



Hydrogen powered bike

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Abstract—HHO otherwise known as hydroxy or Browns Gas is the gas produced from splitting water into hydrogen and oxygen from electrolysis and allowing the gas to stay in a premixed state for use on-demand without the need for storage. In 1918 Charles Frazer, a North American inventor, patented the first water electrolysis machine act as a hydrogen booster for internal combustion engines. Yull Brown, a Bulgarian born Australian inventor patented and attempted to popularize Browns Gas as a cutting gas and fuel additive during the 1970's and 80's. During the 2000's there was a huge influx in Browns Gas devices coming to the mark, with many sensational claims of bringing dramatic reductions in fuel consumption and exhaust emissions in internal combustion engines

INTRODUCTION

1.1 outline of the project

Hydroxy gas (HHO) was produced by the electrolysis process of different electrolytes (KOH(aq), NaOH(aq), NaCl(aq)) with various electrode designs in a leak proof plexiglass reactor (hydrogen generator). Hydroxy gas was used as a supplementary fuel in a four cylinder, four stroke, spark ignition (SI) engine without any modification and without need for storage tanks. Its effects on exhaust emissions and engine performance characteristics were investigated. Experiments showed that constant HHO flow rate at low engine speeds (under the critical speed of 2800 rpm for this experimental study), turned advantages of HHO system into disadvantages for engine torque, carbon monoxide (CO), hydrocarbon (HC) emissions and specific fuel consumption (SFC). Investigations demonstrated that HHO flow rate had to be diminished in relation to engine speed below 2800 rpm due to the long opening time of intake manifolds at low speeds. This caused excessive volume occupation of hydroxy in cylinders which prevented correct air to be taken into the combustion chambers and consequently, decreased volumetric efficiency was inevitable. Decreased volumetric efficiency influenced combustion efficiency which had negative

effects on engine torque and exhaust emissions. Therefore, a hydroxy electronic control unit (HECU) was designed and manufactured to decrease HHO flow rate by decreasing voltage and current automatically by programming the data logger to compensate disadvantages of HHO gas on SFC, engine torque and exhaust emissions under engine speed of 2800 rpm. The flow rate of HHO gas was measured by using various amounts of KOH, NaOH, NaCl (catalysts). These catalysts were added into the water to diminish hydrogen and oxygen bonds and NaOH was specified as the most appropriate catalyst. It was observed that if the molality of NaOH in solution exceeded 1% by mass, electrical current supplied from the battery increased dramatically due to the too much reduction of electrical resistance. HHO system addition to the engine without any modification resulted in increasing engine

MAJOR COMPONENTS

After a year of constant useage, these plates are shiny and not corroded thanks to proper use of stainless parts Two stainless steel straps that were made are used to attach the plate assembly to the screw cap of the booster 4-inch diameter PVC pipe, 12-inches long 1, this Forms the body of the generator 4-inch diameter PVC pipe end-cap 1, this Closes the bottom of the generator. 4-inch diameter PVC pipe screw cap 1, this makes the top of the generator 90-degree Quick Connect Outlet fitting 1 3/8" O.D. Tube x 14" NPT from Hardware store Level indicator Nylon barbed tube fitting 2 1/4" Tube x 1/8" NPT from your local hardware store or home depot Quarter-inch I.D. Poly sight tube 8" Water-level indicator tubing Stainless steel switch covers 16 these make plate assembly components or stainless steel sheet metal flat pieces from ebay or steel yard Stainless steel straps 12-inches long 2 The electrical connections to the plates or stainless steel utensils like spoons or forks from cooking supply stores or

dept stores will work 3/4" Inside Diameter Clear poly tube 12-inch From your local hardware store or lowes home depot 5/16" stainless steel bolts 1.25" long 2 Electrical strap connection to the top cap 5/16" stainless steel nuts & washers 6 each To fit the steel bolts in the cap top 5/16" diameter nylon threaded rod 8" min. Nylon Threaded Rod 5/16"-18 Thread. 2 needed 5/16" inch nylon washers 1.6 mm thick 1-pack Nylon 6/6 Flat Washer 5/16", pack of 100 5/16"-18 s/s jam nuts (1/4" thick) 20 needed 90 degree Bubbler Fittings 2 1/4" Barbed Tube 1/2" NPT. Check valve 1 1/4" tube, aquarium shop

Parameter	2.5% FE H2 Load	2.5% FE H2 75% Load	5% FE H2 25% Load	5% FE H2 75% Load
NO	-16.9%	-3.4%	-24.2%	-5.4%
NO2	53.3%	72.1%	68%	87%
BSFC	0.3%	0.4%	0.6%	0.6%

Table 1. Change in NOx emissions and BSFC on a 2.5L turbo diesel at 1800r/min

DESIGN

In electrolysis, people have tried different ways to increase the output of gas while decreasing the input of current. Some designs are more effective than others. Some people have tried to improve the conventional way, called "wet system", consisting on plates or tubes submerged in water, while others have created and developed a design called "dry cell" where the water is constantly running through the plates.



Fig. 1 hydroxy generator

Engine specification

Engine	Bajaj m80 ,air cooled
Cubic capacity	80 cc
Stroke	2 stroke
Brake power	7.37 HP (5.4KW) @ 8000 RPM
Speed	1500 RPM
Number of Cylinders	Single

Table 2. engine specifications

TRIAL NO	AMOUNT OF GASOLINE CONSUMPTION	DISTANCE COVERED
1	100 ml	4.8 km
2	150 ml	6.7 km

Table 3. without hydrogen test

Trial no	AMOUNT OF GASOLINE CONSUMPTION	DISTANCE COVERED
1	100 ml	7.2 km
2	150 ml	12 km
3	200 ml	17 km

Table 4. with hydrogen test

EXPERIMENTAL DESCRIPTION

There is a lot of skepticism about HHO generators for vehicles found online. Our final thesis gives valid evidence that, in fact, they do work. It was determined that in order to supplement fuel consumption with hydrogen gas completely, many modifications need to be made to the fuel system of the car, that were out of our reach. Even if these were accomplished, the amount of energy needed for the car to run as well as to power the generator is not enough without the energy coming from the fuel. The hydrogen cell produced oxygen and hydrogen from water through electrolysis. Minimization the cost was done by using wildy available materials. Once Plan A was not successful, Plan B was implemented. From the results of the experiment it can be concluded that having an HHO generator such as this one, will improve gas mileage. The findings of this senior thesis benefit the environment and society.

Since implementing the hydrogen generator will produce less carbon dioxide to the atmosphere, as well as, less consumption in gas. Therefore it will reduce greenhouse gasses. Hence, less effect on global warming on the long run. Moreover, since implementing a hydrogen generator will provide more fuel efficiency, it will save money for people who will use our product. It is hard to tell if the

generator will continue to be as efficient in the long run, because we couldn't take into account alternator wear or battery productivity.

Result of emission tests

Emission test without hydrogen supply

FORM (Computerised Pollution Under Control Certificate/Petrol/CNG/LPG)
(Base Rule 118 - B (19) (C))
(Authorized By the Transport Department)

Anna Nagar Auto Service, E/100, 3rd Avenue, Anna Nagar, Chennai-102.
Centre Code: TN-02-010 Authorization No: 46/Chennai/2002 Valid Till: 9-12-2017

I.D. Number: TN 01 AY 5461 Type of Vehicle: ZW Fuel: Petrol
Vehicle Number: TN 22BJ 9144 Type of Engine: 4S Date: 25-Mar-2016
Month & Year of Manufacture: 01-05-2010 Maker's Name: HONDA_MOTORCYCLES Time: 13:18
B S II Compliant: 2015 Maker's Class: SHINE

Odometer Reading (km): 0

PARAMETER	Regulation Limit	Actual
CO (% by Vol.)	3.5	0.56
HC (PPM)	4500	770
LAMBDA		

Validity: 6 Months 24-Sep-2016
Certificate Valid upto: 24-Sep-2016
Centre Code: TN 02 013 Testing Charges: Tuning Charges:

Name of the Driver/Owner: Signature of the Driver/Owner: Signature of the Licensed/Testing Person:

AIR POLLUTION IS A HEALTH HAZARD

Emission test with the hydrogen supply

FORM (Computerised Pollution Under Control Certificate/Petrol/CNG/LPG)
(Base Rule 118 - B (19) (C))
(Authorized By the Transport Department)

TamilNadu Automobile Pollution Checking Centre, 100 Petrol pump, H2, 3rd Avenue, Anna Nagar East, Chennai-102.
Centre Code: TN-02-013 Authorization No: 10/2003 Valid Till: 10-9-2018

I.D. Number: TNTN 02 Type of Vehicle: ZV Fuel: Petrol
Vehicle Number: TN 22BJ 9144 Type of Engine: 4S Date: 25-Mar-2016
Month & Year of Manufacture: 01-05-2010 Maker's Name: HONDA_MOTORCYCLES Time: 13:18
B S II Compliant: 2015 Maker's Class: SHINE

Odometer Reading (km): 0

PARAMETER	Regulation Limit	Actual
CO (% by Vol.)	3.5	0.09
HC (PPM)	4500	117
LAMBDA		

Validity: 6 Months 24-Sep-2016
Certificate Valid upto: 24-Sep-2016
Centre Code: TN 02 013 Testing Charges: Tuning Charges:

Name of the Driver/Owner: Signature of the Driver/Owner: Signature of the Licensed/Testing Person:

Reduce Exhaust Emissions in Vehicle

RESULT EXHAUST EMISSIONS

This section will focus on the effects of HHO and water injection on oxides of nitrogen (NOx) emissions. NOx are highly reactive gasses found in exhaust emissions of internal combustion engines created from the high peak temperatures generated

during the combustion stroke. NOx gases contribute to smog, greenhouse emissions and acid rain, and react with other chemicals forming toxic compounds dangerous to human and plant life. For these reasons maximum limits on NOx emissions are continually being reduced, and to meet these limits technologies that reduce NOx emissions are continually being developed. Emission testing on the diesel generator set was performed with the same rates of oxyhydrogen and water injection as the BSFC tests. The main difference with the emissions test included only running externally powered electrolysis for the HHO production, and the time base for each system state was reduced from 100g fuel consumption to a 75g fuel consumption period. The gas analyser was a CODA, it sampled CO, CO2 and NOx on a 187ms time base. The time at each load level was around 75s and 52s for the 9.91kW and 19.1kW loads respectively, allowing between 400 and 290 exhaust emission samples. The last half of each set of samples were averaged to yield the results outlined in this section.

HHO and water injection reduced NOx between 1.3% and 11.8% due to water and or HHO injection. At 30% engine load NOx was most affected by HHO injection, when combined with water injection there was a total reduction of 11.8% NOx emissions

CONCLUSION

As we can see the results of emission test with the generator shows that from current Indian standards of emission control, the hc value is nearly reduced to 8% of the projected maximum value by the government. These hydrocarbon concentrations can increase gradually due to severe weather conditions and due to vehicle maintenance

But with addition of hho the vehicle maintenance is reduced to a great amount

All these are happening because hho gas enhances and ensures the complete combustion of fuel inside the combustion chamber of engine thus less maintenance is required

Also the carbon value is reduced to 10% of the projected maximum value by the government. If this is the case then the pollution will be controlled comparably by the hho gas that would prevent the pollution from reaching its peak along with the increase in number of vehicles day by day. Thus by the introduction of hho gas in the air manifold we obtain and achieve the perfect and guided amount of emissions from the internal combustion engines.



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