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Energy Yield Value Evaluation of a HHO Technology Induced Diesel Engine

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Abstract: ***By some estimates, the total number of vehicles worldwide could double to 2.5 billion by 2050.And the number is increasing day by day and the pollutants it releases are carbon dioxide, nitrogen dioxide, sulphur dioxide, sulphur trioxide, hydrocarbons which damage the atmosphere and changes the climate. A rough estimate shows that 14, 560 miles average per year per vehicle and an estimate of 30 average kilometers/liter gives an average of 589 gallons per year and an estimation of 9.320 pounds of carbon dioxide per year. The alarming statistics show that there is a widespread need of using the alternative sources of energy and at the same time utilizing the available resources efficiently. The study shows the aim of decreasing the vehicle emissions by using the brown gas enriched fuel into an IC engine and explaining its advantage over conventional engines. Finding the characteristics of an engine such as efficiency and emission traits and comparing it with conventional and other enriched engines.***

Keywords: Energy Yield Value, RPM, Torque, Fuel, Energy, Combustion Heat

1. Introduction

As the growing needs of hydrocarbon fuel makes it costlier and at the same time there is a major disadvantage of using this fuel is emissions which pollute the environment and increase the need of replacement of the fuel.As the difficulty to find the best alternative solution is another tough task for the scientists, still the use of hydrogen as a fuel is a good idea which has higher reactivity, higher energy content, heating value than diesel, flammability but it has major demerits such as storage which makes its use a difficult one. If we use diesel and air, disadvantages are emission and scarcity, a better alternative is in between the two solutions is the mixture of diesel air and hydrogen enriched fuel which has increased values than the diesel mixture.In this context we will be showing how it varies and to what extent and making the cost analysis of the design to install it in a four wheeler.

2. How the Mixture of H2 Diesel and Air be a Fuel?

Getting into theoretical field the, Oxy-Hydrogen gases will combust in the combustion chamber when brought to its auto-ignition or self-ignition temperature. For a stoichiometric mixture at normal atmospheric pressure, auto-ignition of oxy hydrogen gas occurs at about 570°C(1065°F).

Brown Gas (HHO) as a Fuel

The gas HHo is a mixture of monoatomic and diatomic hydrogen and oxygen and a special type of water called electrically water santilli Magnecules. Brown gas is produced by a similar design of electrolyser that splits water into its various substitutes. Brown gas has a plethora has unusual traits that seem to defy the current chemistry. The main attempt is to help solidify the current theory of brown gas. Brown gas is defined as the entire mixture of gases evolving from an electrolyser specially designed to electrolyze water and not to separate the resulting gases." the brown gas produced by the electrolyser is made to pass through the manifold and then by dissociating it into the diesel fuel, we get the required fuel.

Energy Yield Value

Energy yield value is defined as the additional output of useful energy that results from injection of a gas into an internal combustion engine. The aim in this context is to quantify the output energy (additional) per unit quantity of injected HHO gas is an important step in developing a more systematic approach.

Consideration used in calculating the Energy Yield Value:

1) The load and speed are maintained as same for both the fuels.
2) The total power output is the same so the total energy doesn't make a difference.

3. Way of Approach

Fuel consumption with and without the injection of HHO gas under identical conditions are taken and the considerations as said above the load and speed are maintained same for both the fuels. fuel consumption for the HHO fuel are done by weighing the fuel container, running the engine for a specific amount of time, weighing the fuel container and calculating the difference to obtain the weight of fuel used during the test period. NOTE: weight is a better consideration then volume because the volume is dependent on various other factors such as temperature, pressure and humidity.

For calculating the output power : RPM *torque =horse power

Approach for Energy Yield Value

NOTE: efficiency is taken as N, N1=engine efficiency without injection, N2=engine efficiency with gas equation, Ng=additional energy efficiency then

Ng=N2-N1CONSIDERATION TOTAL POWER OUTPUT IS SAME and energy output per unit of fuel consumed per unit time is given by E-amount of useful energy produced by engine(WATT x seconds) m1=weight of fuel without gas

injection
m2=amount of fuel with gas injection then equation becomes E/m2-E/m1
E/m2-E/m1
Calculating the efficiency of the engine which defines as output energy divided by the input energy the for the two considerations
N1=E/km1where k=amount of energy per unit of fuel 47MJ/Kg
fraction of efficiency that results from gas equation =Ng/N2 and by substituting the proper equations we get 1-(N2/N1 or (N2-N1)/ N2 as the power output is same for both the case we get

(N1/N2)=(E/km1)/(E/km2)and finally we conclude that the parameter needed is a function of fuel consumed

E/mg=amount of total energy output per gram of gas for finding the yield value ENERGY YIELD VALUE=(E/mg) (1-m2/m1)

Experimental Setup of HHO Cell, Cost Analysis, and Derivation of HHO Induction

Cost Analysis: For a Four Wheeler Automatic or Manual Transmission Truck

Assumptions: As it is Impossible to Derive the Income Produced Over Wide Range of Speed and Load Conditions So We Consider Only at 1200 RPM and 75 PER of load						PROJECTED BENEFITS		
PRICE OF EQUIPMENT					COST			
1)HHO generator					1000	total investment		1900
2) vacuum pipes	pipes				50	if spent in diesel		317litres
3)water trap					50	gives energy		13720MJ
4) gas trap					50	time		25.50KM/l
5)wiring kit					50			
6)fuel heater					50			
7)scan gauge monitoring system					200			
8)wire stripper/ crimer clamps					50			
9) seven function multimeter					100			
SHIPPING HANDLING AND TRANS PORTATION					5			
INSURANCE TAXES					100			
OTHER EXPENSES					100			
TOTAL MONEY $					1900			

An SS-40 unit are taken into account, The specifications of the HHO cell used in cars and is based upon 12Volts.It has made of stainless steel and the other end is grounded. The gas comes out of the hose barb that is present at the top of the generator. A slide mirror is provided to show the level of electrolyte.

Specifications

Current=40 amperes, Output=192 litres per hour Based on the above data and the data known to us we calculate the Hydrogen per amp per hour. Gas constant equation, the value of 192 liters would be equivalent to cubic meters. Total number moles are given by the ideal gas equation:
PV=nRT taking the values of ideal gas parameters as standard values
P= pressure in atmospheres normal atmosphere R as standard
V=volume 0.192 cu.meters in this cal
n=number of gram moles of gas
T=temperature in kelvin = 298 kA ss40 electrolyser

Calculation

Solving forn=PV/RTton give the total number of gram moles=7.85

The number gram moles of hydrogen gas is2/3 this amount since HHOis a mixture of two particles so the number moles of hydrogen will be 7.85x (2/3 standard atomic weight of hydrogen is 1.01 therefore the molecular weight of hydrogen is 2.02grams per mole moles Xmol. Wt gives grams of as which equals 10.55 finally we conclude grams per hour per ampere equals 10.55/40=0.26

HYDROGEN ADDITIN	*LOAD*	*RPM*	*FUEL (Kg/hr)*	*TORQU in (N-m)*	*AMPERES*	*E1 MJ/hr*	*AMPERES*	*E2 MJ/hr*	*H2 GRAMS/hr*	*EYV*
NO	25	1200	18.5	538.25	0	243.1	0	-	0	-
NO	25	1800	28.57	383.69	0	259.93	0	-	0	-
YES	25	1200	21.31	538.25	25	-	25	243.1	6.7	-3.79
YES	25	1800	21.31	368.78	46	-	46	249.82	12.24	4.96
NO	50	1200	31.11	940.93	0	424.96	0	-	0	-
NO	50	1800	51.25	707.73	0	479.4788	0	-	0	-
YES	50	1200	29.48	924.66	48	-	48	417.62	12.76	2.58
YES	50	1800	41.73	694.17	50	-	5	470.28	13.29	6
NO	75	1200	42.95	1369.37	0	618.99	0	-	0	-
NO	75	1800	66.95	1130.75	0	766.0512	0	-	0	-
YES	75	1200	30.29	1351.75	49	-	49	610.55	13.03	14.89
YES	75	1800	60.78	1149.73	48	-	48	605.03	12.76	8
NO	100	1200	48.94	1538.85	0	695.03	0	-	0	-
NO	100	1800	83.46	1582.23	0	1045.28	0	-	0	-
YES	100	1200	44.45	1538.85	42	-	42	695.03	695.04	5.48
YES	100	1800	69.85	1542.92	45	-	45	1046.28	1045.28	10.24

4. Experimental Analysis of the Above Energy Yield

The analysis is extracted from a test done on a diesel truck engine, it is a eddy current dynamometer. Due to the unavailability of the dynamometer, we successfully conducted the experiment at a research facility so we tried to obtain data in a limited amount of time. IN the series of steps the engine is operated at different loads such as at 25, 50, 75, 100 and the fuel container was weighed before and after each and every run, the fuel, the rpm, load, torque are observed. With the use of the above derived equation we found the values of ENERGY YIELD VALUE with and without the addition of the gas injection and the concentric of the HHo gas practically. We found the values of the amount of hydrogen produced by the HHo electrolyser.

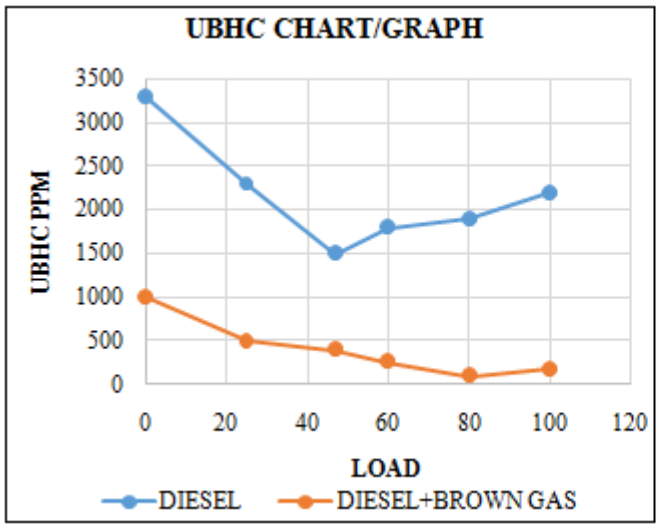
Calculation

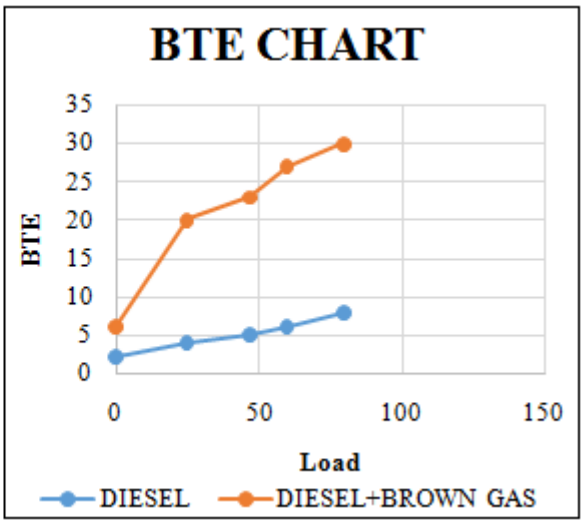
The value of Mg obtained by 48 amperes x 0.2638 grams amp per hour =12.66 grams per hour. Considering for a load condition which is lean that is at 75 percent and the speed is 1200 rpm the energy output value is 618.99MJ/hr which is without the addition of the gas

E1=energy released without gas injection =618.99MJ/hr,
Mg= grams of hydrogen released per hour.
so calculating the total energy output per gram of hydrogen gives
E1/Mg=48.89 MJ/g
for considering the 1200 rpm and 75 per of load we get the energy E
E2= energy released with gas injection=RPMxTORQUEX747.5X3600/10^6 =610.55MJ/hr
the value of output per gram of hydrogen is :E2/Mg =48.2MJ/g
all the values are ready for calculating ENERGY YIELD VALUE the value of m2/m1
30.29/42.95=0.705
recalling the derivation of the ENERGY YIELD VALUE (E/Mg) (1 - m2/m1)
now resetting we get(E1/Mg)-(E2/Mg)(m2/m1)substituting the values we get 14.89 Mj/g H2.
similarly we could find the ENERGY YIELD VALUES for 1200 RPM and at 50 per and 100 per at 1200 RPm and 50 load we get the energy yield in MJ/g H2 values as 2.58 and at 1200RPm and 100 load we get the energy yield value in MJ/g H2 is 5.48

NOTE on 25 per load with the HHO injection all ENERGY YIELD VALUE were positive.

During the experiment we noted the values of brake horse power, mean power, flame speed, and various other properties such as the carbon dioxide emissions before and after the injection of the HHo gas and for nitrogen emissions and other gases. Following are the graphs





Where, UBHC =unburnt hydrocarbon
BTE= Brake thermal efficiency.

5. Drawbacks

On the first 25 per load with the injection of the HHO gas we found the ENERGY YIELD VALUE to be negative because during the starting of the HHO gas was cold which is often known as cold starting as the engine can produce maximum energy per gram of hydrogen only at lean conditions. It needs some time for the electrolyser to reach equilibrium with the ambient conditions, and after sometime it works efficiently.

6. Innovation

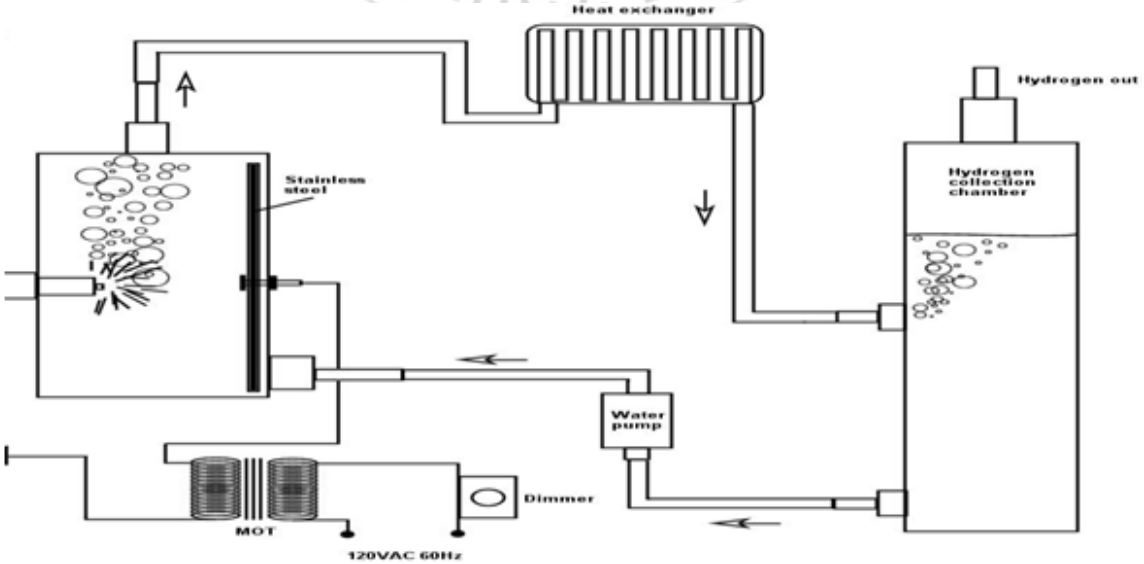
As the main aim was to reduce the emissions introducing the HHO gas was an important step towards climate change and we found that even with the injection of the HHo gas the emissions are reduced by 75 percent but not to a full extent further reduction can be obtained with the help of Fischer trposch Process to convert the carbondioxide into fuel.

7. Advantages over Conventional Engines and Green Engine (6 Stroke)

1) It has higher brake power, higher thermal efficiency, and lower fuel consumption and it has lower emissions.
2) In context of the green engine which has robust and heavy structure and higher mean effective pressure when compared with gas injection engine it has moderate values which are even beneficial
3) The gas can be used for various other process such as conversion of carbon dioxide to fuel
4) It don`t have higher moving parts as compared to green engine (6 stroke).
5) It is as simple as conventional engine and has same reciprocating parts

8. Disadvantages of the HHO Engine

It increase the weight of the vehicle and during the starting of the HHo, the HHO generator is left for some time to reach equilibrium otherwise the ENERGY YEILD VALUE will be negative.



Flow chart of HHo injection (engine)

9. Conclusion

Our experiment found that the density of fresh HHO is 51 percent higher than what would be expected but there was no error analysis of the measurement. The exact molecular composition of fresh HHO is uncertain. The average of all the EYv is 6.5Mj/g and the maximum value is 14.89Mj/g also the maximum value of 14.89Mj/g is over 105 times higher than the heat of combustion of hydrogen gas 0.1419Mj/g the HHO generation which can be used is simple, easily constructed, and easily integrated with existing engine at optimal cost. The optimal size is when the surface area of an electrolyte needed to generate sufficient amount of HHo is twenty times that of the piston surface area also the volume of water needed in the cell is about one and half times the engine capacity.

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