductility**

Aluminum is ductile and has a low melting point and density. In a molten condition it can be processed in a number of ways. Its ductility allows products of aluminum to be basically formed close to the end of the product's design.

### 3.8.2.6 Impermeable and Odorless

Aluminum foil, even when it is rolled to only 0.007 mm thickness, is still completely impermeable and lets neither light aroma nor taste substances out. Moreover, the metal itself is non-toxic and releases no aroma or taste substance which makes it ideal for packaging sensitive products such as food or pharmaceuticals.

### 3.8.2.7 Recyclability

Aluminum is 100 percent recyclable with no downgrading of its qualities. The re-melting of aluminum requires little energy: only about 5 percent of the energy required to produce the primary metal initially is needed in the recycling process.

### 3.8.3 Baking Powder (sodium bicarbonate)



**Figure 3.9 Baking Powder**

Baking soda is a dry chemical leavening agent used to increase the volume. Sprayed baking soda acts by carbon dioxide into a mixture. In an acid-base reaction, causing bubbles in the mixture mixed. Most of the commercial baking powder made from commercial baking powder is made of (usually baking soda, also known as sodium bicarbonate) alkalinity, one or more of the acid salt, and baking soda a common starch is a source of carbon dioxide, and the acid-base reaction can be generically represented as:

