# Experimental investigation of improving the efficiency of internal combustion engine using hydroxyl gas as secondary fuel

**V.Vigneshwaran [1],Dr. D.Lenin singara velu[2],I.Justinantony raj[3], J.Sebastin joyal [4]**

[1 3 4] *Assistant Professor, Department of Mechanical Engineering, Vandayar engineering college , Thanjavur-613501-TN-india.*

[2] *Assistant Professor, Department of Production Engineering, NIT –Tiruchirappalli,TN,india.*

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**Abstract:** *The rapid depletion of fossil fuels and rising of oil prices has led to the search for secondary fuels. The secondary fuels that we are using should have the same efficiency or greater efficiency of the engine that uses ordinary fuel .In this project the secondary fuel HHO gas is used. HHO otherwise known as hydroxyl. It reduces the exhaust gas emitted during the working of engine and the temperature of the engine is also reduced which is produced by the burning of ordinary fuels.The HHO gas is injected into the inlet manifold of the combustion chamber through the air filter of the engine. The fuel utility is reduced from 10% to 30% which minimizes the carbon deposition from this design . Engine torque also increased and pollution gets reduced to maintaining the greenhouse effect .In normal petrol engine only 80% of fuel is burnt and 20% of fuel remains unburnt. We are making the unburnt fuel to burn by passing the hydrogen gas in to the carburetor. The hydrogen gas is removed from water by electrolysis and is purified before passing to the carburetor .The unburnt fuel is also used in the combustion chamber ,so the efficiency of engine is increased.*

**Keywords:** ***Fuel ,I.C engines, Efficiency ,pollution ,HHO.***

## 1. INTRODUCTION

Harmful emissions are almost negligible when compared to gasoline and other fossil fuels and there is no cause of concern relating to the sustainability of the fuel as hydrogen is a vastly abundant element is studied. NOX emissions are about 10 times lower than with gasoline operation CO and HC emissions are almost negligible as expected is studied. Combustion properties of hydrogen favor fast burning conditions such as a high speed engine is researched. Design changes that would allow the engine to greater speeds would have a beneficial effect is researched. Appropriate changes in the combustion chamber together with better cooling of the valve mechanism would increase the possibility of using hydrogen across a wider operating range is studied.

**LITERATURE SURVEY:**

**Bhavesh v.chauhan et al.(2016)**. Above researcher conducted the experiments on "An Experimental investigation of HHo gas and varying compression ratio on emission characteristics of constant speed diesel engine".

**A.Vamshi Krishna reddy(2014)**: Above researcher conducted the experiments on improving the efficiency of I.C Engine using secondary fuel **Research Gap:** Above researcher is not done research over reduction of harmful emissions and not researched over increase the possibility of using hydrogen across a wider operating range.

## 3. EXPERIMENTAL DETAILS:

### 3.1 Water fuel engine settings

The water fuel engine consists of the following components to fulfill the requirement for complete of the machine.

- Battery
- Reaction vessel
- Engine(two stroke)
- Fuel tank
- Stainless steel

**Fig.1 .Water fuel engine**

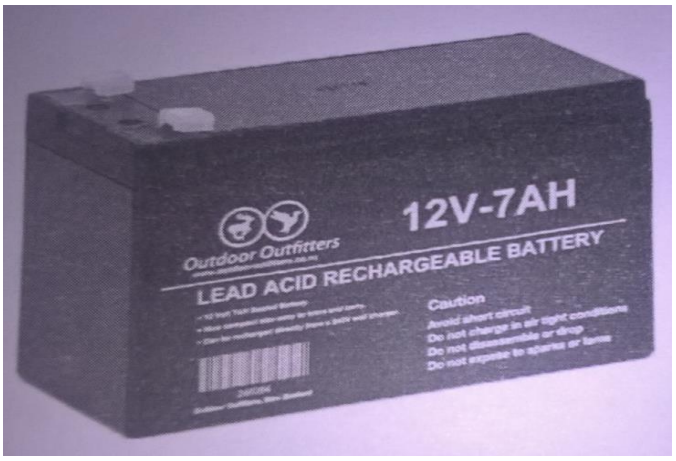


**Fig.2 .Battery**

## Battery specification:

Voltage :12V,Amps :7Amps ,cycle :14V -14.4 V,Max initial current :1.4A,stanby use :13.6V-13.8V.

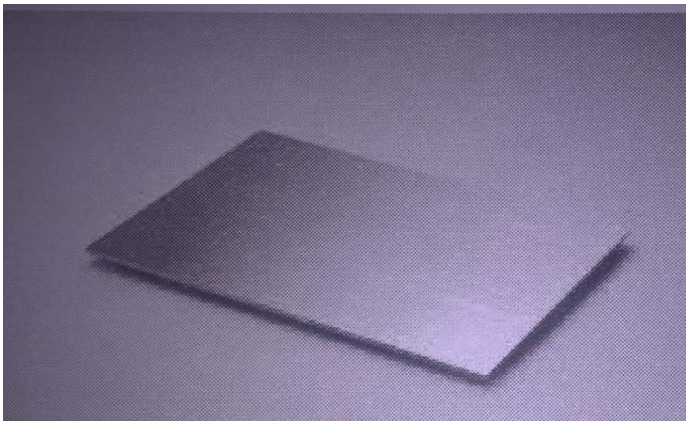

**Fig.3.Stainless steel plate**

## Specification :

(Height:12cm,Breath;1cm)

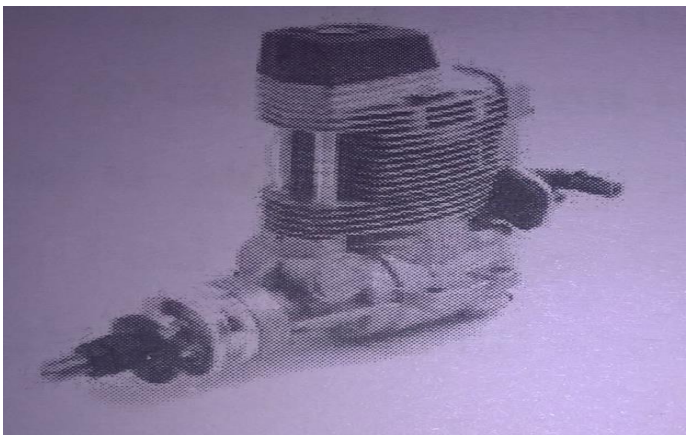

**Fig .4.Engine**

## Specification:

Displcement:98.00cc,Type :2 stroke ,single cylinder,power:7.8 bhp at 5500rpm,Fuel control :OHC,Cooling system:Air.

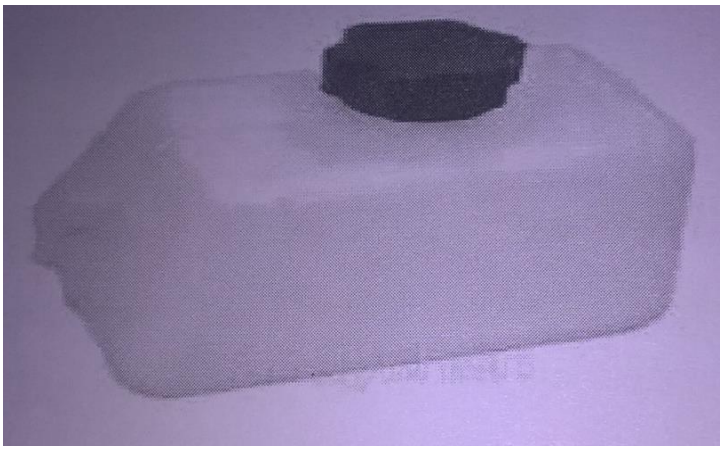

**Fig.5.Fuel tank**

## Specification :

(Height:120mm,Diameter:30mm)

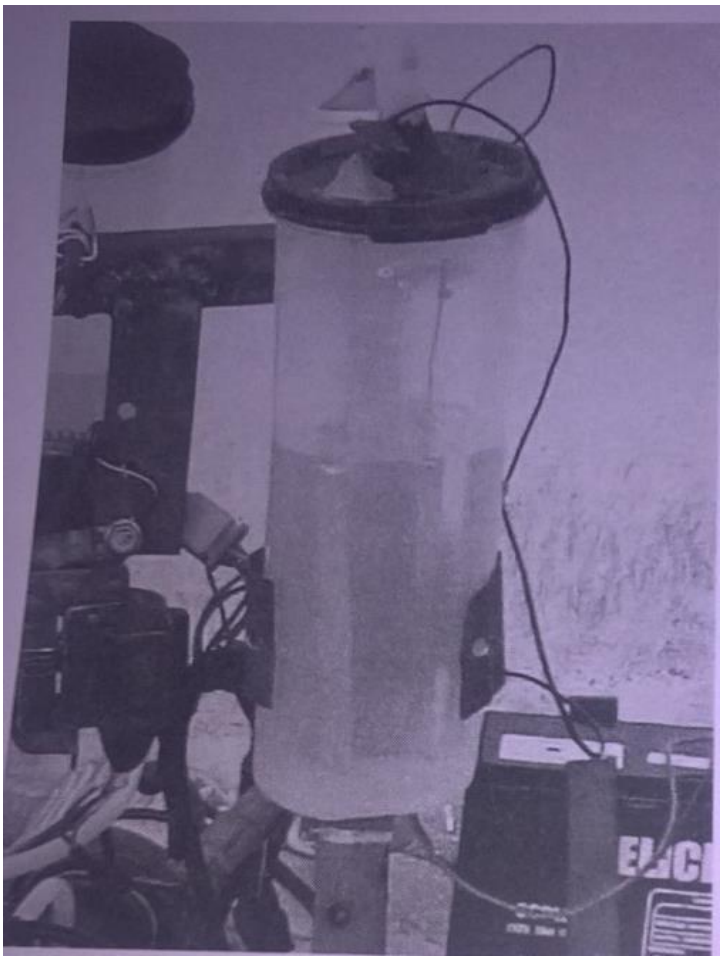

**Fig.6.Reaction vessel**

**Specification:**

(Height:20cm,Diameter;10 cm)

## 4.METHODOLOGY

**Table 1:**WORKING PRINCIPLE

| S.NO | CONTENTS | |
|---|---|---|
| 1. | Process of electrolysis | |
| 2. | The plate conditioning process | |
| 3. | Electrolysis reaction | |
| 4. | Fuel mixing | Mixture formation and engine operation |
| | | Internal fuel mixing |
| | | External Fuel mixing |
| 5. | Water induction | |
| 6. | Pre-ignition and backfire | |
| 7. | Reaction | Combustion |
| | | Expansion |
| | | Exhaust |
| | | Overlap |
| | | Intake |
| | | Compression |

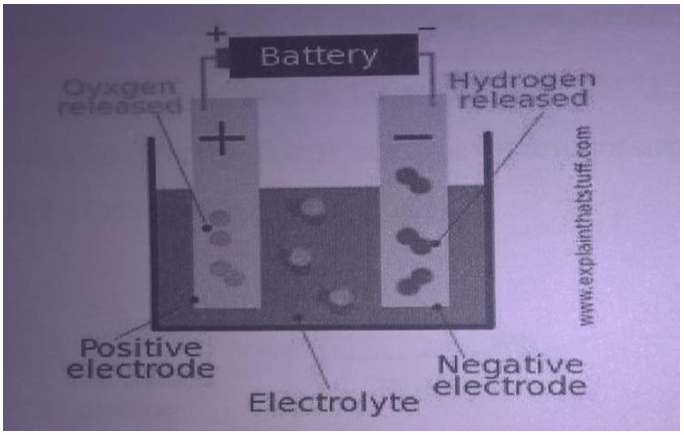


**Fig.7.process of electrolysis**

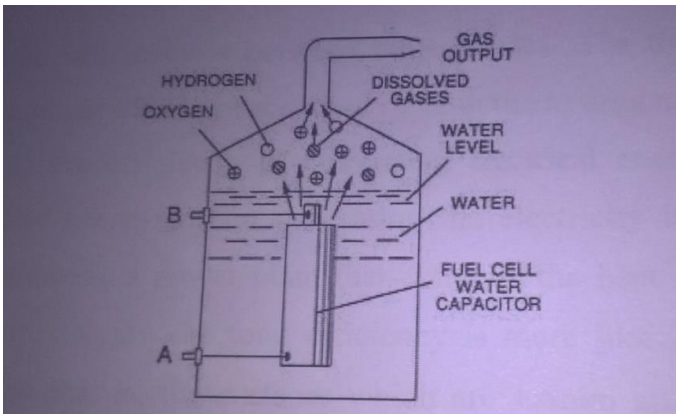


**Fig.8.The plate conditioning process**

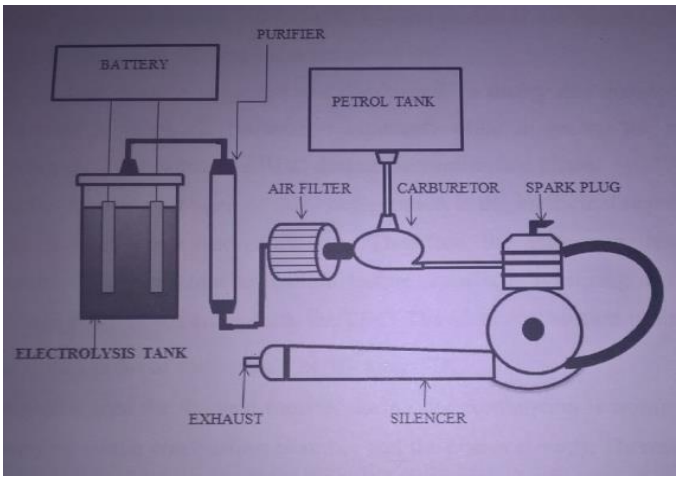


**Fig.9.Block diagram**

## 5. RESULT AND DISCUSSION

**Table.2.** Time taken under normal and with secondary fuel

| Sl.NO | Fuel consumed | Time taken under normal petrol (sec) | Time taken with secondary fuel hho gas (sec) |
|---|---|---|---|
| 1. | 10ml | 142 | 165 |
| 2. | 10ml | 154 | 173 |
| 3. | 10ml | 146 | 169 |
| 4. | 10ml | 149 | 178 |
| 5. | 10ml | 152 | 160 |
| | Average | 148 | 169 |

**Table No:3** Engine rpm under various degree of acceleration

| Sl.no. | Engine acceleration(deg) | Under petrol (rpm) | With secondary fuel hho gas (rpm) |
|---|---|---|---|
| 1. | 30 | 34 | 42 |
| 2. | 60 | 61 | 73 |
| 3. | 90 | 77 | 87 |

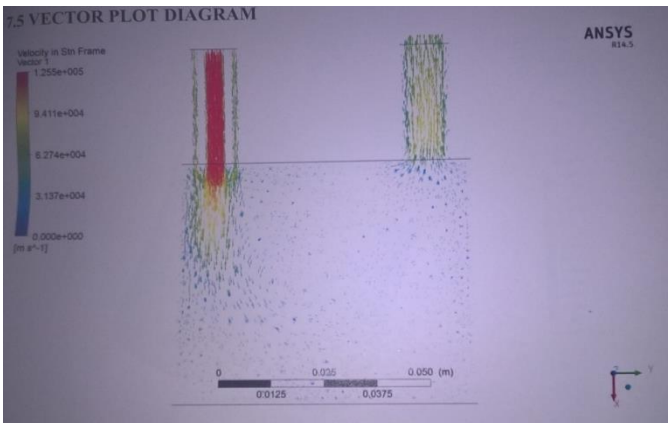


**Fig.10.Vector plot diagram**

**Specification:**

(Fuel mass flow inlet =1.986Kg/M$^3$)
(Oxygen mass flow inlet =5.424 Kg/M$^3$)

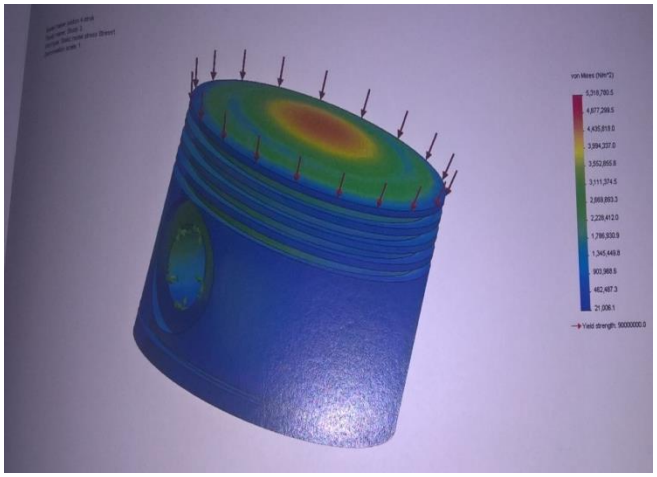

**Fig.11.Stress analysis.**

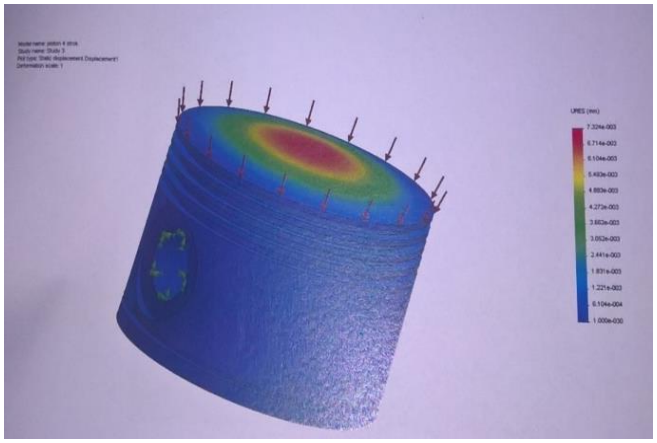

**Fig.12.Replacement**

## 6.CONCLUSION

1) Harmful emissions are almost negligible when compared to gasoline and other fossil fuels and there is no cause of concern relating to the sustainability of the fuel as hydrogen is a vastly abundant element.
2) NOX emissions are about 10 times lower than with gasoline operation CO and HC emissions are almost negligible as expected .
3) Combustion properties of hydrogen favours the fast burning conditions such as in a high speed engine.
4) Design changes that would allow the engine to greater speeds would have a beneficial effect.
5) Appropriate changes in the combustion chamber together with better cooling of the valve mechanism would increase the possibility of using hydrogen across a wider operating range.

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