

Emission Reduction and Mileage Boosting using HHO Kit: A Review

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Abstract— In today's world, fuels like petrol and diesel plays important role for development of any country. But, people living in the society are facing basically two types of problems related to fuel:-1) Increase in fuel prices.2) Emissions of harmful gases from automobile. Worldwide research is being conducted to reduce these two problems, also various automation companies are searching for a device that could reduce fuel consumption by engine and also reduce emission from the engine. As a result, brown gas (HHO) has been introduced to automobile industries as a new source of energy. This brown gas is produced by electrolysis process which contains a mixture of 2/3 of hydrogen and 1/3 of oxygen [3]. This electrolysis process to generate brown gas is carried out in HHO dry cell made up of a stainless steel plate acting as electrodes. The electrolyte used in this process is made by mixing KOH or NaOH in distilled water. Power required to carry out electrolysis process is taken from battery of vehicle. The propose HHO device is compact and can installed in vehicle near engine. This article gives a review of effects of HHO gas on engine exhaust gases and vehicles fuel consumption.

Key words: Wireless Sensor Networks, WSNs Design, Network Topologies, OSI Model Layers, Sensor Nodes

I. INTRODUCTION

As we know that, in an IC engine, complete combustion of fuel does not take place and near about 20 to 30% of energy of fuel is wasted through exhaust gases and incomplete combustion. To overcome this problem, the system or device is to be used which would carry out complete combustion of fuel and increase thermal efficiency of engine. Thus the concept of hydro powered vehicles is introduced. These are the vehicles which use hydrogen as well as conventional fuel for driving the vehicle, which results in increase of mileage of the vehicle[3]. Hydrogen gas kit is the latest invention to increase mileage and power of vehicle. The gas produced from this kit is Odourless, Colourless and lighter than air and highly flammable much more than gasoline. Also the hydrogen is a clean fuel which on combustion produces water vapor as the only product [4]. The use of hydrogen in IC engine helps to reduce pollution and reduce the poisonous gases like carbon monoxide, nitrous oxide etc., along with increase in efficiency of engine. This generated HHO gas is then supplied to intake manifold of engine.

II. WORKING PRINCIPLE AND EXPERIMENTAL SETUP

Electrolysis process is used for producing brown gas and the electrical supply used for this process is supplied from vehicle's battery. The setup usually consists of two tanks-1) Electrolyte tank 2) Bubbler tank. HHO gas is produced in HHO dry cell. Dry cell consists of number of steel plates. The DC power is supplied to these steel plates. When the electric supply is passed through these steel plates, hydrogen is

liberated at cathode and oxygen is liberated at anode. The amount of hydrogen liberated depends upon number of various factors such as number of plates, surface area of plates, spacing between plates, electrolyte, etc. Amount of hydrogen generated is twice the number of moles of oxygen and both are proportional to total electrical charge conducted by the electrolyte solution. This HHO gas is then supplied to bubbler tank which acts as a flame arrester and restricts the back flow of flame during the operating condition. Proportional amount of HHO gas is supplied to intake of engine. Current is supplied through electrolysis circuit when the vehicle is started, and HHO starts producing [3].

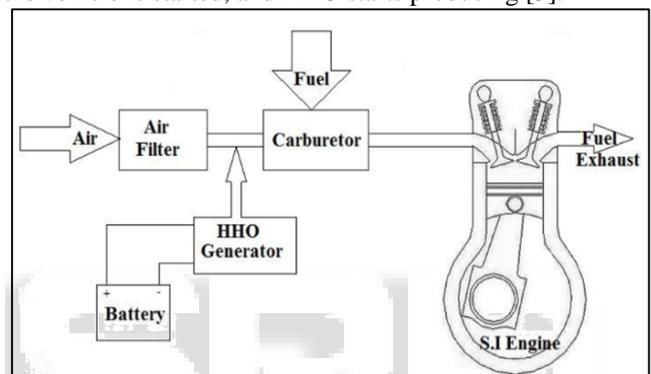


Fig. 1: Working Principle [2]

III. WORKING

As the vehicle is started, electric supply is given by the battery to the steel plates of dry cell. The electrolyte is circulated through plates of dry cell. Due to passage of electric current, electrolysis occurs in the plates which lead to liberation of hydrogen and oxygen on anode and cathode. Hydrogen generated at cathode is supplied to the air hose pipe in between the air filter and carburetor. This HHO gas then mix with the air coming from the air filter and thus further gasoline is mixed in this mixture in the carburetor. This entire mixture of gasoline and HHO gas is sent to engine cylinder during suction stroke. During the ignition stroke of engine, spark is generated by spark plug, thus combustion of gasoline and HO gas occurs. HHO gas contains 1/3 oxygen and 2/3 hydrogen by volume and has octane rating of 130 and improves the octane rating of gasoline after mixing with it. Due to presence of hydrogen, the combustion rate of gasoline is highly increased, burning the combustion chamber complete and clean. The hydrogen explosion fills the combustion chamber 3 times faster than the gasoline explosion, hence more power is generated which leads to increase in mileage of vehicle and also complete combustion of fuel leads to reduction in exhaust gases. PWM is used to control the voltage of supply current [4].

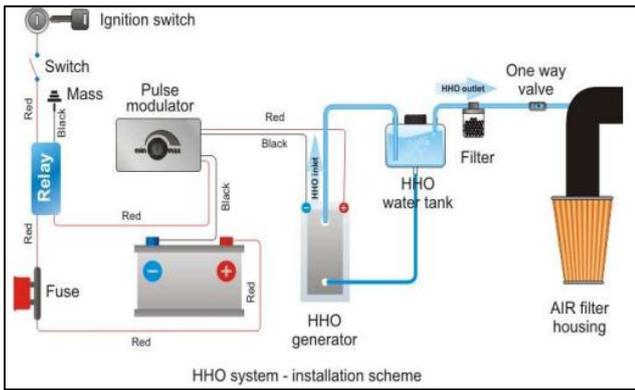


Fig. 2: HHO Kit Installation Diagram [3]

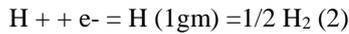
IV. ENERGY CALCULATION

If small battery of power rating 12V and 5 ampere is used, the following calculation can be obtained, [4]

$$Q = I \times t \quad (1) = 5 \times 60 = 300 \text{ C}$$

In electrolysis half moles of H_2 is generated. According to faraday's law, 1F of charge deposits 1 gm equivalent (equivalent weight in gm) of any compound.

In electrolysis;



1F deposits 1 gm hydrogen

Since $1F=96500C$ Therefore

96500 C charge deposits 1gm H_2

Therefore amount of H_2 deposited by 300 C charge = $(1 \times 300) / 96500 = 0.0031088 \text{ gm}$

A. The amount of H_2 liberated:

Amount of H_2 generated = 0.0000031088 kg

Calorific value of $H_2 = 121000 \text{ kJ/kg}$

Energy released by hydrogen = $m \times CV \text{ of } H_2$

$$= 0.0000031088 \times 121000 = 0.3761 \text{ kJ} = 3761 \text{ J}$$

B. The amount of O_2 liberated:

During electrolysis, $O_2 - 2e^- = O \text{ (16gm)}$

2F deposits 16 gm O_2

1F deposits 8gm O_2

96500C deposits 8gm O_2

300C will deposit this amount of $O_2 = (8 \times 300) / 96500 = 0.099948 \text{ gm}$.

Amount of O_2 liberated = 0.0009948 gm

C. Approximate fuel calculations:

For running 2.25min (145sec), engine requires 5ml fuel

For running 60 sec fuel required = $(5 \times 60) / 145 = 2.06 \text{ ml}$

Calorific value of gasoline (LCV) = 44400 KJ/kg

2.06 ml = 2.06 gm = $2.06 / 1000 = 0.00206 \text{ kg}$

Energy released by fuel in 60 sec = $m \times CV \text{ of fuel} = 0.00206 \times 44400 = 91 \text{ kJ}$

V. RESULTS

The further results are possible by using HHO kit for a 150cc petrol engine. These results are obtained with and without supply of hydrogen gas to engine. This graph shows the emission of HC and NO_x with respect to rpm[4]. Also, SFC, BHP and RPM graphs shows the improvement in an engine performance and increase in mileage after supply of hydrogen to the engine[1].

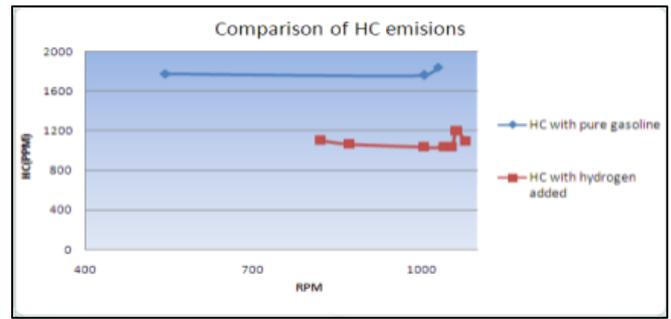


Fig. 3: HC vs RPM Graph [4]

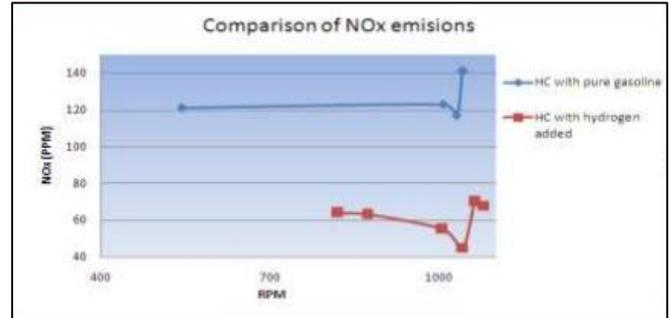


Fig. 4: NO_x vs RPM Graph [4]

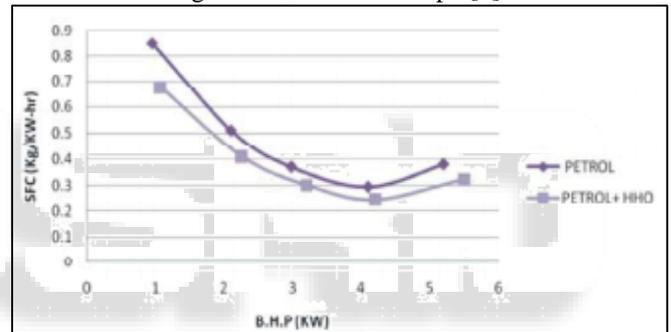


Fig. 5: SFC vs BHP [1]

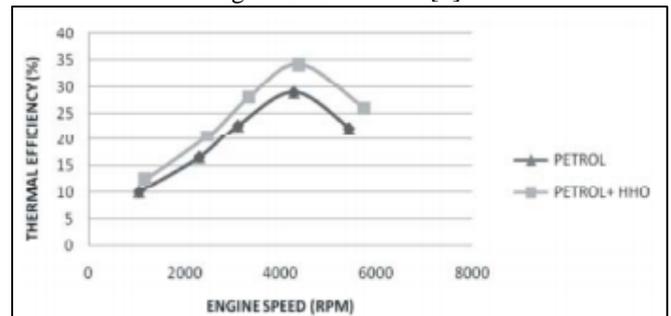


Fig. 6: Thermal Efficiency vs Engine Speed [1]

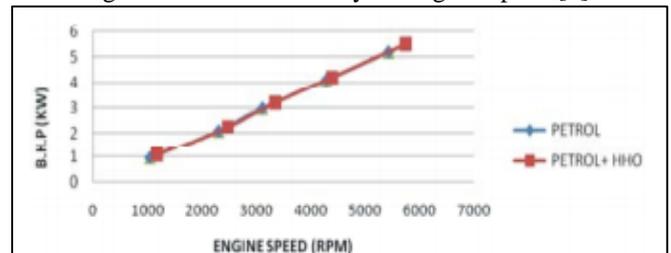


Fig. 7: BHP vs Engine Speed [1]

VI. CONCLUSION

Hydrogen being highly flammable cannot be stored in any container. There is huge chance of explosion of hydrogen by such storing. But, by using an HHO kit, hydrogen can be created at the time of requirement instantly. This reduces the chances of certain accidents. The use of hydrogen in IC engines can reduce HC and NO_x emissions up to great extents. Also complete combustion of fuel may lead to increase in mileage of vehicle. This could help in reducing the pollution and also reducing the fuel consumption. There are further research going on the production of hydrogen at higher rate and using the hydrogen in an IC engine instead of gasoline fuel.

REFERENCES

- [1] V. Jose Ananth Vino, Vyas Sunil Ramanlal, Yemmina Madhusudhan "Performance Analysis of Petrol-HHO Engine".
- [2] Dhananjay Babariya, Jay Oza. Bhavin Hirani, Gaurang Akbari "An Experimental Analysis of SI Engine Performance with HHO as Fuel".
- [3] Shadabkhan Pathan, Sanket Saundatte, Asif Shaikh, Sahir Shaikh, Gopal Vadar, Prof.M.B.Tandale "Efficiency Improvement of IC Engine by Using HHO Kit"
- [4] Saumya Khulbe, Narayan Khatri, P.S.Ranjit "Feasibility Establishment With on Board Generated Hydrogen supplementation and Studies on Emission characteristics of Gasoline Engine".
- [5] Aaditya, Abhishek, Ajay, Vipin, Deepak "Hydrogen Powered Petrol Engine.