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Hydrogen Gas Assisted Combustion

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ABSTRACT:- *The internal combustion engine has become an integral part of the lives of every person on earth. They're the devices that have allowed us to cross continents reliably, generate electricity in remote areas and fly around the world in a matter of hours. All these engines do is burn fuel and convert its energy into work. It's these heat engines that have really changed the world. However the convenience they bring has come at a great cost. The major problem with the internal combustion engine is the environmental damage it has caused. It is only now we are beginning to realize the full extent of this damage.*

The first and most obvious source of pollution from vehicles is the Exhaust pipe. Exhaust emissions majorly contain carbon monoxide, un-burned hydrocarbons and oxides of nitrogen. It was found that these pollutants were having an adverse effect on the environment and in extreme cases were actually causing visible smog.

Carbon monoxide and hydrocarbons are formed due to the incomplete combustion of fuel in the engine cylinder. If the combustion of charge is maximum in the engine cylinder, the pollutants like carbon monoxide and un-burned hydrocarbons decreases which in-turn reduces the pollution as well as increases the efficiency of the engine due to the excess power produced by the combustion of CO and un-burned HC. One of the reason for the incomplete combustion of charge is flame propagation speed. Hence hydrogen gas is used to increase the flame propagation speed in the engine cylinder.

Keywords:- Carbon Monoxide, Combustion, Flame Propagation, Fuel, Internal Combustion Engine, Pollution, Un-Burned Hydrocarbons.

I. INTRODUCTION

Generally internal combustion engines, particularly reciprocating internal combustion engines, produce moderately high pollution levels, due to incomplete combustion of carbonaceous fuel, leading to carbon monoxide and some soot along with oxides of nitrogen and sulfur and some un-burnt hydrocarbons depending on the operating conditions and the fuel/air ratio. The primary causes of this are the need to operate near the stoichiometric ratio for petrol engines in order to achieve combustion (the fuel would burn more completely in excess air) and the "quench" of the flame by the relatively cool cylinder walls.

Diesel engines produce a wide range of pollutants including aerosols of many small particles that are believed to penetrate deeply into human lungs. Engines running on liquefied petroleum gas (LPG) are very low in emissions as LPG burns very clean and does not contain sulfur or lead.

Many fuels contain sulfur leading to sulfur oxides (SOx) in the exhaust, promoting acid rain.The high temperature of combustion creates greater proportions of nitrogen oxides (NOx), demonstrated to be hazardous to both plant and animal health. Net carbon dioxide production is not a necessary feature of engines, but since most engines are run from fossil fuels this usually occurs. If engines are run from biomass, then no net carbon dioxide is produced as the growing plants absorb as much, or more carbon dioxide while growing.

The efficiency of various types of internal combustion engines vary. It is generally accepted that most gasoline fueled internal combustion engines, even when aided with turbochargers and stock efficiency aids, have a mechanical efficiency of about 20 percent. Most internal combustion engines waste about 36 percent of the energy in gasoline as heat lost to the cooling system and another 38 percent through the exhaust. The rest, about six percent, is lost to friction. Most engineers have not been able to successfully harness wasted energy for any meaningful purpose, although there are various add on devices and systems that can greatly improve combustion efficiency.

Hydrogen gas Injection, is an engine add on system that is known to improve fuel economy of internal combustion engines by injecting hydrogen as a combustion enhancement into the intake manifold. Fuel economy gains of 15 percent to 50 percent can be seen. A small amount of hydrogen added to the intake air-fuel charge increases the octane rating of the combined fuel charge and enhances the flame velocity, thus permitting the engine to operate with more advanced ignition timing, a higher compression ratio, and a leaner air-to-fuel mixture than otherwise possible. The result is lower pollution with more power and increased efficiency. Some Hydrogen gas Injection systems use an on board electrolyser to generate the hydrogen gas used. A small tank of pressurized hydrogen can also be used, but this method necessitates refilling.

Hydrogen generator Kits operate on a 100 year old, proven technology called electrolysis. By sending electricity through stainless steel plates that are submerged in water in a certain pattern, we are able to separate water in to the H_2 and O_2 gases.

A hydrogen generator installed on your bike will help you increase fuel mileage by making petrol work more efficiently. It does not require any engine modifications, so your bike warranty is still in tacked, instead a hydrogen generator uses your battery to create hydrogen gas. This mixture of hydrogen and petrol burns cleaner, longer, and is also safer for your family and for the environment.

One is that more of the gas you buy gets used (or burned), not blown out through your exhaust system. This has a huge impact on fuel economy up to 60%. It also means your engine will feel vastly more powerful. Horsepower and performance will soar. The hydrogen gas created in your hydrogen generator also makes your engine run smoother, quieter, and shift more easily. Water inside the combustion chamber is the cause.

The hydrogen generator also has an impact on the environment. Water helps your engine run at a lower heat, and emissions of CO_2 are drastically reduced. Your bike begins to help the environment by adding oxygen, instead of adding carbon dioxide and other toxic byproducts.

Finally, hydrogen gas does not just improve fuel economy, it also decreases the emissions. It is also a safer substance for your family. Since the gas created by hydrogen generator is part hydrogen, it is fifteen times lighter than air and disperses in the air more quickly. Where heavier fuel and fuel vapors will remain on the ground, a flammable hazard, hydrogen disappears into the atmosphere harmlessly. Hydrogen is also completely non-toxic, petrol and diesel fuel and fumes are notoriously toxic for human beings and all animals.

II. CONVENTIONAL FUEL USED IN SI ENGINE

Gasoline or Petrol is a complex chain of over 500 Hydrocarbon molecules. In the right conditions underground, there is a Carbon molecules that binds with a Hydrogen molecule and with a few hundred thousand years passing it ends up forming oil. After we pump it up and refine it we get the fuel we put into our car tanks.

About half of these 500 molecules are more simple and can be burned at temperatures of 200 degrees. The other half burn when there is about 400 degrees. When your spark plug fires up, it starts to ignite the 200 degree molecules which in turn start to ignite the 400 degree molecules. The problem is that by the time they start to do this the power stroke of your piston has mostly finished. These molecules either continue to burn in your exhaust, or they remain un-burned as hydrocarbons that go out your tail pipe.

Introducing a supply of Hydrogen gas into the combustion chamber simply helps to ignite the 400 Degree molecules within the cylinder at a time when it helps to push the piston down. If you start burning all the fuel within the cylinder you get more power and end up using less fuel to travel the same distance.

2.1.Ideal Reaction:

Under ideal settings, where only hydrocarbon and oxygen are present, the chemical reaction commonly called combustion or burning produces only water, carbon dioxide, and energy as the following basic equation shows.

$$CH_4 + 2\ O_2 \rightarrow 2\ H_2O + CO_2 + \text{Energy}$$

In the above ideal reaction, the energy gained from the reaction is greater than the energy put into the reaction. It is common knowledge that a spark is needed to make a hydrocarbon burn. The spark represents the energy need to break the carbon-carbon and carbon-hydrogen bonds of the hydrocarbon molecule as well as the oxygen-oxygen bond of the oxygen molecule. The typical C-C bond requires 350 kJ/mol to break, the typical C-H bond requires 413 kJ/mol, and the O-O bond requires about 498 kJ/mol.

We know, however, the energy is released from these reactions and it is released when new bonds are formed. The H-O bonds of water release about 464 kJ/mol of energy when formed and the C=O bonds of CO_2 release about 800 kJ/mol when formed. The net outcome is the release of energy in the form of heat.

2.2.Oxygen as Limiting Factor:

The atmosphere is not pure oxygen. It contains a number of other gases including nitrogen (78%), argon, hydrogen, iodine, and other trace compounds. The effect of these other compounds is two-fold. First, they act as contaminants in the reaction, which is discussed in this section. They also act to effectively limit the concentration of oxygen. Rather than 100% oxygen, reactions that occur under atmospheric conditions are subject to only 21% oxygen. When oxygen is a limiting factor, it is not possible to pair every carbon atom with two oxygen atoms during a combustion reaction. Thus, some carbon atoms end up with only one oxygen atom. This produces carbon monoxide. When a combustion reaction produces CO, it is referred to as incomplete combustion.

Atmospheric combustion would then be more closely modeled by the equation that follows (note this is not a balanced equation).

$$CH_4 + 2\ O_2 \rightarrow 2\ H_2O + CO_2 + CO + \text{Energy}$$

III. ELECTROLYSIS OF WATER

3.1 Chemical energy from electrical energy:

Spontaneous reduction / oxidation reactions can be used as a source of electrical energy. We can cause reduction / oxidation reactions to occur by the passage of electrical energy from a power supply through a conducting liquid.This process is called electrolysis.

3.2 Electrolysis:

Electrical energy is converted into chemical energy. The reactions that occur in electrolytic cells are essentially the opposite to those occurring in galvanic cells. Reactions in electrolytic cells would not normally happen without the application of electrical energy, and so they are called non-spontaneous reactions. Chemicals formed by electrolysis are often difficult to obtain by other means.

IV. COMBUSTION EQUATION OF HYDROGEN GAS

Hydrogen combustion is the process by which hydrogen reacts with an oxidizing agent and burns. Hydrogen combustion is an exothermic combustion, meaning that it releases heat energy. Endothermic processes, on the other hand, absorb energy.

Hydrogen burns based on the chemical formula,

$$2\ H_2 + O_2 \longrightarrow 2H_2O$$

Meaning that it reacts with oxygen. While it is not shown in the chemical equation, an input of energy is necessary to begin the reaction, which releases a significant amount of energy when carried through to completion.

Combustion reactions are more often simply called burning. There are two parts that are essential to combustion reactions, including hydrogen combustion: a fuel and an oxidizing agent. With the input of heat, hydrogen reacts with oxygen to release heat and light energy. The end products of the reaction include water vapor and heat. The energy released comes from the energy that was stored in chemical bonds that are broken during the reaction.

Hydrogen combustion has shown some potential for powering automobiles and generating energy to meet other human needs. Fossil fuels are more commonly used for fuel and energy, but the supply of such fuels is very limited and their combustion releases harmful gases into the atmosphere. Hydrogen, on the other hand, is a hugely abundant resource that only produces water vapor when burned. While it is still a relatively new area of study, there are several different kinds of vehicles that have been made to utilize hydrogen combustion because of its cleanliness and its renewable nature. Large quantities of hydrogen are actually used to launch space shuttles into space.

In the chemical reaction, combustion products are produced. Because the products are of high temperature, the cold flammable medium expands strongly on combustion. The expansion generates a flow field that carries along the flame front. Relative to the reactive mixture (which is in motion), the flame front propagates at the laminar burning speed. Laminar burning speeds for the most common stoichiometric hydrocarbon-air mixtures are on the order of only 0.5 m/s. The laminar burning speed of stoichiometric hydrogen-air equals approximately 3.5 m/s.

V. SUPPLY OF HYDROGEN GAS TO I.C.ENGINE

Hydrogen gas generated in the dry cell is passed through buffer tank and flash back arrestor for safety aspects. Flash back arrestor outlet is connected to the air filter.

As the ICE starts, at the suction stroke the air fuel charge is sucked from the carburetor. Along with the air from the air filter, hydrogen gas is sucked into the carburetor and mixed homogeneously for proper combustion.

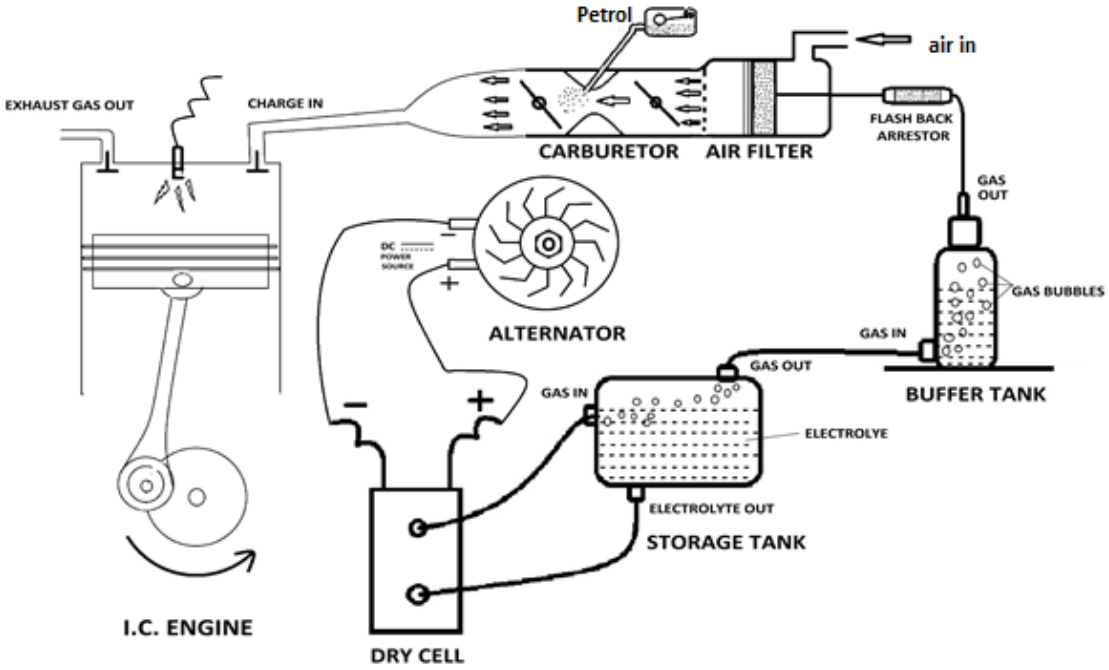
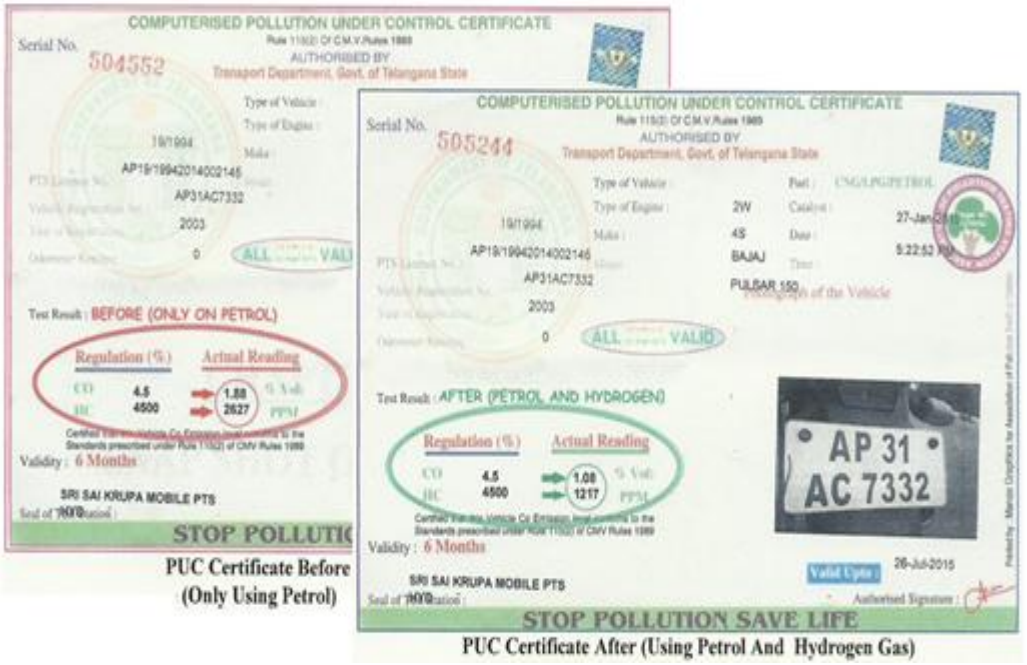


Fig.1 Line diagram of arrangement of experiment

VI. Why Hydrogen?

Hydrogen can help Lower Pollution by reducing harmful emissions, while also releasing oxygen and water vapor into the atmosphere. Using a safe, affordable fuel. In fact it's the cleanest fuel because hydrogen from water converts back into water vapor and oxygen after it burns! Since Hydrogen causes gasoline to burn faster, less heat is transferred to the engine, resulting in lower engine temperature and reduced wear. Hydrogen injection also increases overall vehicle performance, improving torque and horsepower while reducing vibration and cleaning out the inside of your engine.



Figures And Tables 7.1 PUC Certificate:

Fig.2 PUC Certificate comparison with only Petrol and with Petrol and Hydrogen

7.2 POLLUTION UNDER CONTROL COMPARISON:

TABLE 1. Comparison between pollutants

Pollutants	PUC Limits For 2/3 - Wheeler	Measured Values (Before - only Petrol)	Measured Values (After - Petrol & Hydrogen)
Carbon Monoxide (% Vol)	4.5	1.88	1.08
Hydro Carbons (ppm)	4500	2627	1217

VII. CONCLUSION

The project work "Hydrogen Gas Assisted Bike" is designed and developed successfully. It is a working model is constructed & results are found to be satisfactorily while designing and developing this working model. This project is manufactured relatively low cost, and increasing Better mileage of the bike using electrolysis process to produce the hydrogen gas. The normal water and NaOH solution used in electrolysis process. Compared to other vehicles, the maintenance cost is low and Eco-friendly to environment. Increase engine's life and overall performance.

Increase in mileage of vehicle up to 40% & in some case more. Eliminate harmful exhaust emission that pollute the environment and contribute to global warming. Your engine will add oxygen to the environment instead of polluting it. Increase in pick-up of vehicle. Better smoother running engine. Remove carbon deposits and prevent future carbon build up. Reduce knocking of engine. Reduce the operating temperature of the engine. Engine can make less polluted. This gas is then injected into your vehicle's air intake system as a Supplemental Fuel. Hydrogen Gas has proven to increase mileage while improving horsepower and lowering emissions.Increase engine's life and overall performance.

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