

Experimental Studies on Application of Biogas/Butane and H.H.O. Gas as a Fuel Supplement for 4-Stroke Petrol Engine

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Abstract—Our environment is constantly changing, with the massive incursion of natural disasters and adverse atmosphere conditions such as erratic colossal winds, heavy rainfall, and change in warming and cooling periods and much more. People need to be aware of what type of environment problem our planet is facing; we are in a state of planetary exigency, with environmental problems build up high around us. Pollutions of air, water, and solids required millions of years to recoup. Air pollution is caused by various gases and toxins released by industries and ignition of fossil fuels in engine of automobiles. Both the pollution problems and oil shortage require new ways of powering our automobile. Due to growing cost of petroleum, researchers hunting for alternate fuels are escalating more and more.

The main objective of this research was to convert a traditional SI engine to a partially (on blends) run on a biogas/butane and HHO gas as fuel supplements which conducted on single cylinder 4-stroke petrol engine. Due to the presence of carbon dioxide in the biogas, it has poor combustion properties and because of short carbon chain in methane; it produced low smoke and particulate emissions than petrol. HHO gas is added in small amount by electrolyzer unit to decrease the intensification of carbon dioxide in biogas on energy basis. An electrolyzer is a device which turns water into parts line of hydrogen and oxygen gas at desire amount. Due to very high combustibility in nature of hydrogen gas, it completely burns inside the IC engine. Hence there is no scope for incomplete combustion also butane is utilized as supplement for better performance in terms of torque and power of engine. The experiment results were analyzed for the selection of better fuel supplements of biogas/butane and HHO gas with petrol as pilot fuel on SI engine for better performance with reduced pollution.

Keywords: Internal combustion engine (IC engine); Gasoline Engine (Petrol engine); Hydrogen gas, Electrolyzer (E-Unit); Spark Ignition engine (SI engine); Hydroxy Gas (HHO gas).

1. INTRODUCTION

The automobile become now the main transport for the enormous majority of mankind. But it is unfortunately main global pollutant of ecological. With a rising demand for transportation IC engines have gained lot of importance in

automobile industry. It is consequently necessary to produce resourceful and economical engines. In the near future; gasoline and diesel are expected to become pricier. Present civilization can't endure lacking of motor car and electricity. Crude oil and petroleum product are proposed to become very costly. Petrol is a fossil fuel made from crude oil. The supply of petrol is not enough. India is mainly needy on Arab countries for their fuel supplies. The specter of economy ruin due to depleted oil reserves has changed the interest of scientist and research work towards alternative fuels for motor vehicle. Since the dawn of the oil Age, man has burnt about 800 million barrels of petroleum. About 71 million barrels are burnt every day though out the world and this consumption figure goes up by around 2% every year. By 2010 the world would have consumed one-half the total amount is technically and economically feasible to extract. And the current rate of consumption, 1600 billion barrels would be exhausted in 60 years. It is the time to think about the alternate's fuels. India is largest cattle breeding country; there is large quantity of raw material for producing biogas. Also municipal sewage can be used for this purpose. The main advantage of biogas is that it can be produced in rural areas from readily available materials. Biogas consist mainly methane and carbon dioxide is low but its knock resistance is high. [1] Biogas can be used for the replacement of fossil fuels in both heat and power generation thus contributing to reduction of greenhouse gas (GHG) emissions. Biogas can be used as a good alternative fuel for internal IC engine applications. In oil crisis situations, it may act as a capable alternative fuel, especially for both gasoline and diesel engines. [2] Biogas will give lower exhaust emissions than fossil fuels, and so help to improve local air quality, although technology changes in future years. [3] In additional HHO gas and butane gas is to supply to engine. Electrolysis of water is one of economical method of the decomposition of water (H₂O) into oxygen (O₂) and hydrogen gas (H₂) due to an electric current being passed through the water. This method can be used to make hydrogen

fuel (hydrogen gas) and breathable oxygen; though currently most industrial methods make hydrogen fuel from natural gas instead. Hydrogen is very easily ignited. [4] Due to the small quenching distance and high auto ignition temperature, hydrogen is suggested in internal combustion engine as an alternate fuel as a substitute of gasoline. [5] Hydrogen air-mixture burns nearly ten times faster than gasoline air-mixture. General butane is a colorless, flammable gas with a petroleum-like odor. Butane as a fuel for spark ignition engines, it has many of the same advantages as natural gas with the additional advantage of being easier to carry aboard the vehicle. Typically used in the manufacture of aviation fuels, organic chemicals and as a heating fuels. Its major disadvantage is the limited supply. Butane enters an engine's combustion chambers as a vapor; it does not strip oil from cylinder walls or dilute the oil when the engine is cold. This helps to have a longer service life and reduced maintenance costs of engine. [6]

While developing an IC engine it is required to take in consideration all the parameters affecting the engines design and performance. There are enormous parameters so it becomes difficult to account them while designing an engine. So it becomes essential to conduct tests on the engine and determine the measures to be taken to improve the engines performance.

2. LITERATURE REVIEW

Idea of this project after reviewing following references:-

Venkata Ramesh Mamilla¹, V.Gopinath², C.V.Subba Rao³, Dr. G Lakshmi N. Rao, "Performance And Emission Characteristics Of 4 Stroke Petrol Engine Fueled With Biogas and L.P.G Blends", 2011 and they concluded The various blends of L.P.G and Biogas are used and conducted the tests on 4-stroke, single cylinder, air cooled SI engine. The experimental results were analyzed for the selection of better blend of L.P.G and Biogas suitable for SI engine for better performance with reduced pollution. [1]

Debabrata Barik^{1*}, Sudhir Sah², S. Murugan, "Biogas Production and Storage for Fueling Internal Combustion Engines", 2013 and the concluded that the study concludes the potential explore of biogas production from various organic biomass wastes. Attention is also focused for making biogas as a transport vehicle and stationary engine fuel by storing it in cylinders and reinforced plastic bags [2]

Sarah Haybittle, "Bio Gas as a Transport Fuel", 2006 and they concluded that The environmental benefits of biogas compared to other transport fuels would appear strong, and although there is a case for using the gas for electricity production, it would seem sensible to provide sufficient incentives to allow a market for biogas in transport to develop.[3]

B.Rajendra Prasath, E.Leelakrishnan, N. Lokesh, H. Suriyan, E. Guru Prakash, K. Omur Mustaq Ahmed, experimentally

"Hydrogen Operated Internal Combustion Engines a New Generation Fuel", 2012 and they conclude that NO_x emission in both S.I engine and C.I engine also reduces to the maximum considerable amount. This makes it possible to run the engine leaner, resulting in lower emissions of CO₂, CO and HC.[4]

J. Akash Nirmal Kumar, N. Gowtham and S. Senthil, "Design and Fabrication of Hydrogen Powered IC Engine", 2014, concluded that, Due to the high specific energy, high flame speed, wide range of flammability, and clean burning characteristics, it is suggested for its high performance in internal combustion engines (ICE). [5]

Albela H.Pundkar, S.M. Lawankar, Dr. Sameer Deshmukh, "Performance and Emissions of LPG Fueled Internal Combustion Engine: A Review", March -2012, concluded that,

In the next five to ten years, LPG will be more widely available and gaining market share across vehicle ranges, In this paper a comprehensive review of various operating parameters and concerns have been prepared for better understanding of operating conditions and constrains for a LPG fueled internal combustion engine. [6]

3. METHODOLOGY

Biogas is produced by extracting chemical energy from organic materials in a sealed container called a digester. The making of biogas is the concept of anaerobic digestion, also called biological gasification. Biogas consists of about 60 to 80 percent methane, 20-40 percent carbon dioxide, and trace amounts (1 to 2 percent) of other compounds such as hydrogen sulfide, ammonia, and water vapor. The gas is similar to natural gas and is produced as a byproduct from the genetic breakdown of organic material. In the agriculture industry, biogas can be produced from livestock manure. On other hand electrolysis of water is the breakdown of water (H₂O) into oxygen (O₂) and hydrogen gas (H₂) due to an electric current passed through the water. An electrical power source is connected to two electrodes, or two plates are placed in the distilled water. Hydrogen will emerge at the cathode as the negatively charged electrode, where electrons enter the water and oxygen will emerge at the anode (the positively charged electrode). An apparatus in which electrolysis is carried out, consisting of one or many electrolytic cells is called as electrolyzer. Normal butane can be used for gasoline blending, as a fuel gas, either unaided or in a mixture with propane. In this form it is often mixed with small amounts of hydrogen sulfide and mercaptans which will give the unburned gas an offensive smell effortlessly detected by the human nose. In this way, butane leaks can simply be identified.

4. EXPERIMENT SET-UP AND PROCEDURE

A horizontal, air-cooled, single cylinder, four strokes, Engine was used for the study. The engine was coupled to rope brake

Dynamometer for load measurement. Essential dead weight and spring balance are included to apply load on brake drum.



Fig. 1: (a). Actual engine setup – side view

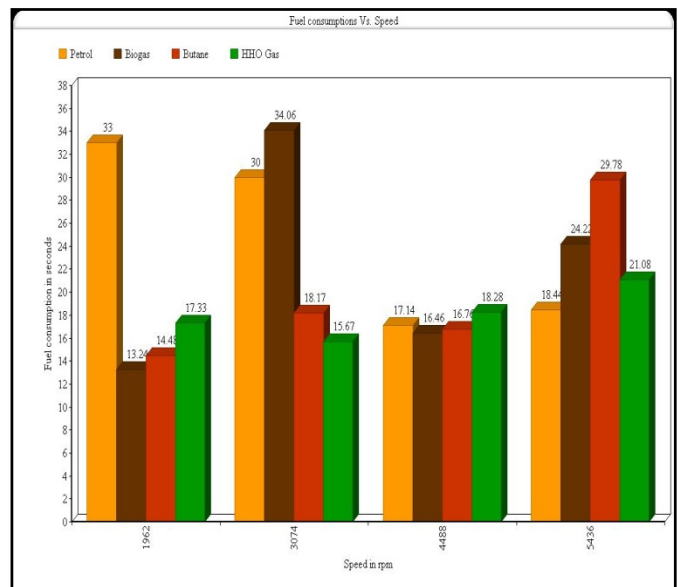


Fig. 1: (b). Actual engine setup

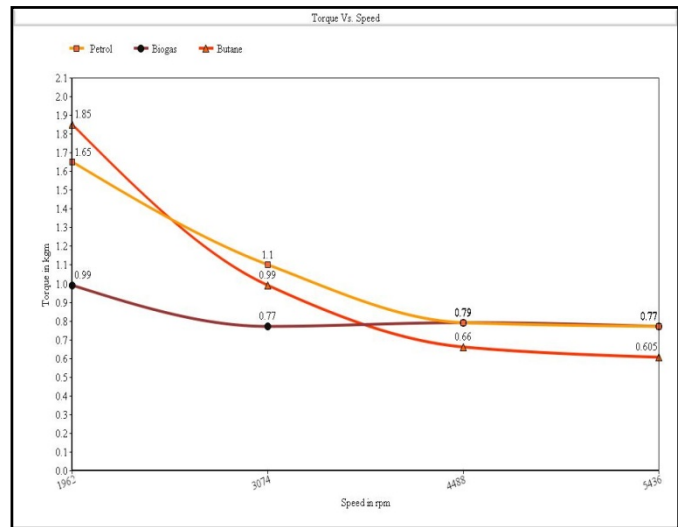
5. COMPARISONS OF PERFORMANCE ON CHARACTERISTIC CURVES:

The testing of various mixtures of biogas (CH₄) /butane (C₄H₁₀) and hydrogen gas (HHO) for the study of their behavior on working condition of four stroke single cylinder petrol engine. This testing enables us to determine various parameters which determine performance in the engine, which are listed as below:

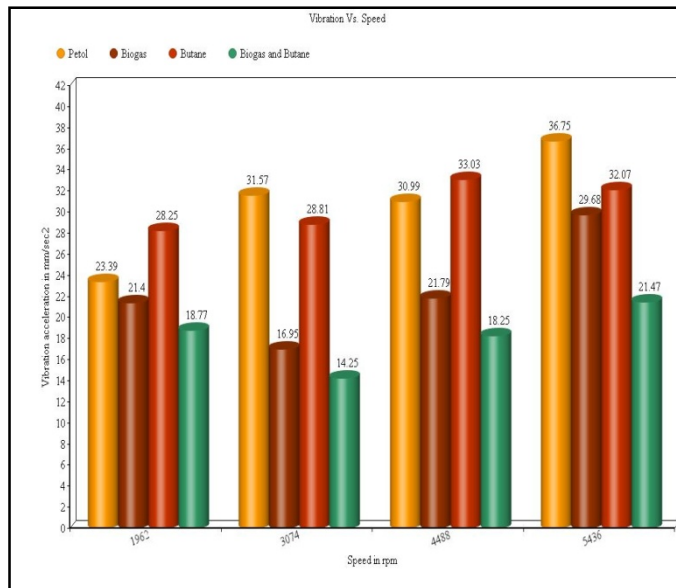
1. Fuel Consumption Test. [GRAPH NO. 1]
2. Torque vs. Speed [GRAPH NO. 2]
3. Vibration Test. [GRAPH NO. 3]
4. Fuel Consumption Test for Different Blends [GRAPH NO. 4]



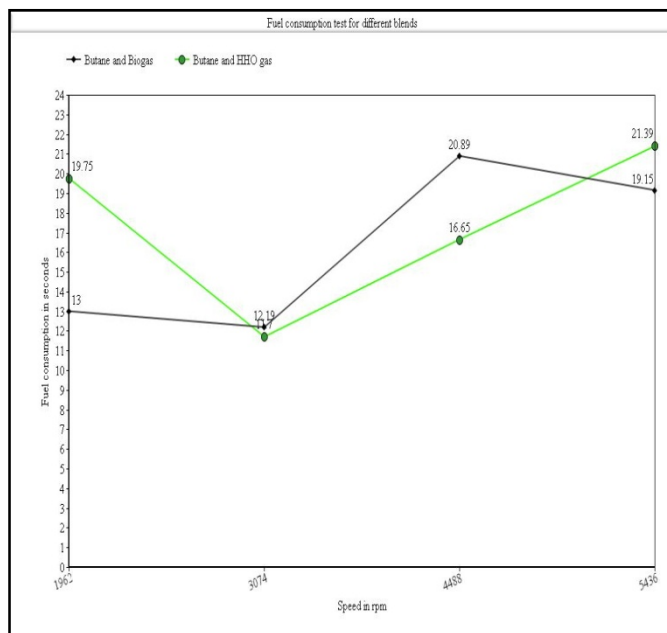
Graph No 1: Fuel Consumption Test



Graph No 2: Torque vs. Speed



Graph No 3: Vibration Test



Graph No 4: Fuel Consumption Test for Different Blends

6. CONCLUSION

We have used different types of fuels as an alternative fuels with orientation to petrol. Our alternative fuels are biogas, butane, hydrogen and their blends. This conduct experiment

found that the performance of the engine optimizes at the usage of different types of fuels. On usage of biogas, we found that, the magnitude of fuel consumption at the initial stage is same but around 5000-6000 rpm the fuel consumptions time abruptly changes, with this engine vibration. Butane also decreases the fuel consumption time around 3000- 4000 rpm but from 0 to 3000rpm it consumes butane as comparable to petrol. The power which is developed is getting increased to that of petrol. The utilization of hydrogen in IC engine is a gigantic achievement because it has increased fuel consumption time with a greater difference. It has decreased the engine power but it is the only supplement which satisfies the need of vibration in our IC engine. In this way, we have studied about all the alternative fuels used as supplement from which we get to know that hydrogen is one of the best fuels ever. Because hydrogen increases the fuel consumption time as well as efficiency of other parameters.

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