USE OF HYDROGEN GAS AS SUPPYMENTRY FUEL IN 4 –STROKE SI ENGINE

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ABSTRACT

In this paper, we are analysing the scope of hydrogen as a supplementary fuel, in 4-Stroke internal combustion gasoline engine. A hydrogen generation system for producing hydrogen and injecting the hydrogen as a fuel supplement into the air intake of carburettor.Hydrogen and oxygen is produced with a fuel cell at low temperature and pressure from water in a tank. The device is powered by vehicle battery .The system is modified such that power is permitted to electrolysis cell only when ignition switch is turned ON.The performance and emission characteristics of a conventional single cylinder spark ignition (SI) engine operated on hydrogen and gasoline has been reviewed.

Keywords-*Emission, Hydrogen,KOH, Mileage, Performance.*

I.INTRODUCTION

The use of hydrogen (H_2) as a fuel in internal combustion engines has been studied by a number of research groups worldwide in response to the consumer demand for more environmentally friendly fuel chains. Compared with conventional, fossil hydrocarbon fuels, hydrogen offers practically an elimination of pollutants such as carbon monoxide and unburnt hydrocarbons, known to pose health risks in densely populated areas. The only nontrivial pollutant from hydrogen engines is nitrogen oxides (NO_x), however the characteristics of hydrogen fuel, such as a high flame speed and extensive leanburn operation possibilities, allow significant reductions in NO_xcompared to when using conventional fuels.

The incentives for a hydrogen economy are the emissions, the potentially CO2-free use, the sustainability and the energy security. In this project the focus is on the use of hydrogen in internal combustion engines (ICE), or more precisely, hydrogen fuelled spark ignition (SI) engines. Internal combustion engines are classified as spark ignition (SI) and compression ignition (CI) engines, depending on the combustion process initiated in the cylinder. A spark plug initiates the combustion of the fuel-air mixture in SI engines. In CI engines, fuel-air mixture is self-ignited by compression. It must be mentioned that hydrogen's auto-ignition temperature is high (about 576), and it is impossible to bring hydrogen to its auto-ignition temperature by compression only. So, Supportive ignition triggering devices should be used in the combustion chamber. The current energy crisis urges us to explore a variety of alternate methods to satisfy the world's energy demands. A major market solution for the energy crisis is increasing supply and reducing demand for crude oil. By increasing the list of feasible fuel alternatives, the demand on crude oil reduces. Among all the potential environment-friendly alternative fuels of the future, hydrogen is one of the most promising in terms of practicality, long term feasibility and low pollution levels.

Hydrogen fuelled engines are known for many advantages, among which the very low concentration of pollutants in the exhaust gases compared to internal combustion engines using traditional or other alternative fuels. Further on, because of the wide flammability limits and the high flame propagation speed of hydrogen, a hydrogen fuelled engine is capable of very lean combustion. To be able to run a hydrogen engine, the mixture

formation of air and hydrogen does not need precise control.Consequently, simple systems such as an external mixture system with a gas carburettor (venture type) can be used for the fuel supply.

The current energy crisis urges us to explore a variety of alternate methods to satisfy the world's energy demands. A major market solution for the energy crisis is increasing supply and reducing demand for crude oil. By increasing the list of feasible fuel alternatives, the demand on crude oil reduces. Among all the potential environment-friendly alternative fuels of the future, hydrogen is one of the most promising in terms of practicality, long term feasibility and low pollution levels. Thus it has the capability to contribute majorly towards solving two major issues: energy security and climate change.

Hydrogen has a very low energy density when compared to gasoline. This is a disadvantage for storage, transport and safety purposes since it will need to be stored at very high pressures. In addition, hydrogen cannot be used to produce energy by combustion at temperatures below 0 Celsius, since the fuel requires a higher temperature to burn. Therefore the challenge becomes storing hydrogen at extremely high pressures without drastically reducing the temperature.

II.SCOPE OF PROJECT

By installing a setup in which hydrogen is being formed and then it is being added to engine through air intake from carburettor a steady rise in mileage of bike is being seen and a great decrease in emission level is being seen. If such setup are being used in each and every vehicle worldwide then the global problem of pollution can be minimized to a certain extent and the growing dependency of our country on foreign oil can be minimized.

In our experimental setup we have made the setup in such a way that after every 1000km of running of engine the water needs to be cleaned and new distilled water has to be top-up upto a certain level and again it has to be fitted into the vehicle. A new technique can be developed in near future where no maintenance is required and the vehicle can continuously run without any maintenance.

III.LITERATURE SURVEY

Hydrogen has received increased attention as an environmentally friendly option to help meet today's energy needs. The road leading to an understanding of hydrogen's energy potential presents a fascinating tour through scientific discovery and industrial ingenuity. Many ways of producing hydrogen have been invented and this hydrogen was used in many ways for various purpose.

These are some of invention done in past history to produce hydrogen and made them use in various sectors

1766 - Hydrogen was first identified as a distinct element by British scientist Henry Cavendish after he separated hydrogen gas by reacting zinc metal with hydrochloric acid. In a demonstration to the Royal Society of London, Cavendish applied a spark to hydrogen gas yielding water. This discovery led to his later finding that water (H2O) is made of hydrogen and oxygen.

1800 –English scientists William Nicholson and Sir Anthony Carlisle discovered that applying electric current to water produced hydrogen and oxygen gases. This process was later termed "electrolysis."

1839 – The fuel cell effect, combining hydrogen and oxygen gases to produce water and an electric current, was discovered by Swiss chemist Christian Friedrich Schoenbein.

1920s – German engineer Rudolf Erren converted the internal combustion engines of trucks, buses and submarines to use hydrogen or hydrogen mixtures.

1958 – The United States formed the National Aeronautics and SpaceAdministration (NASA). NASA's space program currently uses the mostliquid hydrogen worldwide, primarily for rocket propulsion and as afuel for fuel cells.

1995 – The Chicago Transit Authority unveiled the first of theirthree hydrogen fuel cell buses. The small pilot fleet began operationthe following year.

IV.EXPERIMENTALDETAILS

4.1 Experimental Setup

- The setup consist of H_2 kit, rubber pipe, electric wires, bike.
- The H_2 kit is attached to the bike, It consist of two electrode anode and cathode and the mixture of distilled water and KOH are used
- The H_2 kit is connected to the carburettor through the rubber pipes.
- The cathode of the starter of the bike through the electric wire and anode is connected to the any one part of the metallic part for the purpose of earthing.

The plastic container has treated water and the electrodes such that the electrode is being submerged in the water so that all the stainless steel plates are being submerged inside water. The electrodes are submerged such that hydrogen can be easily formed.

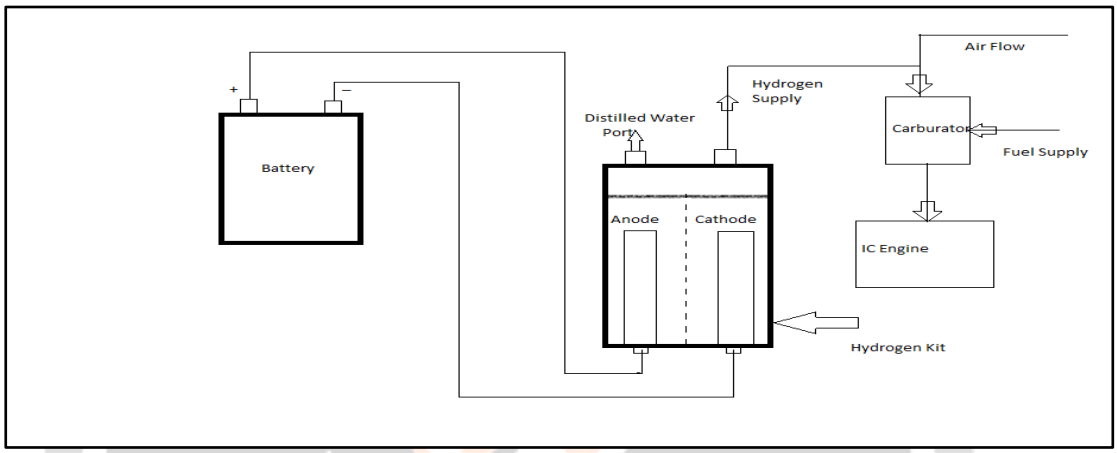


Fig. 1: Schematic Diagram of Hydrogen Production

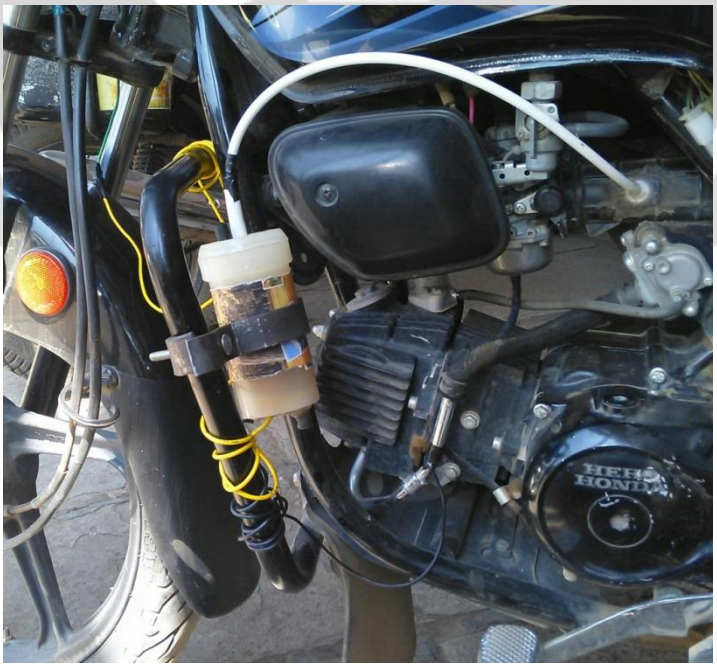


Fig. 2: Plastic container containing treated water and electrodes

4.2 Experimental Analysis

The plastic container containing distilled water and stainless steel plates which are being connected to battery, gives out bubble formation which is very quick and uniform.The bubble formation on connection to the battery

is very quick and this hydrogen gas which is produced at a rate of 1 bubble per second can be easily put inside the engine.

The exhaust of the engine has also very few nitrous oxide content, carbon dioxide content. For hydrocarbon engines, lean operation also leads to lower emissions of carbon monoxide and unburned hydrocarbons. As more oxygen is available than required to combust the fuel, the excess oxygen oxidizes more carbon monoxide into carbon dioxide, a less harmful emission. The excess oxygen also helps to complete the combustion, decreasing the amount of unburned hydrocarbons.

V.RESULT

1) Emission Result

From this experiment we study the emission of vehicle (two wheeler) will be decreased to a great extent. See thereadings which gives from "AUTO EXAHAUST MULTIGAS ANALYSIS MODEL NPM-MGA"for petrol engine vehicle. Emission table given follows.

Table 1.EmissionWithoutH_2 kit :**Table 2.**EmissionWith H_2 Kit:

Gases	Content
Hydrocarbon	1034ppm
Carbon monoxide	1.230 %
Carbon dioxide	1.90 %
Oxygen	15.95 %

Gases	Content
Hydrocarbon	70 ppm
Carbon monoxide	0.032 %
Carbon dioxide	2.90 %
Oxygen	15.92 %

2) Performance Test Result

Performance test result of 4-stroke engine is carried out on Two Wheeler Chassis Dynamometer

2.1Gear test:

Table 3. 3rd Gear Test(Without H_2 kit)

T (N-m)	RPM-Dyno	Vs	P-dyno (BHP)	Pv-Roll (BHP)	P-wheel (BHP)	F-Tractive Effort
3.1	433	24.16	0.19	0.29	0.48	52.46
6	348	19.42	0.30	0.23	0.53	72.05
9.2	336	18.75	0.44	0.22	0.66	93.67

Table 4.3rd Gear Test(With H_2 kit)

T (N-m)	RPM-Dyno	Vs	P-dyno (BHP)	Pv-Roll (BHP)	P-wheel (BHP)	F-Tractive Effort
3.2	453	25.28	0.21	0.30	0.51	53.13
6.1	450	25.11	0.39	0.30	0.69	72.73
9.1	375	20.93	0.49	0.25	0.73	93.00

2.2Braking Performance:

Table 5.(Without H_2 kit)

Brake Speed	Brake Time(Sec)	Brake Dist. (m)
20	0.9	2
30	1.4	5
40	1.7	9

Table 6. (With H_2 kit)

Brake Speed	Brake Time(Sec)	Brake Dist. (m)
20	0.8	2
30	1.5	6
40	1.8	9

3) Fuel Average Test(On Road)

Table 7.(Without H_2 kit)**Graph 1**- Fuel Average Performance (Without H_2 kit)

Road Speed KMPH	Dist. Covered 'm'	Fuel Consumed CC	Average KMPL
40	1681	25	67.24
50	1675	25	67

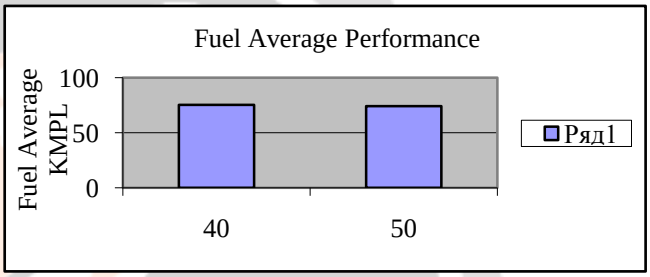
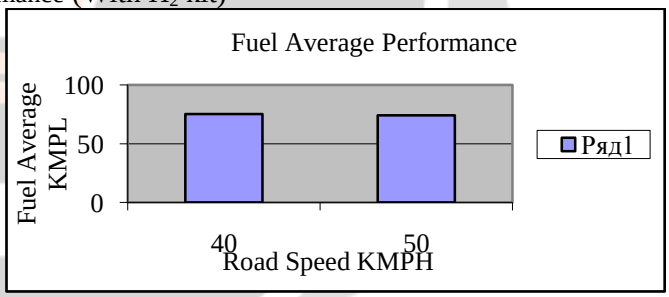


Table8.(With H_2 kit)**Graph 2-** Fuel Average Performance (With H_2 kit)

Road Speed KMPH	Dist. Covered 'm'	Fuel Consumed CC	Average KMPL
40	1880	25	75.2
50	1850	25	74



ADVANTAGES

1) It reduces emission.
2) Easy to service regular maintenance & low maintenance unit.
3) Suitable for petrol, diesel, CNG or LPG engines.
4) Increases pick-up power.
5) Increases average & life of engine.
6) It reduces engine noise & vibration.
7)

MAINTENANCE

1) Check water level at every 200 kms.
2) Check the gas pipe for leakage.

VI.CONCLUSION

Hydrogen is a fuel with heat content nearly three times that of gasoline. From our work we experimentally found out that the efficiency of an IC engine can be rapidly increased by mixing hydrogen with gasoline. We conducted two tests. Experiment with test rig and a road test with two wheeler. In both cases we observed reduction in fuel consumption.it is a clear evidence that addition of hydrogen along with petrol can results in increase in the power of the engine or increase in mileage. Moreover the various emissions normally produced from IC engines can be reduced. Thus use of hydrogen in IC engines as a fuel can be considered a huge leap in the field of automobile engineering. In this project we have proved that the mileage of the bike can be increased up to 9-10% by adding hydrogen with the petrol.

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