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Experimental Analysis on Performance Improvement of Diesel Engine Utilizing Water Gas

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Abstract:

Electrolysis of water can give us hydrogen in form of Water gas which can be used as an alternative fuel for any internal combustion engine .Various methods for the generation of water gas are discussed in the coming paragraphs. An attempt has been made in this work to use alternative fuel in four stroke diesel engine. Our fore most aim in selecting this project is to use Non-conventional fuel against conventional fuel which is becoming scarce and costly now days .The role of hydrogen in emission reduction of diesel engines was also investigated.In this paper we present, apparently for the first time, various measurements on a mixture of hydrogen and oxygen called Water gas produced. This results in a storage problem when used as a fuel in an internal combustion engine which is loaded on automobile. The gas contains condensable oily substances, acids and dust as well. The main aim of the gasified system is to generate a gas with a high proportion of combustible components and a minimum of impurities . Thereby conducting Performance Tests for alternate fuels and comparing the Performance characteristics with diesel fuel.

Key Words:
Electrolysis, hydrogen, Water gas, gasified system.

I.INTRODUCTION :

The outline of this study is to research the effects of HHO produced on-demand combined water injection as an additive for combustion in a diesel generator. The effects of current known phenomena of HHO and water on diesel engine exhaust emissions and fuel consumption will be discussed. This study will describe the design of the experiment – stating the controls and variables. Experimental System, will include analysis of the water injection system, the on-board water electrolyser system, the industrial control system, the diesel supply system and the data logging system used in the experiment. The results of this test will be focused at proving the quality and magnitude fuel consumption and exhaust emissions of HHO on-demand systems similar to what is currently available on the market. There has been much conjuncture in the public domain as to the effects on fuel economy of hydrogen on-demand systems made for internal combustion engines, as is evident with a simple search on the internet. There is little solid experimental evidence from controlled repeatable tests quantitatively proving the economy enhancing effects of on-board HHO for naturally aspirated or turbo diesel engines.

Two independent sets of researchers have shown experimentally that HHO on-board can reduce diesel consumption, while another team found a reduction in engine efficiency. To the authors knowledge no on–board testing has been performed under a controlled environment where the systems variables and environmental conditions are accurately controlled and corrected for. On-board HHO addition means HHO produced by taking a portion of the engines power to crack water into a small volume of HHO to be fed back into the air intake as a fuel saving additive. This study will experimentally verify the economy and emissions effects of adding small rates of HHO produced on-demand by a diesel generators own power combined with 0% water injection and 10% water injection.

II.PREPARATION AND CHARACTERIZATION WATER GAS:

Water Gas is produced by the electrolysis of water which uses an electric current to break down the water molecules into their gaseous state.

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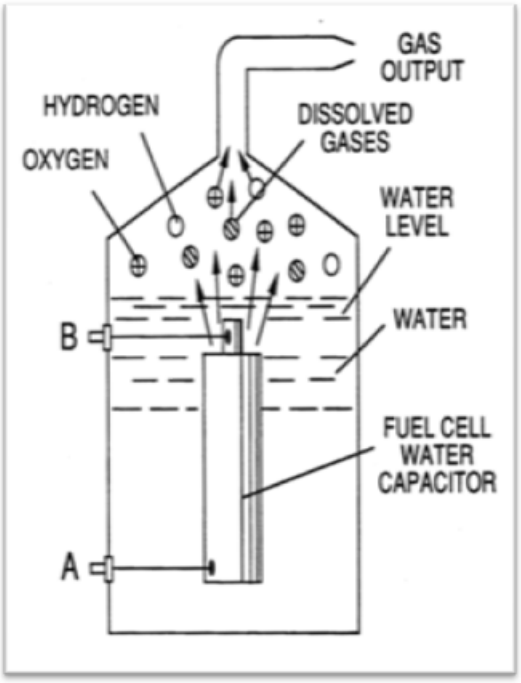

Figure 1: Production of water gas

Components:

Potassium Hydroxide (KOH)

Battery

Clamps

Flexible Tube

Pressure Gauge

Steel Plates

Procedure:

» With the help of battery the electrodes got heated and release the water gas.
» The water gas then enters into the air filter.
» Air filter will combine the gas and air and sends that to carburetor.
» The Air intake of diesel engine will mix the water gas and air mixture.
» The mixed content will be sent to the engine for proper combustion.

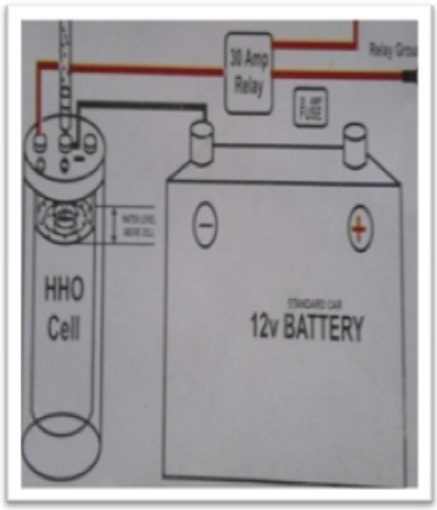

Figure 2: Line diagram of the Electrolyte kit

2.1 Electrolysis process :

Electrolysis of water means using an electric current to dissociate the water molecules to its basic components of Hydrogen & Oxygen.

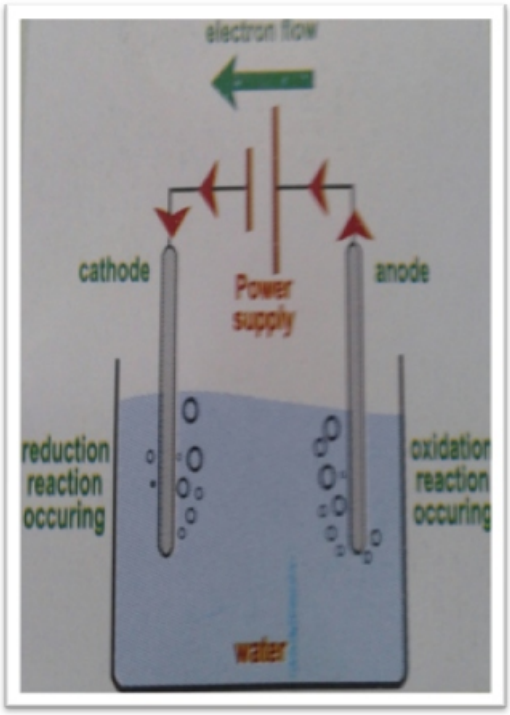

Figure 3:- Electrolysis process

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2.2 Chemical Reaction

2.1. From Water

The industrial hydrogen gas can be prepared from water and forms of water in the following three ways

2.1.1. From Water Gas:

(Bosch Process) A German chemist Bosch, prepared hydrogen on a large scale using inexpensive raw materials such as water and coal by passing steam over red hot coke (carbon) at about 10000C a mixture of carbon monoxide and hydrogen known as water gas is produced carbon monoxide is separated from the mixture by converting it to carbon dioxide.For conversion of carbon monoxide into carbon dioxide, excess steam is mixed with the water gas and passes over a catalyst Fe2O3 + Cr2O3 at 4500C.

H2O + C ---> Co + H2(water gas)

Co + H2 +H2O ---> CO2 + 2H2

Mixture of carbon dioxide and hydrogen gas is passed through water at a pressure of 30 atmospheres, CO is absorbed in water while h2 does not dissolved in water and is collected as such.

2.1.2. From Electrolysis Of Water:

Hydrogen can also be produced by electrolysis of acidized water but the method is inexpensive due to high cost of electricity hydrogen produced by this method is 100% pure.

2H2O H2So4 ---> 2H2+ O2.

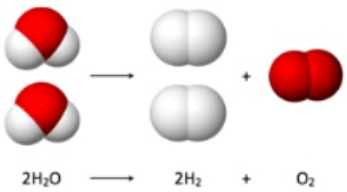

Diagram showing the overall chemical reaction

In pure water at the negatively charged cathode , a reduction reaction takes place with electrons (e) from the cathode being to hydrogen cations to form hydrogen gas (the half reaction balanced with acid):

Reduction at cathode: $2\,H^+(aq) + 2e^- \rightarrow H_2(g)$

At positively charged anode, an oxidation reaction occurs, generating oxygen gas giving electrons to the anode to complete the circuit:

Oxidation at anode: $2\,H_2O(l) \rightarrow O_2(g) + 4\,H^+(aq) + 4e^-$

The same half reaction can also be balanced with base as listed below. Not all half reactions must be balanced with acid or base. Many do, like the oxidation or reaction they must both be balanced with either acid or base.

Cathode (reduction): $2\,H_2O(l) + 2e^- \rightarrow H_2(g) + 2\,OH^-(aq)$

Anode (oxidation): $4\,OH^-(aq) \rightarrow O_2(g) + 2\,H_2O(l) + 4\,e^-$

Combining either half reaction pair yields the same overall decomposition of water into oxygen and hydrogen:

Overall reaction: $2\,H_2O(l) \rightarrow 2\,H_2(g) + O_2(g)$

The number of hydrogen molecules produced in thus twice the number of oxygen molecules. Assuming equal temperature and pressure for both gases, the produced hydrogen gas has therefore twice the number of generated molecules and four times the number of generated oxygen molecules.

III. EXPERIMENTATION

3.1 Experimental Design

Performance tests:

Performance tests are made on a engine mainly to determine how much of our fuel is required for smooth running of an engine at the particular speed and load, i.e. these tests are used to find the efficiency of engine and to compare the performance of engine for different fuels at different conditions like varying load, varying speed etc..

Some of the factors are considered while performing tests on an engine they are:

1. Maximum power or torque available at each speed.
2. Range of power output at constant speed for stable operation of engine.
3. Brake Specific fuel consumption at each operating condition within useful range of operation.By performing these performance tests on engine we are going to find following parameters they are-

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1.Brake Power.
2.Mass of fuel consumed.
3.Brake Specific Fuel Consumption
4.Brake thermal Efficiency.
5.Air fuel ratio.

3.1.1.Process Parameters:

Here we are going to perform performance tests on Engine to measure the parameters relating to our Water gas .These tests are performed on a "Rope Brake Dynamometer".

Following are the Engine Specifications:

Engine	Four Stroke single cylinder diesel engine.
Make	Kirloskar-AV1
BHP	5 HP.
RPM	1500
Fuels	Diesel& Water gas
Bore	80 mm.
Stroke	110 mm.
Starting	Cranking.

Table 3.1 Engine specifications

Figure:- The Electrolized kit is arranged to the air intake of the Diesel engine

3.2.Procedure:

1. Power supply given to the engine
2. Initiall without any load the values are found
3. Now Load is applied at the end of the rope.
4. Note there addings of the spring i.e .Load applied-weight of hanger.
5.Find the manometric difference and time taken for certain amount of fuel consumption
6. Similarly readings are noted for different loads at constant speed.
7. Then calculate the efficiencies using the formulae's and find the average.
8.This is how process parameters are calculated for diesel and water gas on Engine.

IV.RESULT AND DISCUSSIONS:

Performance Characteristics: Performance charts are those which compare the performance parameters which are found on the engine for those produced diesels. These charts mainly drawn basing on the brake power Vs other parameters some of these charts are drawn between the following-

1. Brake Power Vs Mass of fuel consumption
2. Brake Power Vs Brake specific fuel consumption
3. Brake Power Vs Brake Thermal Efficiency
4. Brake power Vs Air Fuel Ratio

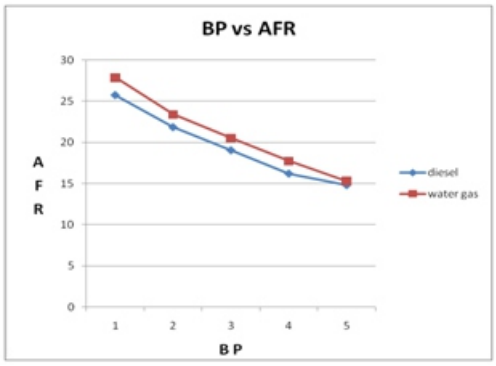

Fig 4.1 Brake Power Vs Air Fuel Ratio

OBSERVATION FROM THE FIGURE 4.1:

the consumption of Water gas with respect to the BP is higher than diesel .so compare to others, engine run with Water gas takes less mass of fuel.

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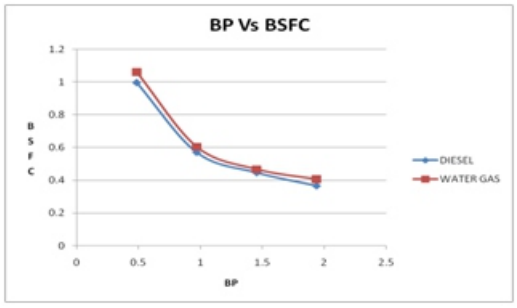

Fig 4.2 Brake Power Vs Brake specific fuel consumption

OBSERVATION FROM THE FIGURE 4.2:

engine consumes more water gas compared to Diesel. So compare to the others running cost of engine using Water Gas is better.

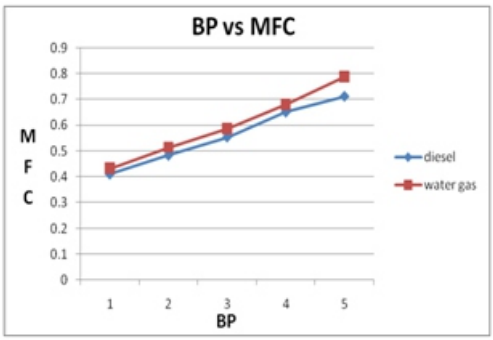

Fig 4.3 Brake Power Vs Mass of fuel consumption

OBSERVATION FROM THE FIGURE 4.3:

the consumption of water gas with respect to the BP is higher than diesel.so compare to others, engine run with water gas takes less mass of fuel.

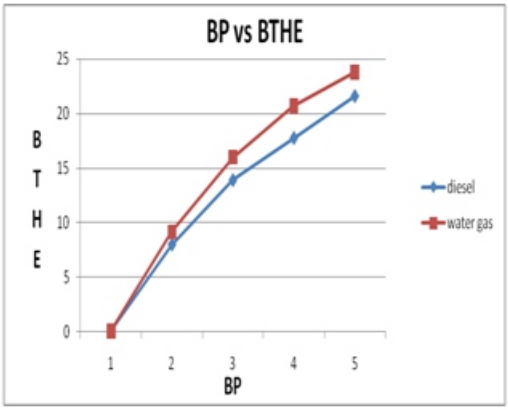

Fig 4.4 Brake Power Vs Brake Thermal Efficiency

OBSERVATION FROM THE FIGURE 4.4:

There is a increase in BTHE of the engine by Using water gas. Hence, there is a better utilization of indicated power for generating 1KW of BP using these water gas. Hence frictional losses are less using these water gas

V.CONCLUSIONS:

- The water gas produced showed viscosity, specific gravity and calorific value are well within the range of diesel oil and all the properties satisfy the B.I.S standards of biodiesel.

- Flash and fire points of water gas are comparatively higher watergas, thus the risk of fire hazards gets reduced and handling and storage of water is safer.

- Water gas can be used in the existing engine without any modifications to the existing engine except fuel tank

- From Fig 4.1:Compare to the other fuels, engine run with water gas takes less mass of fuel

- From Fig 4.2: Compare to the other fuels running cost of engine using water gas is better .

- From Fig 4.3:Compare to the other fuels the engine run with water gas is having minimum frictional losses.

- From Fig 4.4: fuel consumption of water gas is less compare to other fuels.

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