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Performance Analysis of 4 Stroke Hybrid (Petrol +Water) Test Rig

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Abstract

In the present scenario the growing concern of the people living in every part of society is the ever increasing price of fuel and the harmful effects caused due to higher level of pollutants in the atmosphere. For that search, alternative fuels are encouraged. One of the closest solution to control the above two concern is the evolution of the hybrid vehicle. The water hybrid vehicle uses an HHO (Oxy Hydrogen) generator to supply hydrogen on demand by Electrolysis. This reduces the exhaust gas emitted during the working of engine, and the temperature of the engine is also reduced which is produced by the burning of ordinary fuels. The HHO gas is injected into the inlet manifold of the combustion chamber through the air filter of the engine. It minimizes the carbon deposition in the cylinder thereby increasing the changing period of engine oil it also improves the efficiency of the engine and the life span.

Keywords: Hybrid Vehicle, HHO Generator, Electrolysis, Exhaust Analysis, Life Span

I. INTRODUCTION

Alternate fuel is important and it should be fossil one. Actually we spend 30% of our income for our vehicle fueling and it produces harmful decomposed materials like CO, NOx, HC, CO_2 etc. in the form of smoke. These materials affect the engine performance and pollutes the environment. Compare to other kinds of fuel around the world, water is one of the free recourses and by applying the technique, it can be converted into hydrogen with oxygen, its chemical term is HHO and in general "Free Energy". HHO is popular and common gas produced from electrolysis. HHO referred to as Hydrogen gas, water gas, and brown gas (in automotive applications) is a weekly bonded water molecule which exists in gaseous state. It is 2:1 molar mixtures of hydrogen and oxygen this mixed HHO ignites releasing the extra electrons into the igniting fuel and thus the added extra energy from the HHO leads cent percent of complete burning of the fuel. The only by-product resulting from the combustion of Hydrogen gas within the engine is water vapor. The outcome get by this project is that there is increasing in mileage of the vehicles up to certain percentage according to their specification & running condition of vehicle.

II. DETAIL DESCRIPTION

A. Working Principle

An HHO generator is a device which produces HHO gas. Basically, HHO generator involved in production of hydrogen and oxygen through the process of electrolysis. In this process a DC current is passed through water, as a result of which water is divided into its primary constituent's viz. Hydrogen and oxygen. Then the produced HHO gas with the help of electrolysis is added in to the air intake manifold and injects in to the cylinder where HHO & fuel mixture ignites and results complete combustion of the hydrocarbons fuel, lowering emission and increasing fuel efficiency.

B. Properties of Hydrogen

- Wide Range of Flammability: The flammability limits (possible mixture compositions for ignition and flame propagation) are very wide for hydrogen (between 4 and 75 percentage hydrogen in the mixture) compared to gasoline (between 1 and 7.6 percentage). This means that the load of the engine can be controlled by the air to fuel ratio. Nearly all the time the engine can be run with a wide open throttle, resulting in a higher efficiency.
- Low Ignition Energy: Hydrogen has very low ignition energy. The amount of energy needed to ignite hydrogen is about one order of magnitude less than that required for gasoline. This enables hydrogen engines to ignite lean mixtures and ensures prompt ignition.

- Small Quenching Distance: Hydrogen has a small quenching distance, smaller than gasoline. Consequently, hydrogen flames travel closer to the cylinder wall than other fuels before they extinguish. Thus, it is more difficult to quench a hydrogen flame than a gasoline flame.
- High Auto ignition Temperature: The temperature may not exceed hydrogen's auto ignition temperature without causing premature ignition. Thus, the absolute final temperature limits the compression ratio. The high auto ignition temperature of hydrogen allows larger compression ratios to be used in a engine.
- High Flame Speed: Hydrogen has high flame speed at stoichiometric ratios. Under these conditions, the hydrogen flame speed is nearly an order of magnitude higher (faster) than that of gasoline. This means that hydrogen engines can more closely approach the thermodynamically ideal engine cycle. At leaner mixtures, however, the flame velocity decreases significantly.
- High Diffusivity: Hydrogen has very high diffusivity. This ability to disperse in air is considerably greater than gasoline and is advantageous for two main reasons. Firstly, it facilitates the formation of a uniform mixture of fuel and air. Secondly, if a hydrogen leak develops, the hydrogen disperses rapidly. Thus, unsafe conditions can either be avoided or minimized.

Table - 1

Properties of diesel, petrol, CNG, H_2 [3,4,5,6]

Sr. No	*Properties*	*Diesel*	*Petrol*	*CNG*	*H_2*
1.	*Auto Ignition Temperature(K)*	*530*	*533-733*	*723*	*858*
2.	*Minimum Ignition energy(mj)*	*--*	*0.24*	*0.28*	*0.02*
3.	*Flammability Limits (volume% in air)*	*0.7- 5*	*1.4 -7.6*	*0.4-1.6*	*4 – 75*
4.	*Stoichiometric air fuel ratio on mass basis*	*14.5*	*14.6*	*14.49*	*34.3*
5.	*Flame velocity(cm/sec)*	*30*	*37- 43*	*38*	*265-325*

C. Production of Hydrogen

We are using electrolysis method to producing the HHO. It is safe method as compare to the using the readymade HHO cylinder, because the readymade HHO is difficult to handle and store also it is more explosive. So, it requires more care and attention.

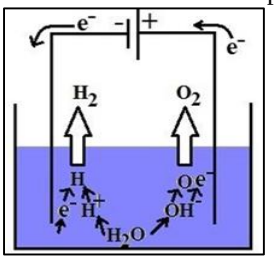

Fig. 1: Electrolysis of Water

In electrolysis of water electrical energy is used to break water into H_2 and O_2. An electrolysis cell consists of two electrodes, commonly flat metal or carbon plates, immersed in an aqueous conducting solution called the electrolyte. A source of DC voltage connected to the electrodes so that electric current flows through the electrolyte from anode to cathode .By placing two pieces of metal in electrolyte and applying electricity, the water (H_20) can instantly be separated into hydrogen and oxygen. The separated gas molecules surface and regroup to form HHO gas, which is an unbounded mixture of Hydrogen and Oxygen. Since water itself is the poor conductor of electricity an electrolyte like KOH is used to increase the electric conduction

D. Experimental Setup

An experimental set-up line diagram is shown as below. A conventional S.I engine of Hero Honda Ambition bike of 100cc is used as an experiment. Hydrogen generation is carried out by the HHO generator which held the process of electrolysis of water .A 12V current which is required to carry out electrolysis process i.e. HHO generation process. Water needed for this process is high quality water like D.M water or Distilled water or R.O water .The water used for this purpose is changed after 1000kms. Or say after water color changes to maroon/red accent. Following is the HHO generator we have used for this experiment.

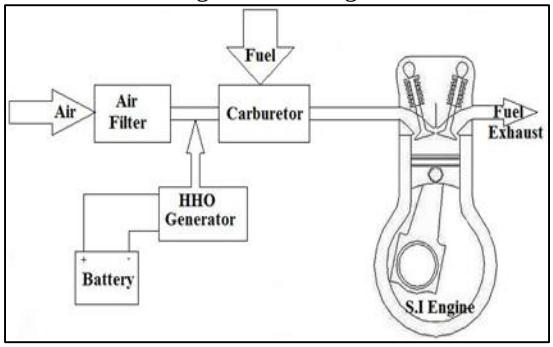

Fig. 2: Schematic illustration of HHO system

III. WORKING &ANALYSIS OF MODEL

Fig. 3: Experimental Setup

Table - 2
Engine Specification

Vehicle Name	*Hero Honda Street*
Type	*Four stroke SI Engine*
No. of cylinder	*One*
Maximum power	*6.5 bhp/8000 rpm*
Start	*Kick*
A/F ratio	*14.7:1*
Engine displacement	*100 cc*

A. Working of HHO gas in engine

In the combustion chamber the Petrol which comes from the fuel tank gets mixed up with the mixture of air and hydrogen gas coming from the HHO generator. The hydrogen gas mixed with air enriches the fuel. As the hydrogen gas is highly flammable it helps in efficient burning of the fuel. Hydrogen has higher flame speed and H_2 addition results in lean combustion.

Fig. 4: Without HHO

Fig. 5: With HHO

We introduce it into the engine by use of the engines vacuum. The HHO combines with air and is burnt together in the combustion chamber. Once burnt, it converts back to H_20.Water absorb the inner heat from the engine normal at 350 - 450°F and turn into super-heated dry steam then it's pushed out during the exhaust stroke and out the tail pipe. The most amazing part of the process is that the emissions are reduced to exceptionally clean low levels.

B. Fuel Consumption & Performance

Table - 3
Fuel Consumption (No Load Condition)

Sr. No	*Fuel Consumed*	*Fuel consumed (sec) petrol only*	*Fuel consumed (sec) petrol+ HHO*
1.	*10 ml*	*64.2*	*71.4*
2.	*10 ml*	*67*	*80*
3.	*10 ml*	*70*	*78*
		Avg= 67.06	*Avg= 76.46*

- Under normal conditions average time taken for 10ml of fuel consumption is 67.06 sec
- Using HHO gas the average time taken for10ml of fuel consumption is 76.46 sec.
- So we save 9.4 sec for every 10ml of fuel consumption.

Table - 4
Engine Readings

Weight, W (kg)	*Spring Balance Reading, S (kg)*	*Net Load on Engine, W-S (kg)*	*Engine Speed, N (rpm)*	*Fuel consumed (Sec) Petrol only*	*Fuel consumed (sec) Petrol-HHO Engine*
25	*6*	*19*	*1045*	*32*	*36*
25	*6*	*19*	*2310*	*25*	*28*
25	*5*	*20*	*3116*	*23*	*27*
25	*5*	*20*	*4287*	*22*	*25*

IV. CONCLUSION

Analysis have been carried out to investigate the effect of HHO gas on the emission and performance of a 4 stroke engine. A new design of HHO fuel cell has been performed to generate HHO gas required for engine operation. The generated gas is mixed with a fresh air in the intake manifold. The exhaust gas concentrations have been sampled and measured. The following conclusions can be drawn.

- HHO cell can be integrated easily with existing engine systems
- The engine thermal efficiency has been increased, when HHO gas has been introduced into the air/fuel mixture, consequently reducing fuel consumption.
- The concentration of NOx, CO and HC gases has been reduced, when HHO is introduced into the system.
- The best available catalyst was found to be KOH, with concentration 6 g/L.
- The proposed design for separation tank takes into consideration the safety precautions needed when dealing with hydrogen fuel.

It is recommended for the future work to study the effect of both compression ratio and ignition advance on the engine performance and emissions with introducing HHO gas into the gasoline engine.

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