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Experimental Study on Performance Analysis of Internal Combustion Engine Operated on Hydrogen Enriched Fuel Cell

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A B S T R A C T

Internal combustion engines, which have become a crucial component of the transportation and agricultural industries, are practically impossible to replace. The supply of fossil fuels is finite and dwindling quickly. Hence, in the future, our energy system must be sustainable and renewable, effective and economical, practical and secure. Many studies and tests on various types of car engines have been conducted in order to address environmental concerns. According to previous studies, hydrogen-fueled vehicles proved to be more environmentally benign and widely available. However, in order for hydrogen powered engines to be developed further and made commercially available, issues such as pre-ignition, backfiring, a quick rate of pressure rise, and knocking must be resolved. This review article essentially discusses the numerous issues with using hydrogen-powered engines in the automotive industry and offers solutions to make this technology economically viable.

Keywords: engines, combustion, fuels, hydrogen, energy, fossil, issues, industries

1. Introduction

1.1 Background

Overuse of fossil fuels results in energy shortages and environmental issues. To achieve carbon neutrality by 2050, many nations have suggested zero-emission plans and sustainable energy roadmaps. Energy consumption and the effects of global warming can be reduced by using hydrogen as a sustainable energy source to replace fossil fuels. More nations are making a commitment to the advancement of fuel cell and hydrogen energy technology.

The fuel cell is a device that uses energy and water to make hydrogen gas electrochemically, without releasing any hazardous gases or greenhouse gases. Fuel cell technology is now advancing quickly in a number of industries, including transportation, housing, and power generation. The benefits of the fuel cell, including its portability, simplicity, and quick start-up, have been used in several industrial and domestic applications. Sadly, the main constraints of cost and durability prevent fuel cells from being widely employed commercially. In order to do this, researchers are examining a number of strategies to increase the robustness and lower the price of fuel cell systems.

With the growth of a hydrogen economy, hydrogen is seen as a promising energy source that can help address the global issues of fossil fuel dependence and climate change.

1.2 Problem Statement

We are trying to make a system that will create hydrogen, and we will test it on an actual engine and compare it to petrol.

The price of fuel cells is high. We will try to make it at a low cost.

Develop a system that will deliver hydrogen made from fuel cells to an engine.

Improve efficiency of vehicle more than the gasoline vehicle.

1.3 Objectives

Develop a system that will transfer hydrogen to engine and take test of spark ignition engine, with minimum design changes.

Improve the fuel efficiency of engine, to counter the depleting fossil fuel reserves and its increasing prices.

Making fuel cell at low cost.

Reduce emission from the engine.

2. Process

We are making a system that will generate hydrogen from water by giving electricity to it and then hydrogen generated from it will be transfer to the spark ignition system. First component of our system is fuel cell, we placed steel plates inside the fuel cell casing. When electricity through battery is given to the steel plates by electrolysis process hydrogen starts generating. We will not store hydrogen created from fuel cell, we will directly send it to engine by the carburetor mechanism. Firstly we are sending petrol in higher ratio than the hydrogen, hydrogen will be lesser as compared to petrol. After we will increase the ratio of hydrogen and we will decrease the petrol ratio. After all this we will take readings like mechanical efficiency, thermal efficiency, torque, etc. and compare it with conventional petrol engine.

3. Components and assembly of setup

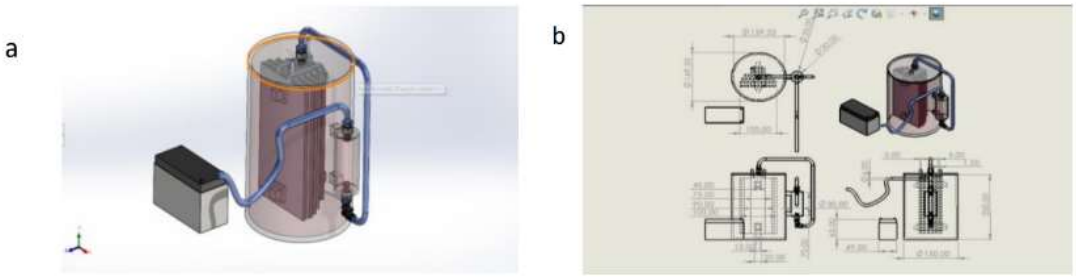

Fig. 1 - (a) Isometric View; (b) Orthographic View.

4. Methodology

In order to produce hydrogen and send it to the spark ignition engine, which does the beneficial job, we are building fuel cells. The scientific community is moving towards ecologically friendly energy sources because of the dangerous impacts of emissions from conventional fuel cars. Although there are many renewable energy options, hydrogen is the best one to use as a fuel for cars. Hydrogen is an energy carrier with the capacity to transport tremendous amounts of energy, just like electricity.

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5. Actual setup

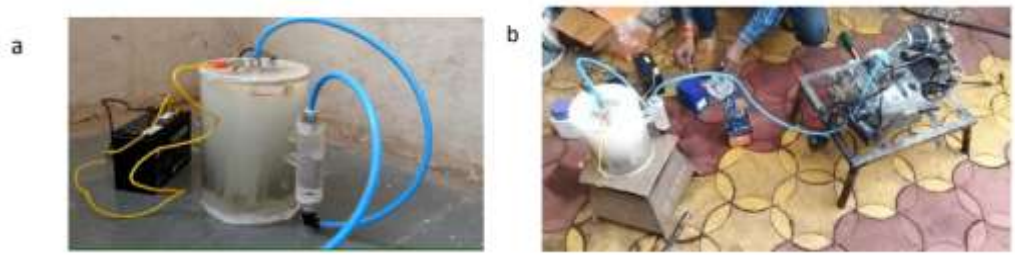

Fig. 2 - (a) Fuel cell; (b) Setup.

6. Engine specification

Engine Specifications	
Engine Type	Air Cooled, 4-stroke
Displacement	97.2 cc
Max Torque	8.05 Nm @ 6000 rpm
No. of Cylinders	1

Cooling System	Air Cooled
Bore	50 mm
Stroke	49.5 mm

7. Test results

While producing hydrogen, a fully charged 2.5 Ah battery discharged in 15 minutes.

Red flames are generated while burning hydrogen.

From 1 kg of water, 110 g of hydrogen gas is produced at normal temperature and pressure.

Ignition temperatures for hydrogen were 660 °C and 250 °C for petrol.

8. Conclusion

Hydrogen is a plentiful alternative fuel, but it cannot be found in nature in a free state; instead, it must be created through a number of different processes. With a few changes, the hydrogen gas can be used in internal combustion engines that typically run on gasoline. Following a review of relevant literature, the following ideas have become clear:

Without requiring significant adjustments, hydrogen can be used as an alternate fuel in engines using compression ignition as well as spark ignition. In the investigation, it was also discovered that the Nox emissions are 10 times lower for hydrogen than with gasoline. Except for a few traces of these emissions caused by the burning of lubricating oil layers on the cylinder walls, HC and CO were determined to be minimal.

The installation of a sequential injection system in place of carburetion can solve the backfire issue. Direct injection of liquid hydrogen into the manifold is another method to lessen the issue of backfire, primarily because of the enhanced cooling.

Pre-ignition in the intake manifold is a different issue related to the hydrogen that can be resolved by direct injection. The study has also shown that internal combustion engines can run on both gasoline and hydrogen.

Using enhanced design can also significantly reduce surface ignition. Lean combustion may be accomplished by hydrogen engines in practice.

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