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Research Article

Design and Development of High Voltage/Current Supply with Constant Current System for HHO Cell A Green Energy System

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Abstract

Currently all countries are facing a common problem of fossil fuel shortages, and many researchers are finding various solution to provide green energy. A large part of energy requirement is there in the transport cars, bike, buses, trucks, auto-rickshaw etc. current these vehicles run on gasoline (petrol), diesel and CNG. In most cases fuel is not combusted efficiently in these vehicles and black thick smoke is seen in exhaust. Oxyhydrogen (HHO) is a technology here we generate hydrogen gas using electrolysis of water. This gas is added in low percentage along with fuel which increases the mileage by 10-20%. Not only mileage it cleans system from inside and removes all carbon deposits, which improves engine performance and decreases knocking sound of engine. The proposed design generates gas at constant rate so that HHO cells runs smoothly with better efficiency. A constant current system is designed to run the HHO cell with current monitoring and PWM methods are used to control the current with the help of power MOSFET and embedded system. For smaller HHO cells 12V supply is required but for larger HHO cell we 110V regulated DC supply with high current capability which is also part of our research.

Keywords: *HHO (Oxyhydrogen), PWM, MOSFET*

Introduction

Every day, the world produces carbon dioxide which is released to the earth's atmosphere which will be there in one hundred years' time. This increased content of Carbon Dioxide increases the warmth of our planet and is the main cause of the so called Global Warming Effect. One answer to global warming is to replace and retrofit current technologies with alternatives that have comparable or better performance, but do not emit carbon dioxide. Not only this we are using up all our fossil fuels and soon they will be depleted. Fuels prices are increasing steeply and no of vehicles on road are also increasing with population. In developing countries like India still so many places we are using old vehicles, most vehicles have improper engine settings or worn out engine. We can identify such vehicles easily just by seeing thick black smoke coming out of exhaust.

Pollution is also one major concern these vehicles not only add carbon dioxide but they contain carbon monoxide due to improper burning of fuel, suspended carbon and hydrocarbon particles with other harmful substance. This all settles in engine also decreases efficiency and increasing knocking. With our system we can reduce fuel consumption, decrease pollution, clean engine & avoid carbon deposits in engine and increase in engine life.

Many green alternatives are found by researchers, like electric cars, solar cars, hydrogen fuel cell cars, hybrid cars but in all of the above requires totally new design and cannot be implement in existing vehicles. But in our system just a supplement installation like you are doing for music system or vehicle security is enough. Installing HHO kit in vehicle is easy and it can be added in existing vehicle without any problems and results can be observed within short time. HHO kit increases mileage and improves engine performance. As all may not be able to afford this kit installation charges though its one-time investment, when car/bike owner give car for service they will run HHO unit with engine on and Hydrogen gas along with fuel which will be burnt in combustion engine this process take 30-45 minutes, car engine internal are cleaned to some extent and carbon deposits are removed by this technique, this short treatment will increases car mileage and improves engine performance but this is temporary, hence installation of HHO kit in car/bike is more recommended but with lower price consumer can see the effects of HHO on their vehicle and this builds confidence in consumer to buy kit for his vehicle.

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Operation and system design

From vehicle battery 12 volts is supplied to 2 electrodes in a water container that can take up to boiling temperature, this process separates hydrogen gas on the cathode (-) rod and oxygen gas comes off the anode (+) rod from H2O with a 1-3% solution of electrolyte. KOH is the best electrolyte, but we can use sulfuric acid. KOH (Potassium Hydroxide) is a base for the electrolysis to happen. Buy at chemical suppliers. The combo of Hydrogen & oxygen gases mix together burn clean and output a high combustion, Called hydroxyl gas or egas. They act like a catalyst to your gasoline or propane burning engines. As long as you burn the gas as you drive there is no danger of storing/compressing the gases in tank.

$$2\,H2O(l) \rightarrow 2\,H2(g) + O2(g) \quad (1)$$

OxyHydrogen generator use electricity from the vehicle's battery to create hydrogen from water while driving. The Hydrogen & Oxygen mix is extracted from the distilled water in a gas form. When this gas reaches the combustion chamber of the engine Fig:1 it is much lighter and causes the fuel to burn more efficiently Fig:2. This means that the engine is stronger and that less fuel is needed for it to perform. This is how we save fuel. Hydrogen and Oxygen mix is a much cleaner gas and as this passes through the engine and through the exhaust it omits a much lighter and cleaner gas reducing the emission output

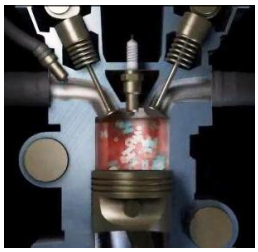


Fig: 1 Mixture of Fuel & Hydrogen

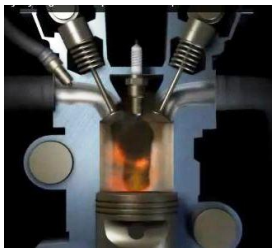


Fig:2 Burning faster & cleaner, Gas exhaust

The HHO is never stored. As soon as it is generated, it gets injected into the engine where it mixes with the existing fuel. The resulting mixture burns more efficiently, reducing fuel consumption and the amount of pollutants released in the air. This innovative Automotive Hydrogen on Demand technology decreases fuel consumption by 20%-60% and offers significant reduction of NOx, CO, CO2 and HC emissions.

One of the main and most important components of a good HHO system is the **PWM (Pulse Width Modulator)**. This little electronic circuit board controls and monitors the electrical current flowing throughout the HHO system and regulates the flow so that the best possible hydrogen gas is produced and the highest fuel savings are achieved.

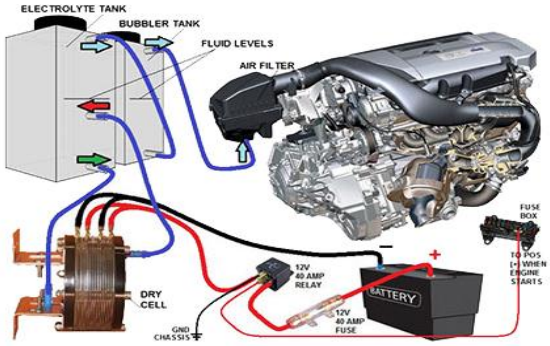


Fig.3. Set-up of the electrolyser using battery only

To run HHO generator PWM is required for better control of the amperage prevents the system from overheating and to have more HHO gas output. PWM is one of the most important gadgets in your HHO System. It keeps the gas/water ratio correct to make the engine run smoothly and efficiently by pulsing the current rapidly on and off. This prevents overheating of the HHO generator and keeps things at a manageable temperature.

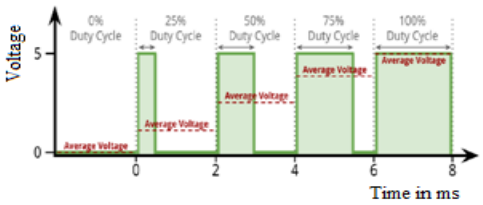


Fig:4 Pulse Width Modulation Duty cycles

PWM Features

- **Maximum Continuous Amperage Output**, not Maximum Amperage. This is the maximum amperage the PWM can be operated at, constantly; long periods, not short operating periods.
- **Automatic Current Limiting**, Constant Current (CC). This allows you to set the Amperage Output to a specific amperage. The PWM then will maintain that amperage, regardless of the water temperature.
- **Adjustable Pulse Frequency**. This allows you to adjust the time between pulses. Fast pulsing causes more heat than slow pulsing. Pulsing turns the cell on and off rapidly; as rapid as you set the frequency.
- **Duty Cycle Adjustment.** The duty cycle reading lets you know if your electrolyte fluids are too weak or too strong as the duty cycle of an automatic current limited PWM will be approximately 70% when the Cell is warmed up (depending on your Cell design). If it is significantly higher, you know you have too little electrolyte and if it's significantly lower, you have too much electrolyte. If the Cell is cold, the current should be at or very close to the set limit (duty cycle will be approximately 100%).

Methodology

To design a constant current supply using pwm method we need to monitor the current and if current crosses the set threshold pwm should be decreased and current is well below set limit then pwm should increase, along with this we are also trying to display the current value too.

Methods can be used to measure current, coupling transformed based, Hall Effect based and sense resistor based. We are using sense resistor based method, in this method current is passed through known value of resistor and IR voltage drop is measure using ADC and current is given by measure voltage divided by resistor value. A very stable value, low value and high wattage resistor is used as current sensor. 10-100 milli ohm 5-10 watt resistors are good selection for our project. As our measurement requirements are from 0.1A to 10A the voltage drop across the resistor will in few millivolts range.

Fig:5 Sense resistor

As the output of the current sensor is very low in few millivolt region. We have designed a amplifier gain of 33(variable is also possible) using dual OpAmp IC LM358. First opamp is designed as differential amplifier and second opamp is designed as comparator. The threshold of comparator can be set as if the current is higher than the predefined hard limit the output of the comparator will go high this is optional extra feature which can be used.

Table: 1 HHO kits mileage results chart

Year	Vehicle information	Engine size	HHO generator	Before	After	Increase
2008	Mini-cooper	1.6 liter	Generator+chip	30 mpg	41 mpg	37%
2009	Mitsubishi Pajero	3.8 diesel	Generator+chip	9.4L/100km	7L/100km	36.0%
2009	Hyundai Genesis	3.8 liter	Generator+chip	22 mpg	40.65mpg	84.77%
2009	GMC yuken	6 liter	Generator+chip	20mpg	33.5mpg	67%
2009	Ford F450	V-10	Generator+chip	7.1mpg	10.1mpg	42.25%
2010	Hyundai Tuscon	2 liter	Generator+chip	14L/km	71L/km	100%
2010	Toyota Camry	2.4 liter	Generator+chip	6km/L	12.33km/L	105.5%

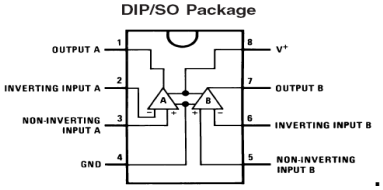
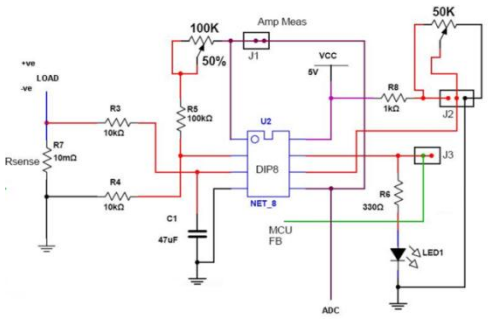


Fig:7 LM358 Pin diagram



Current sensor using sense resistor and LM358 Opamp IC J1 is connected to ADC to current measurement and J3 goes as feed for PWM control. Potentiometer connected at J2 can be used to set the current limit. And 100K potentiometer towards input side is used to set the gain. Here we use I2C ADC PCF8591 which requires only 2 wires (some requires 11 wires ADC0804). This is 4 channel ADC, one channel is used to read current sensor output and other is used for reading voltage at input before regulation via voltage divider network.

Result & discussion

These results are obtained from different vehicles using hydrogen systems, every car is different, and difficult to control the quality of the installation, the shape of the car, how well maintained the engine is, etc., the results may vary. The average gain is 20-50%.

Environmental Friendly

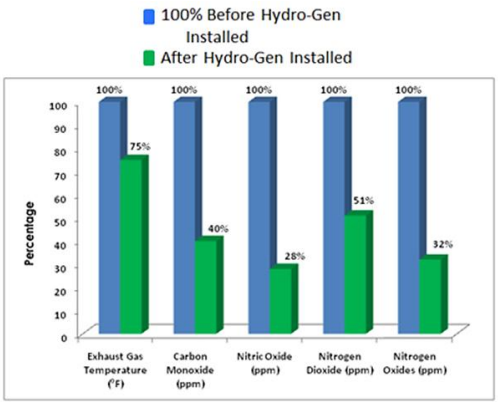
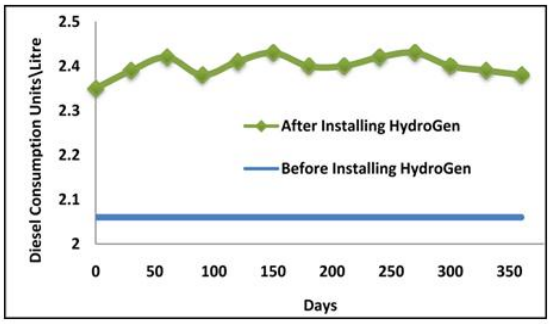


Fig:8 After Hydro-Gen Installed

The bar chart Fig:8 given above show the use of HHO gas reduces the Carbon monoxide (CO) emission to 27%, Nitric Oxide (NO) emission to 28%, Nitrogen dioxide (NO_2) emission to 51%, Nitrogen oxides (NOX) emission to 32%.

Fuel Saving

The below graph Fig:9 shows the excess fuel burnt in the engine which results in the average fuel saving up to 30% depending on the condition of the engine and running platform.



Increase Engine Efficiency

The HHO and Air mixtures, mix with the Hydro Carbon fuel and ignites, which results in complete combustion of the hydrocarbon fuels and lower ignition energy of fuel will results in the following.

1) Increase in fuel efficiency by 10 to 30 %.
2) Investment on Hydro-Gen can be recovered in less than a year.
3) Reducing emission minimum by 60%.
4) Engine runs smoother and vehicle life extended as well.
5) Engine heat-up is minimized to 15 to 20%.

Conclusion

The outcome of experimental studies can draw the following conclusions:

- Results of Hydro-Gen will vary depending on application and the Vehicle. Oxy Hydrogen is not a replacement or alternative fuel for your engine or equipment. It is only the fuel supplementary.
- The dependence of the processing time from the concentration of the electrolyte is exponential in nature.
- HHO system requires very little maintenance. High burning velocity, wide flammability range, oxygen content and absence of carbon make HHO gas an appropriate fuel addition to obtain adequate combustion which yield reputable reduction of HC and CO emissions.
- Hydrogen gas is eco-friendly; it produces low emission and low carbon during use. In this way we can also save LPG for future.

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