

A Review Paper on Investigation on Feasibility of Biogas as Fuel for Automobile/Vehicle Engine

Jayesh D.Vaghmashi¹, Mr.D.R.Shah², Mr.D.C.Gosai³

1 Post Graduate student in Mechanical Department, S.V.M.I.T., Bharuch, Gujarat

2 Associate Professor in Mechanical Department, G.E.C., Gandhinagar, Gujarat

3 Associate Professor in Mechanical Department, S.V.M.I.T., Bharuch, Gujarat

Abstract: Man in his lifetime, uses energy in one form or the other. In fact whatever happens in nature, results, out of the conversion of energy in one form or the other? The blowing of the wind, the formation of the clouds and the flow of water are a few examples that stand testimony to this fact. Of late, erratic and perfunctory usage of energy has resulted in an energy crisis, and there is a need to develop methods of optimal utilization, which will not only ease the crisis but also preserve the environment. This attempts to show how man has been utilizing energy and to explore prospects of optimizing the same. Researches show that the world has already had its enough shares of its energy resources. Fossil fuels pollute the environment. Nuclear energy requires careful handling of both raw as well as waste material. The focus now is shifting more and more towards the renewable sources of energy, which are essentially, non-polluting. The main sources of renewable energy in India are biomass, biogas, solar, wind and hydro power.

Keywords: Bio gas, property of bio gas, literature review

1. INTRODUCTION

According to the World Coal Institute, India is currently the world's eleventh largest energy producer and accounts for approximately 2.4% of the world's total annual energy production. It accounts for around 3.7% of the world's total annual energy consumption which places it as the 6th largest energy consumer. India is also the 6th largest electricity generator, accounting for almost 4% of the global annual generation, as well as the 6th in terms of electricity consumption. Coal currently provides 69% of the electricity demand in India and will continue to be a major source in the future. India has around 10% of the world's coal reserves but this coal is of low quality. This poor quality coal is an inefficient source and highly polluting. Growing concerns for the environment have also driven the need to find substitutes for this energy source. The main sources of renewable energy in India are biomass, biogas, solar, wind and hydro power. Gaseous fuels have wide flammability limits and can easily form a homogeneous mixture with air for good combustion. Thus they will lead to very low levels of pollutants and can be effectively utilized in both spark ignition (SI) and compression ignition (CI) engines. Moreover, gaseous fuels have high hydrogen to carbon ratios. Thus very low CO₂ emissions are possible when they are used in I.C.Engines. Natural gas and Liquefied Petroleum Gas (LPG) are the readily available petroleum-based fuels, while hydrogen, biogas and producer gas can be obtained from renewable sources.

2. BASIC OF BIOGAS

Biogas typically defines a gas resulting from the anaerobic (i.e. absence of O₂) decomposition or fermentation of organic material like: Municipal waste or leftovers landfill gas, Sewerage waste, sewage gas, Liquid manure or dung, Energy crops (corn, wheat, grass) etc.

2.1 Composition and properties of biogas

Biogas is a mixture of gases that is composed chiefly of:

- methane (CH₄): 40-70 vol.%
- carbon dioxide (CO₂): 30-60 vol.%
- other gases: 1-5 vol.% including
- hydrogen (H₂): 0-1 vol.%
- hydrogen sulphide (H₂S): 0-3 vol.%

The calorific value of biogas is about 6 kWh/m³ - this corresponds to about half a litre of diesel oil. The net calorific value depends on the efficiency of the burners or appliances. Methane is the valuable component under the aspect of using biogas as a fuel.

2.2 Feed stock (raw material) of biogas

Agricultural Feedstock

- Animal manure
- Energy crops
- Algal biomass
- Crop residues

Community-Based Feedstock

- MSW
- Sewage sludge
- Grass clippings/garden waste
- Food remains
- Institutional wastes etc.

Industrial Feedstock

- Food/beverage processing
- Dairy
- Starch industry
- Sugar industry
- Pharmaceutical industry
- Cosmetic industry
- Biochemical industry
- Pulp and paper

2.3 Biogas Applications

1. for cooking and heating.
2. as an illuminant for domestic and street lighting.
3. for running tube well and water pump.
4. With minor modifications, conventional internal combustion engines, diesel and petrol engine both run on biogas.

3. LITERATURE REVIEW

E. Porpatham, A. Ramesh, B. Nagalingam (2011)^[1] was examine the Effect of compression ratio on the performance and combustion of a biogas fuelled spark ignition engine. The engine was operated at 1500 rpm at throttle opening of 25% and 100% at various equivalence ratios. The tests were covered a range of equivalence ratios from rich to the lean operating limit and a number of compression ratios. The spark timing was set to MBT (Minimum advance for Best Torque). The performance, emission and combustion characteristics with different compression ratios are compared. The peak power output with a compression ratio of 15:1 is 4.8 kW and it is 10% higher than that with a compression ratio of 9.3:1 is 4.4 kW with an increase in compression ratio from 9.3:1 to 15:1, the peak brake thermal efficiency increases from 23% to 26.8%.

Shyam S. Kapdi, Virendra K. Vijay, Shivanahalli K. Rajesh and Rajendra Prasad (2006)^[2] was work on the topic of Upgrading biogas for utilization as a vehicle fuel. In this research paper, a model bottling plant has been conceptualized for a 120 m³/day capacity biogas plant as a village enterprise. The model bottling plant will give savings of 15768 liters of petrol worth cost about 0.66 million Rs. per annum. It should be replicated at mass scale to reduce import of petroleum products, save environment and generate employment in the villages. The spirit behind the whole concept is to develop self sustained rural enterprises and decentralized fuel station based on compressed upgraded biogas to make rural areas economically developed and competitive in all respects.

Venkata Ramesh Mamilla, V.Gopinath, C.V.Subba Rao, Dr.G.Lakshmi Narayana Rao (2011)^[3] has work on the performance and emission characteristics of 4 stroke petrol engine fuelled with biogas / L.P.G. blends. From this experiment it was clear that at 50% blending of biogas the engine performance is found to be very appreciable. At this 50% blending trial particularly at full load the specific fuel consumption and brake thermal efficiency are high when compare to the petrol, LPG and the mechanical efficiency is high for the 50% blending with compared to the Petrol, L.P.G, and 40% Blending. And, also the emission values of CO, HC and NO_x are minimum for the biogas when compared to the petrol, L.P.G.

Debabrata Barik, S. Murugan (2012)^[4] was work on the area of Production and Application of Biogas as a Gaseous Fuel for Internal Combustion Engines. They conclude that Biogas is a renewable fuel, derived from the anaerobic digestion of organic wastes or biomass crops, and as such it can contribute to reducing carbon emissions from transport and tackling climate change. As a renewable fuel biogas helps to reduce dependence on conventional fossil fuels.

K.A. Subramanian, Vinaya C. Mathad , V.K. Vijay , P.M.V. Subbarao(2013)^[5] was work on the topic of Comparative evaluation of emission and fuel economy of an automotive spark ignition vehicle fuelled with methane enriched biogas and CNG using chassis dynamometer. The emissions such as CO, HC and NO_x are marginally higher with the enriched biogas than base CNG. But, the experimental results indicate that the vehicle's emission with the enriched biogas fuel meets to the BS IV Emission Norms. There is no significant change in fuel economy of the vehicle fuelled with the enriched biogas (24.11 km/kg) as compared to base CNG (24.38 km/kg). The experimental data indicates transient emission characteristics (CO, HC and NO_x) of the vehicle with respect to time for both fuels are very higher with urban cycle (low speed) than extra urban cycle. (High speed) As the methane enriched biogas gives similar performance like fossil CNG, the enriched biogas could be used as an auto fuel for spark ignition vehicles.

4. CONCLUSION OF LITERATURE REVIEW

- After removal of CO₂ and H₂S by use of scrubbing, biogas is enriched in methane (CH₄) and becomes equivalent to natural gas but limitation is production rate is very low.
- Presence of up to 30% carbon dioxide in biogas improved the engine performance as compared to the same running with natural gas
- After studying of research paper, we can say that biogas is a most important renewable source of energy.
- Biogas is a cheaply available in India.
- By using of biogas in automobile/vehicle engine, we can reduce the exhaust emissions at some level instead of using petroleum products.

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