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Emissions measurement of various blends of oxy hydrogen gas and gasoline in 4-S S.I. Engine

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Abstract: The ever increasing cost of conventional fossil fuels and their associated environmental impact have become major concerns worldwide.[1] In order to conserve the petroleum fuels for future and to eliminate the environmental problems there is need of alternative fuel. Using hydrogen or hydrogen enriched gas has proved to be one of the viable solutions for alternative fuel. . this study is carried out to investigate the effect of HHO gas addition on engine emission and it with pure gasoline fuelled engine. Here the HHO gas was produced by the process of water electrolysis and device called HHO generator has been easily integrated with SI engine test rig. The experimental work is carried out on a 250cc single cylinder petrol engine under constant speed with varying load condition. Amount of HHO gas aspirated into the combustion chamber along with intake air system at Four different amperes i.e. 1 ampere,3 ampere 5 ampere and 6 ampere with 12 volts DC supply at compression ratio 7. The result shows that the carbon monoxide (CO) has been reduced by 38.6% and hydrocarbon (HC) has been reduced by 39.7% .

Keywords: Internal combustion engine, Petrol engine, electrolysis, Oxy hydrogen gas, Emission.

INTRODUCTION

Development in science and technology has benefited mankind in many ways but it had also brought some serious challenges. In today, s scenario every house in developed and developing country has at least one two or four wheeler at their home. Almost all energy supplied to the world is by fossil fuels which burns and emits wastes, hazardous emissions like CO, HC, NO_X etc which are responsible for acid rains, glacier melts and serious health hazards. Cost escalation and increase in demand of the crude petroleum and failure to invent an alternative source of fuel are the current day problems. Numerous researchers in the world are involved in the field of developing alternative fuels and to reduce emission by external means like use of catalytic convertors and engine modifications. However some researchers [2] have also suggested the use of additives like brown gas, blending vegetable oils with petrol etc to reduce emissions. In this present research work an attempt to study the effect of brown gas on engine performance and emission was done.

About HHO Gas

It is a mixture of 2/3 of hydrogen and 1/3 of oxygen bonded together molecularly. It is generally produced by electrolysis of water. When electric current passed through water, it divides into hydrogen and oxygen The hydrogen and oxygen rise from the liquid water as gas. This gas is called HHO Gas or Browns gas. After producing gas it is introduced into the air suction pipe and complete combustion occur. Oxy hydrogen gas was used as a supplementary in four cylinders, four strokes, spark ignition (S.I), compression ignition (C.I) engine without any modification and without need for storage tanks. It will help in burning the fuels completely i,e, complete combustion of fuels , which not only saves the fuel but also helps out atmosphere by reducing emissions.

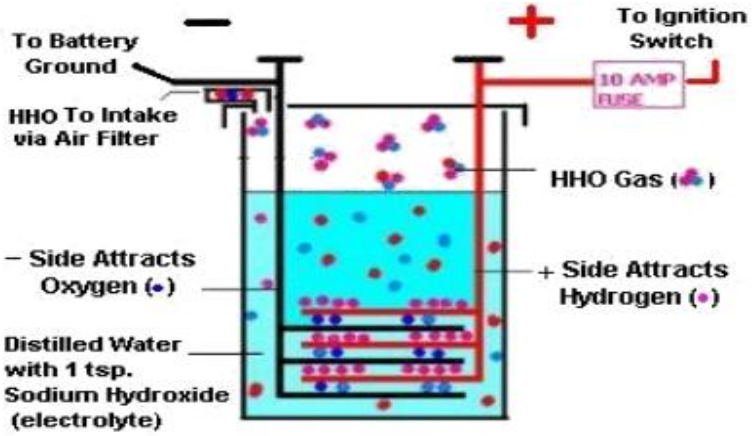

Figure1. Working principle of HHO Generator

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Table 1: Combustion properties of hydrogen and gasoline

Property	Hydrogen	Gasoline
Flammability limits (% by volume)	4 – 75	1.2 – 6.0
Minimum ignition energy (MJ)	0.02	0.25
Laminar flame speed at NTP (m/s)	1.90	0.37 – 0.43
Auto ignition temperature (K)	858	≈ 500 – 750

LITERATURE REVIEW

Most of the work has been done on the use of pure hydrogen as an additive, thought it gives better performance than any other alternative fuels available but, at same time which brings problem of storage, hydrogen supply infrastructure and wide flammability range makes it hazardous therefore viable solution to this problem is to produce it on board through water electrolysis and utilized it in the form of hydrogen-oxygen mixture and a very few research has been done on this concept therefore researches done in the recent years have been reviewed as follows.

S.Bari and M.Esmaeil [3] were performed experimentation on four cylinder direct injection diesel engin e the experiment were carried out under constant speed of 1500 rpm with three different power level of 19 Kw, 22Kw and 28 Kw applied. Under each load condition flow rate of diesel and other parameter were recorded without HHO then small amount of HHO mixture was introduced to the engine and measured the performance parameter at each load condition then flow rate of HHO gas was increases and required data were collected.

The result showed that with introduction of HHO gas at different percentage into diesel engine, the brake thermal efficiency increased by 2.6% at 19Kw, 2.9% at 22 Kw and 1.6% at 28 Kw. The brake specific fuel consumption of engine reduced by 7.3% at 19 Kw, 8.1% at 22kw and 4.8% at 28 Kw. It was also noticed that adding HHO beyond 5% does not have significant effect on engine performance. The emissions HC, CO and CO2 were found to be reduced while NOx increases due to higher temperature achieved during combustion process.

Ammar A. Al-Rousan [4] conducted performance test on the single cylinder spark ignition air cooled 197cc engine and HHO production system was designed, constructed, integrated with a gasoline engine. i.e. the output of fuel cell connected to the intake manifold of the gasoline engine and performance test was performed before and after attaching fuel cell with constant load and variable speed (from 1000 to 2500 rpm) and result shows that brake thermal efficiency increase about 3% for cell B and 8% for cell C and 20 to 30% reduction in fuel consumption and exhaust temperature. And research showed that use of HHO in petrol engine enhances combustion and optimum surface area needed to generate enough amount of HHO is about twenty times that of piston surface area also, the volume of water needed is about one and half times engine capacity. Leelakrishnan and Suriyan [5] investigated the effects of HHO gas enriched air on the performance of a single cylinder, four stroke, 5.4 kW SI petrol engine. Enriched air was supplied to the engine through a passage between the air filter and the carburetor. Results reported indicate 5% improvement in brake power, 7% improvement in thermal efficiency, 6% reduction in fuel consumption, 88% reduction in unburnt hydrocarbons (HC), 94% reduction in CO and 58% reduction in NOx. These values were reported at full load. However, no information was given on the rate of production of the HHO gas or whether there was variation in gas production during the test. Fenil desai, Priyanka dave and Hitesh tailor conducted research on performance and emission assesement [6] of hyro oxy gas in four stroke spark ignition engine.

Elecronic control unit was designed and manufactured to decrease HHO flow rateby decreasing voltage and current. In the experimental setup analysis of the performance of internal combustion engine was analysed where a blend of HHO gas was provided with the conventional fuel like petrol or diesel. With the addition of HHO gas,Specific fuel consumption decreased by 22%at 1960 RPM,whereas Sox and NOx emissions were reduced by 15% and more than 50% CO2 reduction.

Amruthraj M,Natraj J and Sushmit poojary [7] controlled emission in internal comustion engines to a greater extent. A hydrolyse kit was designed which reduced the hydrocarbons emissions by 99.25% and carbon monoxide emissions by 98.688%.

EXPERIMENTAL SETUP AND PROCEDURE

Figure 2 shows the schematic diagram of experimental system. The experiment was conducted on 256cc S.I. engine using carburetor system. The engine was coupled to electrical dynamometer in order to load the engine. For loading engine four electrical

heaters each of 350 watts available in the system. HHO production system was integrated with engine setup.HHO gas generated by dry cell using 12 volt external DC supply. The generated HHO is then introduced into the engine via the air inlet manifold. The current controller and PWM was employed to control the current fed to the electrolytic cell. For the analysis of emission, exhaust gas analyzer connected to the exhaust pipe. It gives emission quantity present in gas like CO and HC.

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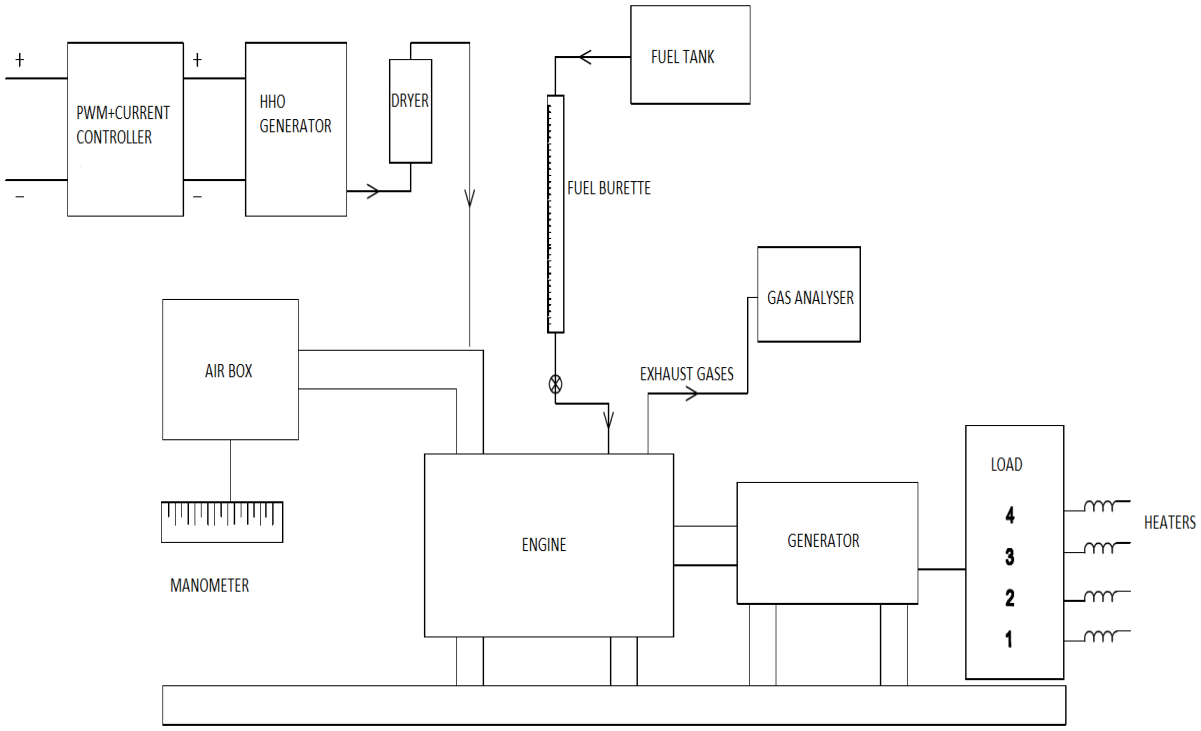

FIG 2- Schematic diagram of experimental setup

ENGINE DETAILS

The engine used in experimentation is constant speed air cooled single cylinder, 4-stroke petrol engine. The specification of engine as follows.

Table 3.1 Test Engine Specification

Make of the Engine	Crompton Greaves MK
Rated Power	2.2 Kw @ 1500 RPM
Bore/stroke (mm)	70mm/66.7 mm
Compression Ratio	7:1
Swept volume (cc)	256 cc

RESULTS AND DISCUSSIONS

In this investigation, emission characteristics of a petrol engine were studied using HHO mixture enrichment at a constant speed of 1500 rpm. The flow rate of HHO mixture was varied to obtain optimum emission and the engine was tested at four different current of 1ampere, 2ampere, 5ampere, 6ampere. In this experiment, the HHO mixture was generated using 12 volts external power supply.

EMISSION PARAMETERS

CO EmissionIt is noticed that the addition of small quantities of HHO gas to the primary gasoline significantly reduced CO exhaust emissions. One major reason for the reduction in CO level could be the availability of oxygen inside the cylinder which enters with hydrogen fuel due to which complete combustion occurs. Also the HHO-gasoline mixture burns faster and more completely than the pure gasoline.

Thus, CO emission at high speed and lean conditions is effectively reduced after hydrogen addition. Optimum reduction in CO is achieved is from 1.8 % to 1.10 % (38.8 % reduction) at 5ampere HHO production at full load condition.

5.2.2. HC Emission
Figure 5.7 depicts the variation of hydrocarbon (HC) with HHO addition under different load condition.

With pure gasoline HC emission is 432 ppm which is reduced to 258 ppm with induction of HHO at 5 amp with 40.277 % reduction.

This decrease in percentage is due to oxygen index of HHO which yields better combustion, flame quenching distance of hydrogen present in gas is very less and also due to absence of carbon of in hydrogen fuel.

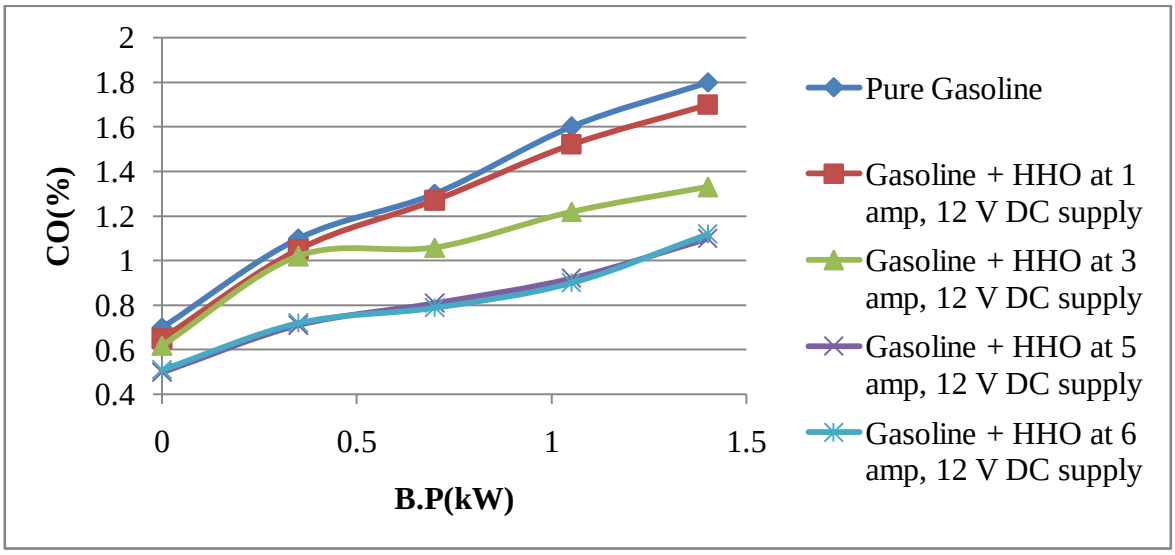

Fig 5.6 Variation of CO% with brake power at CR 7

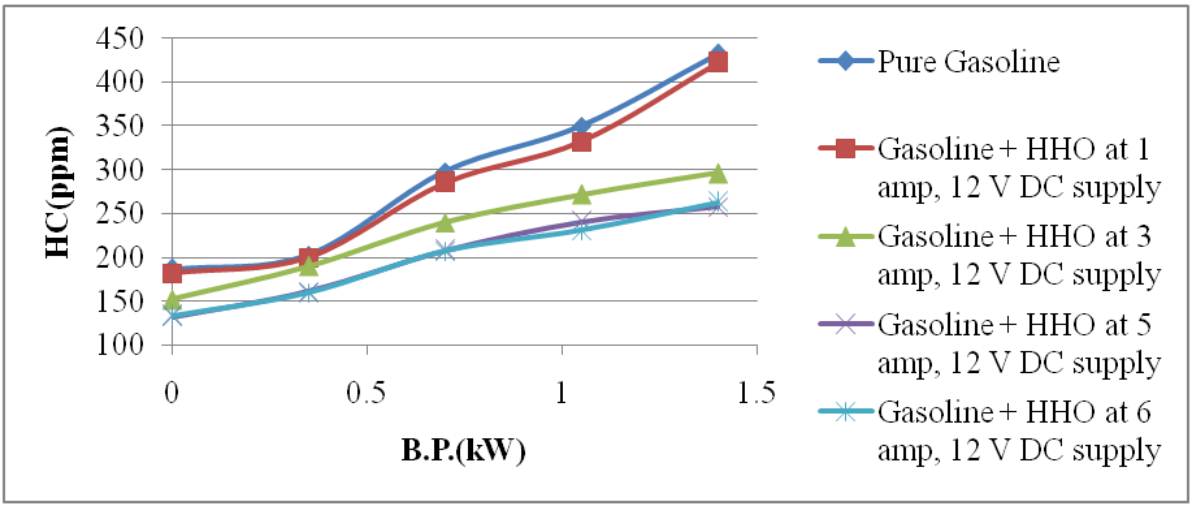

Fig 5.7 Variation of HC with brake power at CR 7

CONCLUSIONS

The main results obtained from the present study are as follows

1) At full load condition, 5 amps, CR 7 the concentration of HC has been reduced by 40.277 %. This decrease in percentage is due to oxygen index of HHO which yields better combustion, flame quenching distance of hydrogen present in gas is very less and also due to absence of carbon of in hydrogen fuel.

2) At full load condition, 5 ampere, CR 7 the concentration of CO has been reduced by 38.88 %. One major reason for the reduction in CO level could be the availability of oxygen inside the cylinder which enters with hydrogen fuel due to which complete combustion occurs. Also the HHO-gasoline mixture burns faster and more completely than the pure gasoline.

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