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# Increasing fuel efficiency by using oxy hydrogen in petrol engines

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**Abstract-The main objective of this project is to fabricate a model which will help to increase the engine efficiency by air pre heating method and also Oxygen hydrogen added in to the air intake manifold and injects into the cylinders (where HHO mixes) with the fuel, ignites results complete combustion of the Hydrocarbon fuel, lowering emission and increasing fuel efficiency. Internal combustion engine is a device, which converts the thermal heat energy from exhaust and converts it to air preheat. HHO generator is an efficient approach that used to increase the fuel efficiency in a combustion engine by increasing the energy produced per mole of fuel during the ignition process. As a result the amount of unburned fuel in a combustion engine was reduced. The proposed approach is based on an ordinary HHO generator.**

**Keywords— HHO, Electrolyte, Battery, Engine, Spark Ignition System**

## I.INTRODUCTION

With such high demand for more efficient engines, our mission is to design and create a device that will increase engine efficiency without loss of its performance. Such device is known as HHO generator. This generator uses electric current to produce hydrogen from water; the hydrogen will be introduced into the combustion chamber of an engine via intake manifold. We have made it compact and affordable. It is mandatory that the amount of energy put into the cell to split the water molecules is less than the amount of output energy of the generator. In order to overcome this challenge we had made it as efficient as possible. This includes coming up with a creative design to get maximum hydrogen out with the least amount of current running through the cell. Taking this aspect sin to consideration we will make the HHO generator as a productive addition to any internal combustion engine.

### A. OBJECTIVE OF THE PROJECT

- To reduce engine emission.
- To increase the performance of the engine.
- To provide maximum fuel economy.
- To provide complete combustion.

## II.COMPONENTS DESCRIPTION

### A. ENGINE

An engine, or motor, is a machine designed to convert one form of energy into mechanical energy. Heat engines, including internal combustion engines and external combustion engines burn a fuel to create heat, which then creates a force. Electric motors convert electrical energy into mechanical motion, pneumatic motors use compressed air and others such as clockwork motors in use elastic energy. In biological systems, molecular motors, like myosins in muscles, use chemical energy to create forces and eventually motion. "Engine" was originally a term for any mechanical device that converts force into motion. Hence, preindustrial weapons such as catapults, trebuchets and battering rams were called "siege engines". The word "gin," as in "cotton gin", is short for "engine." The word derives from Old French engine, from the Latin in gonium, which is also the root of the word ingenious. Most mechanical devices invented during the industrial revolution were described as engines the steam engine being a notable example.

A heat engine may also serve as a prime mover a component that transforms the flow or changes in pressure of a fluid into mechanical

energy. An automobile powered by an internal combustion engine may

Make use of various motors and pumps, but ultimately all such devices derive their power from the engine. Another way of looking at it is that a motor receives power from an external source, and then converts it into mechanical energy, while an engine creates power from pressure. Devices converting heat energy into motion are commonly referred to simply as engines.

## B. SILENCER

A muffler is a device for reducing the amount of noise emitted by the exhaust of an internal combustion engine. Mufflers are installed within the exhaust system of most internal combustion engines, although the muffler is not designed to serve any primary exhaust function.

The muffler is engineered as an acoustic soundproofing device designed to reduce the loudness of the sound pressure created by the engine by way of Acoustic quieting. The majority of the sound pressure produced by the engine is emanated out of the vehicle using the same piping used by the silent exhaust gases absorbed by a series of passages and chambers lined with roving fiberglass insulation and/or resonating chambers harmonically tuned to cause destructive interference wherein opposite sound waves cancel each other out. An unavoidable side effect of muffler use is an increase of back pressure which decreases engine efficiency. This is because the engine exhaust must share the same complex exit pathway built inside the muffler as the sound pressure that the muffler is designed to mitigate.

## C.ELECTRODE

An electrode is a conductor through which electric current is passed. It can be in various forms like wires, plates or rods. Electrode can be constructed of metal, such as copper, stainless steel, silver or lead. However, an electrode may also construct using Non-Metals like carbon. An electrode passes current between a Metallic part and Non-Metallic part of an electrical circuit. In an electrochemical cell, an electrode is called either an anode or cathode.

A cathode is described as a negative electrode. Current enters the cell at the cathode and reduction takes place. Electrons are repelled from cathode. An anode is a positive electrode where oxidation takes place. Current leaves the cell at the anode.

## D.ELECTROLYTE

An electrolyte is any substance containing free ions that make the substance electrically conductive.

The most typical electrolyte is an ionic solution, but molten electrolytes and solid electrolytes. Commonly, electrolytes are solutions of acids, bases or salts some gases may act as electrolytes under conditions of high temperature or low pressure. Electrolyte solutions are normally formed when a salt is placed into solvent such as water.

$$Nacl(s) \rightarrow Na+(aq) + Cl-(aq)$$

If a high proportion of the solute dissociates to form free icons, the electrolyte is strong; if most of the solute does not dissociate, the electrolyte is weak. The properties of electrolytes may be exploited using electrolysis to extract constituent elements and components contained within the solution.

## E.HOSEPIPE

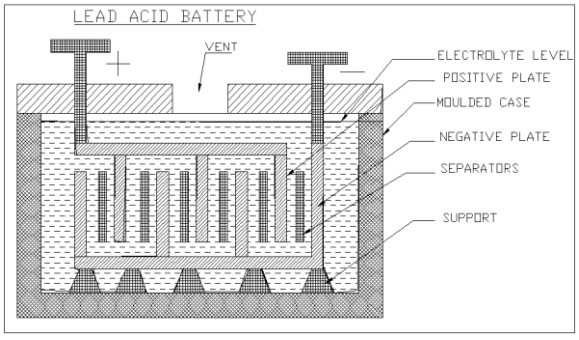
It is used to transfer HHO from electrolyze to air intake of the IC engine. It is used to hold the electrolyzer in the bumper.

## F.NOZZLE

Here nozzle is used to transfer the HHO from electrolyze from the hosepipe which towards the engine direction because the HHO allow to go to engine.

## G.LEAD-ACID WET CELL

Where high values of load current are necessary, the lead-acid cell is the type most commonly used. The electrolyte is a dilute solution of sulfuric acid ($H_2SO_4$). In the application of battery power to start the engine in an auto mobile, for example, the load current to the starter motor is typically 200 to 400A. One cell has a nominal output of 2.1V, but lead-acid cells are often used in a series combination of three for a 6V battery and six for a 12V battery. The lead acid cell type is a secondary cell or storage cell, which can be recharged. The charge and discharge cycle can be repeated many times to restore the output voltage, as long as the cell is in good physical condition. However, heat with excessive charge and discharge currents short ends the useful life to about 3 to 5 years for an automobile battery. Of the different types of secondary cells, the lead-acid type has the highest output voltage, which allows fewer cells for a specified battery voltage.



III. CHEMICAL ACTION

Sulfuric acid is a combination of hydrogen and sulfate ions. When the cell discharges, lead peroxide from the positive electrode combines with hydrogen ions to form water and with sulfate ions to form lead sulfate. Combining lead on the negative plate with sulfate ions also produces he sulfate. Therefore, the net result of discharge is to produce more water, which dilutes the electrolyte, and to form lead sulfate on the plates.

As the discharge continues, the sulfate fills the pores of the grids, retarding circulation of acid in the active material. Lead sulfate is the powder often seen on the outside terminals of old batteries. When the combination of weak electrolyte and sulfating on the plate lowers the output of the battery, charging is necessary.

On charge, the external D.C. source reverses the current in the battery. The reversed direction of ions flows in the electrolyte result in a reversal of the chemical reactions. Now the lead sulfates on the positive plate reactive with the water and sulfate ions to produce lead peroxide and sulfuric acid. This action re-forms the positive plates and makes the electrolyte stronger by adding sulfuric acid.

At the same time, charging enables the lead sulfate on the negative plate to react with hydrogen ions; this also forms sulfuric acid while reforming lead on the negative plate to react with hydrogen ions, this also forms currents can restore the cell to full output, with lead peroxide on the positive plates, spongy lead on the negative plate, and the required concentration of sulfuric acid in the electrolyte.

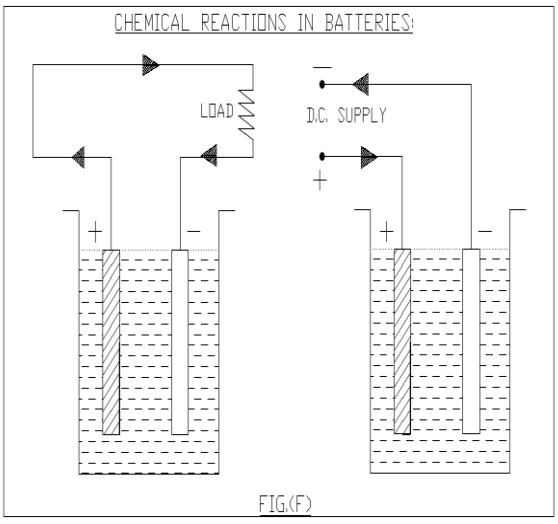



Figure 3.1 Chemical Reactions

On discharge, the pb and $pbO_2$ combine with the $SO_4$ ions at the left side of the equation to form lead sulfate ($pbSO_4$) and water ($H_2O$) at the right side of the equation. One battery consists of 6 cells, each have an output voltage of 2.1V, which are connected in series to get a voltage of 12V and the same 12V battery is connected in series, to get a 24 V battery. They are placed in the water proof iron casing box.

A.CARING FOR LEAD ACID BATTERIES

Always use extreme caution when handling batteries and electrolyte. Wear gloves, goggles and old clothes. “Battery acid” will burn skin and eyes and destroy cotton and wool clothing.

The quickest way of ruin lead-acid batteries is to discharge them deeply and leave them stand “dead” for an extended period of time. When they discharge, there is a chemical change in the positive plates of the battery. They change from lead oxide when charge out lead sulfate when discharged. If they remain in the lead Sulfate State for a few days, some part of the plate dose not returns to lead oxide when the battery is recharged. If the battery remains discharge longer, a greater amount of the positive plate will remain lead sulfate. The parts of the plates that become “sulfate” no longer store energy. Batteries that are deeply discharged, and then charged partially on a regular basis can fail in less than one year.

Check your batteries on a regular basis to be sure they are getting charged. Use a hydrometer to check the specific gravity of your lead acid batteries. If batteries are cycled very deeply and then recharged quickly, the specific gravity reading will be lower than it should because the electrolyte at the top of the battery may not have mixed with the “charged” electrolyte.

Check the electrolyte level in the wet-cell batteries at the least four times a year and top each cell of with distilled water. Do not add water to discharged batteries. Electrolyte is absorbed when batteries are very discharged. If you add water at this time, and then recharge the battery, electrolyte will overflow and make a mess.

Keep the top of your batteries clean and check that cables are tight. Do not tighten or remove cables while charging or discharging. Any spark around batteries can cause a hydrogen explosion inside, and ruin one of the cells, and you.

On charge, with reverse current through the electrolyte, the chemical action is reversed.

Then the pb ions from the lead sulfate on the right side of the equation reform the lead and lead peroxide electrodes. Also the $SO_4$ ions combine with $H_2$ ions from the water to produce more sulfuric acid at the left side of the equation.

### B.SPECIFIC GRAVITY

Measuring the specific gravity of the electrolyte generally checks the state of discharge for a lead acid cell. Specific gravity is a ratio comparing the weight of a substance with the weight of a substance with the weight of water. For instance, concentrated sulfuric acid is 1.835 times as heavy as water for the same volume. Therefore, its specific gravity equals 1.835. The specific gravity of water is 1, since it is the reference.

In a fully charged automotive cell, mixture of sulfuric acid and water results in a specific gravity of 1.280 at room temperatures of 70 to 80ºF. As the cell discharges, more water is formed, lowering the specific gravity. When it is down to about 1.150, the cell is completely discharged.

Specific gravity readings are taken with a battery hydrometer. Note that the calibrated float with the specific gravity marks will rest higher in an electrolyte of higher specific gravity.

The decimal point is often omitted for convenience. For example, the value of 1.220 is simply read "twelve twenty". A hydrometer reading of 1260 to 1280 indicates full charge, approximately 12.50 are half charge, and 1150 to 1200 indicates complete discharge.

The importance of the specific gravity can be seen from the fact that the open circuit voltage of the lead acid cell is approximately equal to

V = Specific gravity + 0.84

For the specific gravity of 1.280, the voltage is 1.280 = 0.84 = 2.12V, as an example. These values are for a fully charged battery.

### C. CHARGING THE LEAD-ACID BATERY

The requirements are illustrated in figure. An external D.C. voltage source is necessary to produce current in one direction. Also, the charging voltage must be more than the battery e.m.f.

Approximately 2.5 per cell are enough to over the cell e.m.f. so that the charging voltage can produce current opposite to the direction of discharge current. Note that the reversal of current is obtained just by connecting the battery VB and charging source VG with + to + and –to-, as shown in figure. The charging current is reversed because the battery effectively becomes a load resistance for VG when it higher than VB. In this example, the net voltage available to produce charging currents is 15-12=3V. A commercial charger for automobile batteries is essentially a D.C. power supply, rectifying input from the AC power line to provide D.C. output for charging batteries.

Float charging refers to a method in which the charger and the battery are always connected to each other for supplying current to the load. In figure the charger provides current for the load and the current necessary to keep the battery fully charged. The battery here is an auxiliary source for D.C. power.

It may be of interest to note that an automobile battery is in a floating charge circuit. The battery charger is an AC generator or alternator with rectifier diodes, driver by a belt from the engine. When you start the car, the battery supplies the cranking power. Once the engine is running, the alternator charges the battery. It is not necessary for the car to be moving. A voltage regulator is used in this system to maintain the output at approximately 13 to 15 V.

The constant voltage of 24V comes from the solar panel controlled by the charge controller so for storing this energy we need a 24V battery so two 12V battery are connected in series. It is a good idea to do an equalizing charge when some cells show a variation of 0.05 specific gravity from each other. This is a long steady overcharge, bringing the battery to a gassing or bubbling state. Do not equalize sealed or gel type batteries. With proper care, lead-acid batteries will have a long service life and work very well in almost any power system. Unfortunately, with poor treatment lead-acid battery life will be very short.

## IV.PRODUCING OXY HYDROGEN (HHO) FROM WATER

### A.DETAILS ABOUT PRODUCING OXY-HYTROGEN FROM WATER

Hydrogen Gas is a volatile gas at room temperature, but when chilled to -35°C and compressed, it makes the perfect fuel. Hydrogen's greatest feature, as a fuel, is that it causes no pollution.

A hydrogen fuel cell works by combing hydrogen gas with atmospheric oxygen. The resulting chemical reaction generates electric power, and the only by product it produces is clean water. At a time when there is real concern about global warming due to carbon emissions, this makes hydrogen fuel a desirable technology and perhaps the most feasible alternative to petrol and gasoline.

Many scientists and re searches are working towards a vision of the hydrogen economy. Hydrogen based fuel could potentially be used to run our cars or even drive larger scale power plants, generating the electricity we need to light our buildings, run our kettles and fridges, and power our computers. But hydrogen does not occur naturally and it has to be processed. The big challenge is the large scale production of hydrogen in sustainable way. There are a number of challenges to be overcome before hydrogen gas is common place as a fuel.

Hydrogen fuel is used to generate electricity, but conversely, electricity is required to generate the hydrogen fuel. Electrolysis uses

electricity to break water into hydrogen and oxygen, with the two gases forming at opposite electrodes. Electricity is also required to power the compression of the hydrogen and the refrigeration to chill it to less than 200 degrees. However, this initial requirement of electricity could be generated sustainably through wind power, biomass, tidal, hydropower, or even nuclear.

Hydrogen can also be generated by extracting it from natural gas, but this process generates carbon dioxide and negates the main motivation for moving to hydrogen fuel cell vehicles: ending dependence on fossil fuels. Further exciting alternative technology at an early stage in development is Solar Powered Hydrogen Generation utilizing water splitting solar panels.

The columns are welded onto the base supports the apparatus. A mild steel plate is welded horizontally such that it bridges the columns. The pneumatic cylinder is mounted on top of this plate. A small L-angle is welded to the mild steel plate to support the solenoid valve.

A female die is fixed on the bottom base by welding. The male die is threaded on the free end of the piston rod threaded side. Female die is fixed whereas the male die reciprocates up and down.

The two hoses are connected from solenoid valve to the cylinder. The air goes through the tubes. The tubes are also connected by the nozzle head. The supporting stands are placed in the base side by means of welding. Finally the unit is connected to the compressor.

### B.HYDROGEN GAS FROM WATER MIXED WITH KOH

Here's some information on a simple homegrown method for producing pure hydrogen gas. The beauty of this system is that it uses a common inexpensive chemical which is not consumed in the reaction, so it can be used again and again almost indefinitely. The chemical is Potassium hydroxide, commonly called caustic potash. It's chemical formula is KOH, and its used to manufacture soaps, dyes, alkaline batteries, adhesives, fertilizers, drain pipe cleaners, asphalt emulsions, and purifying industrial gases. The chemical reaction we are interested in occurs with water in the following equation.

$$KOH + H_2O = KOOH + H_2$$

The balanced equation is

$$2KOH + 2H_2O = 2KOOH + 2H_2$$

Notice the free Hydrogen gas $2H_2$ which is stripped from the water added to the KOH. Making this reaction more than a one-time event is the key to cheap hydrogen production, which means controlling the reverse reaction to recover the KOH without giving back the hydrogen. There is an easy way to do this however.

Stripping the Hydrogen from the water removed stored energy from the first reaction, and it must be replaced to drive the reaction in the opposite direction, but instead of giving back the hydrogen gas we can give back the energy in another form like solar radiation.

## V.WORKING PRINCIPLE

### A.WORKING PRINCIPLE OF OXY HYDROGEN GENERATOR

Oxy hydrogen added in to the air intake manifold and injects into the cylinders (where HHO mixes) with the fuel, ignites results complete combustion of the Hydrocarbon fuel, lowering emission and increasing fuel efficiency.

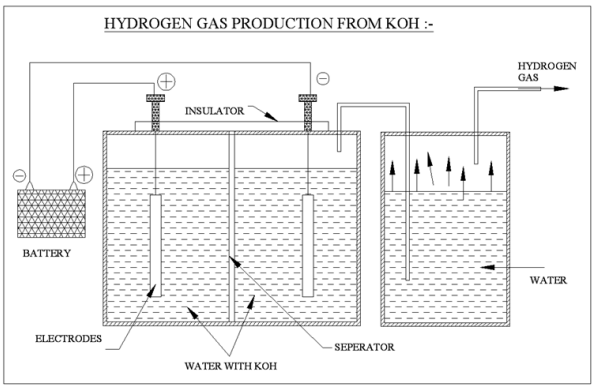



FIGURE 5.1 HYDROGEN GAS PRODUTION FROM KOH

Thus, heating the KOOH in a solar cooker will produce the following reaction: KOOH + HEAT → KOH + O. The balanced reaction is 2KOOH + HEAT → 2KOH + $O_2$ Notice the free Oxygen gas released in this reaction.

The combined result of our double reaction cycle is the splitting of $H_20$ into 2 free gases, and our initial Potassium Hydroxide is ready to be used again. Furthermore, not only have we created a fuel supply, but also an oxygen supply. Designing a continuous fuel supply system from this reaction cycle would require 2 potassium hydroxide tanks. One for each reaction they would have to be exchanged between reactions on a regular timed schedule.

Hydrogen production can be regulated with a flow control value from the $H_2O$ storage tank. $O_2$ production is regulated by heat input. Matching gas production with consumption would reduce the size of tanks needed for surplus gas storage. I haven't done the exact calculations on how much potassium hydroxide is needed to supply the average gas requirements per capita consumed in the US, but I am guessing that it wouldn't require very many pounds of KOH, so the system size could be pretty small. The solar collector for the

oxygen reaction would probably be the biggest component, and I suggest a focusing solar collector be used for higher heat input.
There you have it, a nonpolluting source of free hydrogen and oxygen from nothing but the Sun and water.

## VI. SPECIFICATION OF FOUR STROKE PETROL ENGINE

| | | |
|---|---|---|
| Type | : | Four strokes |
| Cooling System | : | Air Cooled |
| Bore/Stroke | : | 50 x 50 mm |
| Piston Displacement | : | 98.2 cc |
| Compression Ratio | : | 6.6: 1 |
| Maximum Torque | : | 0.98 kg-m at 5,500 RPM |

## VII.BENEFITS AND APPLICATIONS

### A.ENVIRONMENTAL FRIENDLY

As shown in the given diagram, use of HHO gas reduces the Carbon monoxide (CO) emission to 27%, Nitric oxide (NO) emission to 28%, Nitrogen dioxide (NO2) emission to 51%, and Nitrogen oxides (NOX) emission to 32%.

### B.FUEL SAVING

Additional fuel burning resulting fuel saving up to 30% depending on the condition of the engines and running platform.

### C.INCREASE ENGINE EFFICIENCY

Hydrocarbon fuels and lower ignition energy of fuel resulting.

- Increased fuel efficiency between 10 to 30% results, investment on Hydrogen can be recouped in less than a year.
- Reducing emission minimum by 60%.
- Engine runs smoother and Vehicle life extended as well.
- Engine heat-up is minimized at 15 to 20%.

### D.SAFE

HHO will be produced on demand, meaning no worries about transporting and storing dangerous pressurized gas fuel tanks ensure safe and continuous operation. Storing only water.

### E.ADVANTAGES

- Improved mileage
- Increases engine power
- Fuel saving

### F.FUTURE WORK

Future research will focus on limiting the current flow through the generator to obtain an optimal rate of HHO production.. Next step of this researchistoconnecttheproposedHHOgeneratorwit haninternalcombustion engine, i.e. a spark ignition engine and measure the efficiency of the fuel in vehicle and also to measure the reduction of emission of air pollutants such as $CO_2$, CO, etc

## VIII. CONCLUSION

Oxy hydrogen gas has been generated by electrolysis process and producer gas by paralysis. Both the alternative fuels mixed with fresh air before entering the combustion chamber. BSFC, Brake thermal efficiency, speed and load are the performance parameters kept under observation.
The following conclusions are drawn

- It is very easy to integrate both the alternative fuels with existing engine. No major hardware modification is required.

- Combustion efficiency increases with both alternative fuels due to presence of hydrogen in the blend. Since hydrogen is present in larger quantity oxy hydrogen gas compared to producer gas, the oxy hydrogen and diesel blend has shown best combustion efficiency as a result of which larger values of BSFC and brake thermal efficiency are obtained for the same engine.

Presence of extra oxy in both alternative fuels helps to improve the combustion efficiency further more. Water vapor is one of byproduct of combustion process with oxy hydrogen and diesel blend. This decreases the combustion chamber temperature and thus decreases the chances of engine detonation. Very less amount of oxygen is available with producer gas and diesel blend hence it is not the case with this combination. Cost of the producer gas generation is more compared to oxy hydrogen gas generation. Three phase AC power source is required for the generation of producer gas using pyrolysis process.

Oxy hydrogen gas module requires only 12 V DC supply from the battery. The size of the producer gas generation module is very large and nearly impossible to fit on automobile engines, hence best suitable for the stationary engines application like pump, generators etc. Coal is coming as one of the byproduct of the pyrolysis process, can be used for domestic purpose, and hence an added advantage.

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