Hydro Petrol Engine - A Technical Review

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Abstract

Now a day's energy crises and pollution are major problems. The present investigation is to enhance performance and lower emission characteristics of a single cylinder spark ignition engine operating with hydrogen blends. The hydrogen is blended in different percentage of 5%, 10% & 15% of petrol in a four stroke single cylinder. The load is varied from no load to full load in step by step. The engine in which the experiment to be conducted is a variable speed engine. To change the speed an accelerator is connected with carburetor. The performance and emissions parameter of engine are. 1) Brake Thermal Efficiency, 2) Brake Specific Energy Consumption, 3) Volumetric Efficiency, 4) Emission (CO HC NOx). These all parameter are to be determined and compared with base line readings of petrol.

Keywords- Hydro Petrol Engine, Spark ignition engine (SI engine), Hydrogen Blends

I. INTRODUCTION

A. Engine:

An engine, or motor, is a machine designed to convert one form of energy into mechanical energy. Heat engines, including internal combustion engines and external combustion engines (such as steam engines) burn a fuel to create heat, which then creates a force. Electric motors convert electrical energy into mechanical motion, pneumatic motors use compressed air and others—such as clockwork motors in wind-up toys—use elastic energy. In biological systems, molecular motors, use chemical energy to create forces and eventually motion.

1) Types of Engine

1) Internal Combustion Engine
- Spark ignition engine
- Compression ignition engine

2) External Combustion Engine
- Steam engine
- Turbines

B. Internal Combustion Engine:

In an Internal combustion engine, combustion takes place within working fluid of the engine, thus fluid gets contaminated with combustion products.

Petrol engine is an example of internal combustion engine, where the working fluid is a mixture of air and fuel.

Internal combustion engines may be classified as:

- Spark Ignition engines.
- Compression Ignition engines.

1) Spark ignition engine (SI engine): An engine in which the combustion process in each cycle is started by use of an external spark.
2) Compression ignition engine (CI engine): An engine in which the combustion process starts when the air-fuel mixture self-ignites due to high temperature in the combustion chamber caused by high compression.

Spark ignition and Compression Ignition engine operate on either a four stroke cycle or a two stroke cycle

3) Four stroke cycle: It has four piston strokes over two revolutions for each cycle.
4) Two stroke cycle: It has two piston strokes over one revolution for each cycle.

We will be dealing with Spark Ignition engine and Compression Ignition engine operating on a four stroke cycle.

II. NEED OF THIS PROJECT

Anytime fuel source are decreasing and pollution by them is increasing day by day. Like noise pollution, air pollution etc. so that present fuelling system is put in question. Every day many gallon petroleum products irrupt from earth and that source of fuel is day by day gating low. Moreover, in order to meet the stringent EUROeVI standards, automobile manufacturers are compelled to try out emission, more precisely NOx and smoke reducing alternatives like LPG, ethanol, CNG (compressed natural gas),Hydrogen etc. As a result a lot of the research studies are now oriented toward finding a cleaner burning fuel with satisfactory combustion and performance signatures.

Here we are trying to create a better fuel mixture of hydrogen and petrol without additives in conventional S.I engine to achieve hydro-petrol mixture and to reduce emission of pollutants.

Finally it is decided to use following fuel as hydrogen in petrol engine to increase the performance and reducing the emission of an engine.

- Petrol
- Hydrogen

Table 1: Properties of Hydrogen and gasoline

Property		Gasoline	Hydrogen
Molecular mass, [$kgkmol^{-1}$]		114	2.016
Theoretical air-fuel ratio, [$kgkg^{-1}$ comb]		14.5	34.32
Density at 0°C and 760 mmHg, [kgm^{-3}]		0.735-0.760	0.0899
Flammability limits in air, at 20 °C and 760 mm Hg	vol.%	1.48-2.3	4.1-75.6
	λ	1.1-0.709	10.12-0.136
Flame velocity in air (λ = 1), at 20 °C and 760 mmHg [ms^{-1}]		0.12	2.37
Octane number		90-98	>130
Minimal ignition energy in air [mJ]		0.2-0.3	0.018
Autoignition temperature, [K]		753-823	848-853
Lower heating value (gas at 0 °C and 760 mmHg)	Stoichiometric fuel-air mixture [kJm^{-3}]	3,661	3,178
	[$kJkg^{-1}$]	42,690	119,600

III. LITERATURE REVIEW

A. *Shivaprasad K.V, Dr. Kumar G.N, Dr.Guruprasad K.R:*

Fast depletion of fossil fuels and their detrimental effect to the environment is demanding an urgent need of alternative fuels for meeting sustainable energy demand with minimum environmental impact. A lot of research is being carried throughout the world to evaluate the performance, exhaust emission and combustion characteristics of the existing engines using several alternative fuels such as hydrogen, compressed natural gas (CNG), alcohols, liquefied petroleum gas (LPG), biogas, producer gas, bio-diesels, and others.

Expert studies indicate hydrogen is one of the most promising energy carriers for the future due to its superior combustion qualities and availability. This paper provides a comprehensive overview of hydrogen as a fuel for Spark Ignition (SI) internal combustion engine. Discussed topics are introduction to hydrogen, its basic properties, flexibility of hydrogen as a fuel for SI engine, performance and emissions of hydrogen fuel operated SI engine. Also it includes the most significant advances and developments made on the technical adaptations in the SI engine which operate with hydrogen. Finally, it describes the best design of the fuel induction system for SI engines when they are fed with hydrogen.

In recent years, the internal combustion engine powered vehicles have been criticized for their role in environmental pollution through exhaust emissions of mainly the oxides of nitrogen (NOx), carbon monoxide (CO), and unburned hydrocarbons (UBHC). Hydrogen is considered to be clean and efficient alternative fuel among the available. Like electricity, hydrogen is an energy carrier not an energy source. Many scientists have worked both experimentally and analytically with internal combustion engine with hydrogen as fuel. Some of those literatures related to hydrogen are discussed with respect to hydrogen fueled spark ignition engine.

A primary advantage of hydrogen over other fuels is that its only major oxidation product is water vapour. The hydrogen is the most abundant material in the universe and during its combustion with air does not produce significant amounts of carbon monoxide (CO), hydrocarbon (HC), smoke, oxides of sulphur (SOx), leads or other toxic metals, sulphuric acid deposition, ozone and other oxidants, benzene and other carcinogenic compounds, carbon dioxide (CO2), formaldehyde and other greenhouse gases. The only undesirable emission is nitric oxide (NO) and nitrogen dioxide (NO2), which are oxides of nitrogen (NOx) which can collect and avoid their emission to the atmosphere.

B. Suhas B.G:

Considering energy crises and pollution problems today much work has been done for alternative fuels for fossil fuels and lowering the toxic components in the combustion products. The present investigation is to find performance and emission characteristics of a single cylinder spark ignition engine operating with hydrogen blends. The hydrogen is blended in different volume fraction of 3%, 6%, 9% and 12% of petrol in a four stroke single cylinder Villiers's engine for different load. The load is varied from no load to full load in steps of one fourth, half and three forth of the full load. The engine in which the experiment to be conducted is a constant speed engine. The performance and emissions of engine such as, brake thermal efficiency, brake specific energy consumption, volumetric Efficiency, exhaust gas temperature, carbon monoxide, unburnt hydrocarbons and oxides of nitrogen are to be determined and compared with base line readings of petrol.

1) The brake thermal efficiency increases as percentage of hydrogen blend increases. There is an average increase of 6.32%, 10.8%, 14.63% and 17.8% for the hydrogen blend of 3%, 6%, 9% and 12% respectively with respect to gasoline.
2) The brake specific energy consumption decreases as the percentage of hydrogen blend increases. There is a an average decrease of 15.66%,21.32%,28.72% and 36.34% for the hydrogen blend of 3%,6%,9% and 12% respectively with respect to gasoline.
3) The volumetric efficiency decreases as the percentage of hydrogen blend increases. There is an average decrease of 6.15%, 11.22%, 18.23% and 24.36% for the hydrogen blend of 3%, 6%, 9% and 12% respectively with respect to gasoline.
4) The carbon monoxide decreases as the percentage of hydrogen increases. There is an average decrease of 11.38%,20.56%,28.67% and 38 43% for the hydrogen blend of 3%, 6%, 9% and 12% respectively with respect to gasoline.
5) The Unburnt hydrocarbon decreases as the percentage of hydrogen blend increases. There is an average decrease of 8.82%, 14.47%, and 24.05% for the hydrogen blend of 3%, 6%, 9% and 12% respectively with respect to gasoline
6) The NOx increases as the percentage of hydrogen blend increases. There is an average increase of 17.92%, 32.56%, 50.61% and 61.2% for the hydrogen blend of 3%, 6%, 9% and 12% respectively with respect to gasoline.
7) From the experiment that was conducted, one can conclude that the engine goes towards lean mixture. This is because of higher flammability of hydrogen and higher diffusion speed.

C. N.S.GandhiA.V.Kulkarni, Dr.R.S.Jahagirdar:

Energy sector is presently facing two major problems of future energy crisis and environmental degradation. To combat the above mentioned difficulties, use of hydrogen as an energy carrier may be a strategic plan in near future. Researchers are working on this issue throughout the world in the quest of powering two- and three-wheelers as well as passenger cars and buses) to decrease local pollution at an affordable cost. This paper offers a comprehensive overview of the fundamentals of hydrogen combustion, dedicated hydrogen engine features, the effect of mixing hydrogen with other hydrocarbons and the related performance and emissions. The high octane number and the low lean-flammability limit of hydrogen provide the necessary elements to attain high thermal efficiencies in an engine. The brake thermal efficiency and most of the emissions are improved when hydrogen blends are used as fuels in IC engine.

D. N.S.GandhiA.V.Kulkarni, Dr.R.S.Jahagirdar:

Fossil fuel consumption is steadily rising in industrial as well as in transportation sector as a result of population growth in addition to improvements in the standard of living. The continually depleting resources of fossil fuel and the highly toxic emissions which are produced due to these fuels have largely hastened the need for alternate fuels for internal combustion (IC) engines. Several fuels have been tried for running internal combustion engines. These include straight vegetable oil, biodiesel, alcohol, natural gas and hydrogen. Hydrogen has been found to have several properties which are essential for a green alternate fuel to be used in IC engines.

Its high auto ignition temperature and low ignition energy coupled with its various other combustive properties help in enhancing engine performance. The high diffusivity of hydrogen which is about four times that of gasoline improves the mixing process of fuel and air. As the burning velocity rises the actual indicator diagram is nearer to the ideal diagram and the thermodynamic efficiency increases. However, due to the high adiabatic flame temperature of hydrogen, the pure hydrogen-fuelled engine always suffers a poor NOx emissions performance, which has become the biggest barrier for its wide commercialization.

Andrea et al. investigated the effect of various engine speeds and equivalence ratios on combustion of a hydrogen blended gasoline engine and found that the combustion duration decreased with the increase of hydrogen blending fraction. Li et al. [4]

Demonstrated that the NOx, HC and CO emissions from a hydrogen enriched gasoline engine were reduced. Demopoulos indicated that greenhouse emissions can be effectively reduced by hydrogen addition. Ji and Wang investigated the effect of hydrogen addition on a gasoline-fuelled SI engine performance under idle and stoichiometric conditions.

IV. SUMMARY OF LITERATURE REVIEW

- Hydrogen is one of the most promising energy carriers for the future due to its superior combustion qualities and availability.
- Fast depletion of fossil fuels and their detrimental effect to the environment is demanding an urgent need of alternative fuels.
- The volumetric efficiency decreases as the percentage of hydrogen blend increases. There is an average decrease of 6.15%, 11.22%, 18.23% and 24.36% for the hydrogen blend of 3%, 6%, 9% and 12 respectively with respect to gasoline in %.
- The carbon monoxide decreases as the percentage of hydrogen increases. There is an average decrease of 11.38%,20.56%,28.67% and 38 43% for the hydrogen blend of 3%, 6%, 9% and 12% respectively with respect to gasoline.
- The Unburnt hydrocarbon decreases as the percentage of hydrogen blend increases. There is an average decrease of 8.82%, 14.47%, and 24.05% for the hydrogen blend of 3%, 6%, 9% and 12% respectively with respect to gasoline
- The NOx increases as the percentage of hydrogen blend increases. There is an average increase of 17.92%, 32.56%, 50.61% and 61.2% for the hydrogen blend of 3%, 6%, 9% and 12% respectively with respect to gasoline.
- Researchers are working on this issue throughout the world in the quest of powering two- and three-wheelers as well as passenger cars and buses to decrease local pollution at an affordable cost.
- that HC emissions are effectively reduced with the increase of hydrogen blending ratio, in a spark ignited ethanol engine and reach the minimum value of 1019 ppm at a H2= 5.49%.
- State that hydrogen addition in fuel reduces unburnt hydrocarbons to an extent of 6 to 20% depending on fuel consideration.
- Drop in NOx emissions from 52 ppm at the original engine to a largely lower value at 4.5% of the hydrogen enriched gasoline engine.
- On the upper literature review we conclude that we working on the different ratio of hydrogen and petrol and get the better fuel mixture for engine and better future. We try to get best emission of hydrogen mixture and get less polluted norm like NOx, HC or CO.

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