Hydroxy production as a mileage booster for two-wheeler

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Abstract. The overall goal of this project is to demonstrate the potential for commercialization of hydrogen as a fuel enhancer. The major component of this project is conversion of gasoline powered motorcycle to use hydrogen as an additive and increase the fuel combustion. The eventual goal is to supply the vehicle with domestically produced renewable hydrogen. Renewable hydrogen can be obtained from process such as electrolysis process using low cost electricity, hydrogen as a by-product [1]. The produced hydrogen is supplied to the air intake valve. Here it combines with the air fuel mixture and enters the combustion chamber of the engine. The hydrogen assists in complete combustion of the fuel thereby reducing the fuel consumption. The reduced fuel consumption increases the fuel efficiency of the engine. The gases released through the exhaust comprises more of oxygen compared to carbon dioxide. This method also allows as to decrease environmental pollution and to reduce the consumption of fossil fuels.

Key words. HHO Generator, Bubbler, Sodium hydroxide flakes, Battery

1. Introduction

The average annual rate of energy consumption and the gross domestic product have been growing at a significantly greater rate in India and China as compared to worldwide averages. With this project, we aim at reducing the emission of greenhouse gases and thereby reducing the carbon footprint made by every engine [1]. The difficulty in storage feasibility of hydrogen has led to the ON-DEMAND production of hydrogen. The overall goal of this project is to demonstrate the potential for commercialization of a hydrogen-enhanced vehicle using HHO generator on demand. Hydrogen mixes with the air-fuel mixture thereby increasing rate of combustion. The combustible hydrogen is provided through the engine air-intake. The assembled HHO generator is fixed onto a 150cc bike and an external battery source is provided to power up the generator. An HHO gas generator uses electrolysis process to split water into its base molecules, two hydrogen & one oxygen [2-3]. The produced hydrogen-oxygen gas mixture is passed through the water bubbler for filtration process.

2. HHO GENERATOR

The steel plates are connected with the help of nylon screws and individual cells are set-up. The plates are arranged in the manner plate-washer-plate-nuts. The connecting plates are used to keep the entire set-up intact and connect the plates to the external screw, through which the electric charge is passed. [3] This screw is passed through
the Teflon cap keeping the plates in contact with the cap. The entire plates is covered and kept inside the acrylic tube. The tube is enclosed with the Teflon caps on either sides with the help of m-seal. The electric charge is applied to the generator and the hydrogen produced is applied onto the bubbler for filtration process. The HHO generator circuit was set-up. Sodium Hydroxide added to the generator. When connected to a 12V battery electrolysis process began. The produced hydrogen is bubbled through water filter. The produced gas confirmed to be hydrogen with the pop sound on combustion.

![Project Methodology](image)

**Figure 1.** Project Methodology

| S.No | List of Components                  |
|------|-------------------------------------|
| 1.   | Two-wheeler                         |
| 2.   | HHO Generator                       |
| 3.   | Bubbler                             |
| 4.   | Battery                             |
| 5.   | Connecting wires                    |
| 6.   | Connecting tubes                    |
Table 2. Two-wheeler Specification

| Parameter               | Value                  |
|-------------------------|------------------------|
| Displacement            | 147.5cc                |
| Maximum power           | 12bhp@7000rpm         |
| Maximum torque          | 10.5Nm@6000rpm        |
| No. of cylinders        | 1                      |
| No. of gears            | 5                      |
| Ground clearance        | 155mm                  |
| Fuel tank capacity      | 12L                    |

Table 3. Materials used for creating the hydrogen Generator and their dimensions

| Materials                  | Dimensions        | No. Off |
|----------------------------|-------------------|---------|
| Big plates                 | 152x75mm          | 2       |
| Small plates               | 152x38mm          | 4       |
| Connecting plates          | 152x25mm          | 1       |
|                            | 101x25mm          | 1       |
|                            | 82x25mm           | 1       |
| Acrylic tubes              | 177.8x101.6mm     | 1       |
| Teflon caps                | _                 | 2       |
| Plastic washers            | _                 | 6       |
| Nylon screws               | _                 | 2       |
| Nuts                       | 8mm               | 6       |
|                            | 10mm              | 10      |
| Distilled water            | _                 | 1L      |
| Sodium hydroxide           | _                 | 100g    |
| M6 screw                   | 40mm              | 2       |

Figure 2. 101mm diameter acrylic tube
The steel sheet was cut in basic engineering lab as per the following dimensions:

Big plates: 152x75mm
Small plates: 152x38mm
Connecting plates: 152x25mm, 101x25mm, 82x25mm.

Figure 3. Steel plates, screws, washers and nuts

Figure 4. Finished generator product
3. Bubbler

It is made by enclosing the top and bottom end of an 80mm long 25mm diameter acrylic tube with PVC caps. It has an inlet and outlet holes. Quarter portion of the bubbler is filled with water. Through the inlet, there is a small pipe going into the bubbler, which should be immersed into the water. As a result, the hydrogen enters into the water and forms bubbles. This gas is passed through the outlet of the bubbler. [4] The hydrogen is passed into the combustion chamber by making a hole in the carburetor and inserting by a tube coming from the bubbler.

4. Battery

12V 35amps battery is used as a power source for the generator. The positive and negative terminals of the battery are connected to generators ends using connecting wires, being in contact the current is passed onto the plates and the electrolysis of water takes place. As a result splitting the water molecules into two-hydrogen molecule and one oxygen. The process of hydrogen production can vary depending on the power source applied. When tried with a more powerful battery more bubble formation was observed.

Figure 5. Bubbler
5. Connecting Wires
Two wires of 1 meter long are used. One end of both the wires is inserted and fixed onto a connector pins. These wires helps in transporting the current to the generator.

II. Stepwise Progress
Stage A- Required acrylic tube of 101mm diameter and stainless steel plate of 304mmx609mm was bought.

The steel sheet was cut in basic engineering lab as per the following dimensions:
- Big plates: 152x75mm
- Small plates: 152x38mm
- Connecting plates: 152x25mm, 101x25mm, 82x25mm.
- Required nylon screw, washers and nuts bought. The acrylic tube was cut at 177.8mm long using a hacksaw blade sodium hydroxide flakes used as catalyst was acquired.

![Figure 6. Sodium hydroxide flakes](image)

Stage B
- Plates are drilled to insert screw through them. The plates are arranged to form electrodes. They are arranged in the manner plates-washer-plates-nuts. Nylon screws are used to keep the plates together. Metallic nuts are used to space the plates evenly. Distilled water and catalyst sodium hydroxide mixed. Entire generator was set up.
Stage C
The gap between the acrylic tube and the Teflon cap is sealed with m-seal. Generator tested and production of hydrogen confirmed. Generator fixed on bike and remaining tests taken

Figure 7. Holes being punched on metal sheets

Figure 8. Equipment fixed on bike (Full view)
6. Testing & Result

A. Test to Do

As our project, title shows ‘MILEAGE BOOSTER’, our ultimate aim is to show the increase in mileage. To show this, production of hydrogen itself is not enough, we have to apply it into a running engine and obtain the result. In addition, the production of hydrogen has to be proved. Proof for hydrogen is done using the splint test.

B. Major Tests

Mileage test, before and after applying hydrogen. Emission test, before and after applying hydrogen. Emission test is done to show the decrease is pollution by using hydrogen as an additive.

The hydrogen generator was initially made by applying PVC caps on both ends and filling the gap with silicone gel. This did not seems like a good option as the caps were placed loosely and under high pressure, leakage of hydrogen could be possible and dangerous. Therefore, these PVC caps were replaced with Teflon caps, which provided intact position and no leakage. As a final measure, the m-seal was used to fix the caps onto the tubes.

When the generator was first tested using a low powered battery, the production of hydrogen was fatal. As a result there was a change made to the number of plates in the generator, few plates had to be removed and then applied a powerful battery. This showed great result in production of hydrogen.

C. Splint Test

The production of hydrogen was confirmed with this test. Here on applying current to the generator the formation of bubbles inside the bubbler could be observed. Hydrogen is very flammable gas and explodes on contact with flame. To conduct the test the outlet tube from the bubbler was immersed into a small cap filled with water. Formation of bubblers observed on it, soon when brought to flame a sudden explosion took place giving a pop sound, as hydrogen is explosive in nature. This confirmed the presence of hydrogen [5].

D. Mileage Test

The bike used for testing this project is a 2003 model TVS Fiero FX. To take the mileage reading the bike had been driven in different landscapes. The distance travelled per litre of petrol was observed and noted down in a table and the mileage was obtained. This test was conducted before and after applying hydrogen.
Before Applying Hydrogen

Table 4. Mileage table, before applying hydrogen

| Type of road | Mileage |
|--------------|---------|
| Highway      | 38      |
| City traffic | 35      |
| Off-road     | 32      |

After Applying Hydrogen

Table 5. Mileage table after applying hydrogen

| Type of road | Mileage |
|--------------|---------|
| Highway      | 56      |
| City traffic | 52      |
| Off-road     | 50      |

Emission Graph. 1

E. Emission Test

Emission test is taken to show the pollution level in vehicles. By this, we could prove that adding hydrogen as additive not only increases mileage but also lowers the pollution level in vehicles. Two tests were taken before and after applying the hydrogen.
Table 6. Emission test before applying hydrogen

| Parameter          | Regulation limit | Actual |
|--------------------|------------------|--------|
| CO(% of Vol)       | 3.5              | 0.89   |
| HC(PPM)            | 4500             | 754    |

Figure 10. Emission reading before applying hydrogen

Figure 11. Emission reading after applying hydrogen
Emission graph 2

Table 7. Mileage test on highway

| Before applying hydrogen | After applying hydrogen |
|--------------------------|-------------------------|
| Distance traveled in half liter(km) | Mileage (km/l) | Distance traveled in half liter(km) | Mileage (km/l) |
| 19 | 38 | 28 | 56 |

Table 8. Mileage test on city traffic

| Before applying hydrogen | After applying hydrogen |
|--------------------------|-------------------------|
| Distance traveled in half liter(km) | Mileage (km/l) | Distance traveled in half liter(km) | Mileage (km/l) |
| 17 | 35 | 26 | 52 |
Table 9. Mileage test on off-road

| Before applying hydrogen | After applying hydrogen |
|--------------------------|-------------------------|
| Distance traveled in half liter (km) | Mileage (km/l) | Distance traveled in half liter (km) | Mileage (km/l) |
| 16                       | 32                      | 25                       | 50                      |

7. Future Enhancement

- This system could be made more compact by reducing the number and size of plates.
- A smaller amp battery can be used if the plates are smaller.
- Do to compact arrangement it will be sufficient for two-wheeler.
- The set-up arranged by the initial calculation is suitable for four wheelers.
- Adding a more powerful catalyst will increase the rate of production.
- The amount of greenhouse gases emitted can be reduced.
- Decrease the fossil fuel consumption.

8. Conclusions

The hydrogen generating cells were fabricated and arranged in an orderly fashion. The generator was then immersed in an alkaline solution of distilled water and caustic soda (NaOH).

When the current was passed through the system, it was found that the water molecules began splitting into hydrogen gas and oxygen. This hydrogen was then tested using splint test. Upon confirmation, the entire generator was mounted on a test bike and mileage and emission tests were carried out.

It was found out that there was a marginal decrease in emission rates as well as an increase in mileage. Additionally, this project has led to an understanding of the process of hydroxy gas generation and working of hydrogen fuel cells. We could conclude that by adding hydrogen as an additive to the fuel, it will decrease the pollution level in vehicles and can be suitable for mass production.

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