Impact Factor (SJIF): 4.542

International Journal of Advance Research in Engineering, Science & Technology

e-ISSN: 2393-9877, p-ISSN: 2394-2444

Volume 4, Issue 3, March-2017

Analysis of the performance of Unscrubbed & Scrubbed Bio-gas on Gasoline Operated Engine

Chauhan Hemrajsinh[1], Desariya Anas[2], Patel Dhaval D[3] , Singh Nikhil[4] ,Pankaj Ahir[5]

[1,2,3,4] *Students, Department of Mechanical Engineering, ITM UNIVERSE VADODARA*
[5] *Assistant professor, Department of Mechanical Engineering, ITM Universe VADODARA*

Abstract — *Biogas is a clean environment friendly fuel. Raw biogas contains about 55-65% methane (CH_4), 30-45% carbon dioxide (CO_2), traces of hydrogen sulfide (H_2S) and fractions of water vapours. Presently, it can be used only at the place where it is produced. There is a great need to make biogas transportable. This can be done by compressing the gas in cylinders which is possible only after removing its CO_2, H_2S and water vapour components. This paper reviews the efforts made to improve the quality of biogas by scrubbing CO_2 and the results obtained. There is a lot of potential if biogas could be made viable as a transport vehicle fuel like CNG by compressing it and filling into cylinders after scrubbing and drying.*

Keywords- Raw Biogas, Biogas Enrichment, Scrubbing of Biogas, Otto engine.

I. INTRODUCTION

The situation of energy in the world today, whether in emerging or industrialized countries, is regularly discussed in economic, political, and technical terms. Meanwhile the main sources of energy like coal, natural gas, crude oil, and even nuclear energy are becoming scarce. Bio energy is deriving more and more significance in terms of research and development.
Most of the energy used in the world is supplied by fossil fuels. Burning of the fossil fuels generates waste materials, mainly emissions to the atmosphere in the form of combustion fuel gases and dust, as well as some ash. These waste materials have hazardous effects on the environment, some of them locally, others with more widespread or even global impact. Another problem with petroleum is the emission of pollutants, such as CO_2, NO_x, CO and hydrocarbons (HC).So, the world had to search for other sources of fuel and now a day the most useful and eco-friendly source are gaseous fuels

II. APPLICABILITY OF BIOGAS AND HYDROGEN IN IC ENGINES

The self-ignition temperature of biogas is high and hence it resists knocking which is desirable in SI engines. Thus biogas has a high anti-knock index and hence biogas engine can use high compression ratios, which can lead to improvements in thermal efficiency.

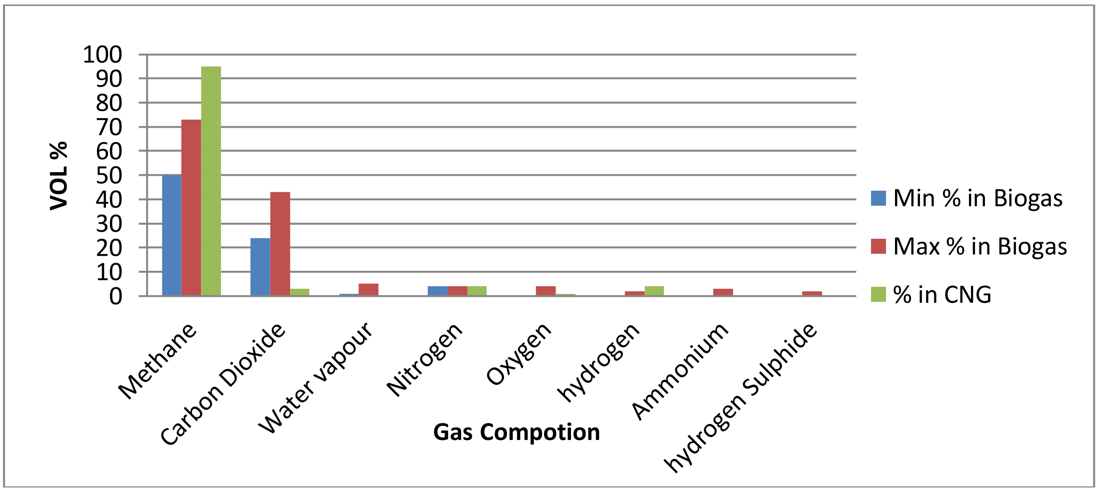


Fig.2.1 Comparison of gas impurities of raw biogas with natural gas

There are varoius effort made to improve the quality of biogas.

There is a lot of potential if biogas could be made viable as a transport vehicle fuel like CNG by compressing it and filling into cylinders after scrubbing and drying. Varieties of processes are being used for removing CO_2 from natural gas in petrochemical industries, Like Physical absorption, Chemical absorption, Adsorption on a solid surface, Membrane separation, Cryogenic separation, water scrubbing etc [1]. Water scrubbing is very simple process in which biogas passes through water flow at high pressure (10 bars) shown in fig.

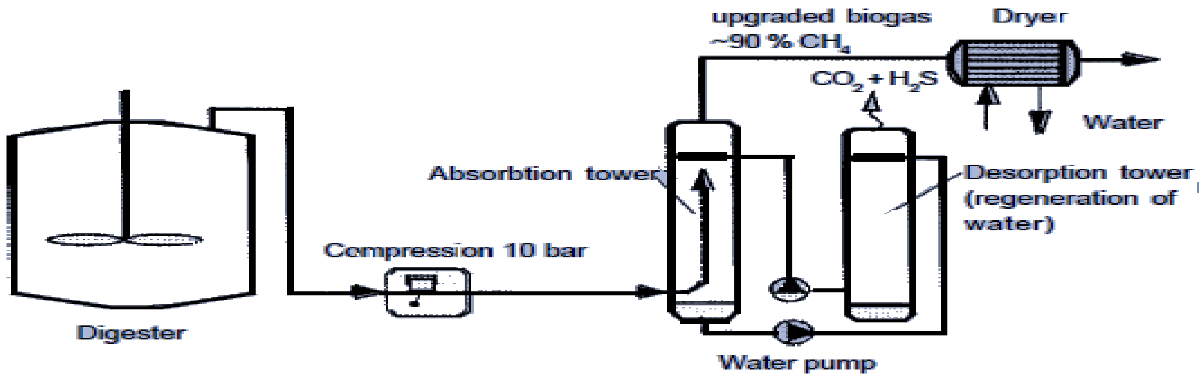


Fig. 2.2 Line diagram of Biogas scrubbing process

Biogas scrubbing and compression at high pressure for storage in cylinders are essential. Different methods of scrubbing are reviewed and found that water scrubbing is simple, continuous and less expensive method for CO_2 removal from biogas for Indian conditions. It simultaneously also removes H_2S. After removal of CO_2, biogas is enriched in methane (CH_4) and becomes equivalent to natural gas. It can be used for all such applications for which natural gas is being used viz. as a fuel for vehicles, CHP, electricity generation, etc.

Effect of variations of carbon dioxide in biogas inject with diesel on the performance and emission characteristics of the diesel engine to simulate the performance of the engine running with biogas from different sources (varying proportion of methane and carbon dioxide). Results indicated that as the percentage carbon dioxide in biogas increases, the biogas supply to produce the same power also increases. The rate of increase of biogas at higher substitution is higher. Also bsfc decreases up to 20 to 30 percentage of carbon dioxide in biogas.[2]

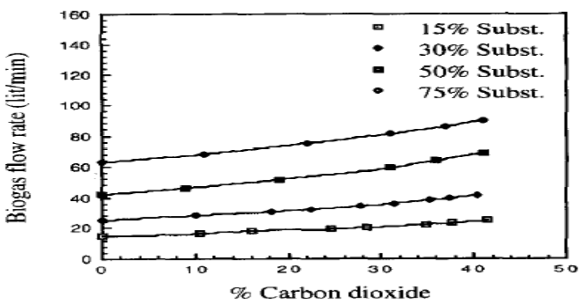


Fig.2.3 Variation of biogas flow with the Carbon dioxide

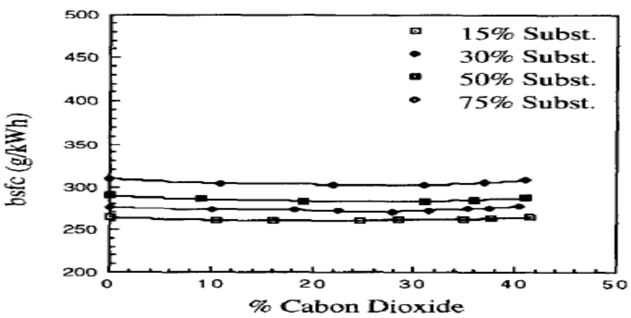


Fig.2.4 Variation of bsfc with in biogas with the Carbon dioxide

The emission test shows that the carbon dioxide in the mixture may dissociate (to break mixture) into carbon monoxide and oxygen, because the flame temperature of diesel is very high to initiate dissociation. It is evident that carbon monoxide is comparatively fast burning gas than other alternative fuels so, the burning rate to the total gas air mixture might be accelerated for the presence of carbon monoxide; Thereby reducing the ignition delay as well as enhancing the combustion of unburned carbon particles.

Study experimentally influence of reduction in the concentration of CO_2 in biogas on performance, emissions and combustion in a constant speed spark ignition (SI) engine. The tests covered the range of equivalence ratios from rich to the lean operating limit at a constant speed of 1500 rpm and at compression ratio of 13:1.
There is an increase in the brake power output as expected with a reduction in the CO_2 concentration. At any given equivalence ratio lowering the CO_2 level will mean an increase in the amount of methane admitted. Fig.2.5 indicates that there is a considerable increase in the brake thermal efficiency with a reduction in the CO_2 concentration. [3]

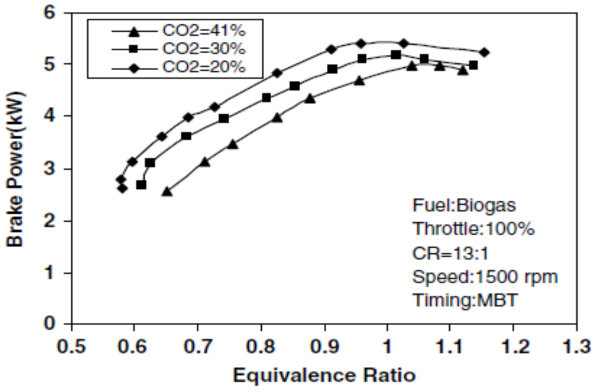


Fig.2.5 Brake power at full throttle

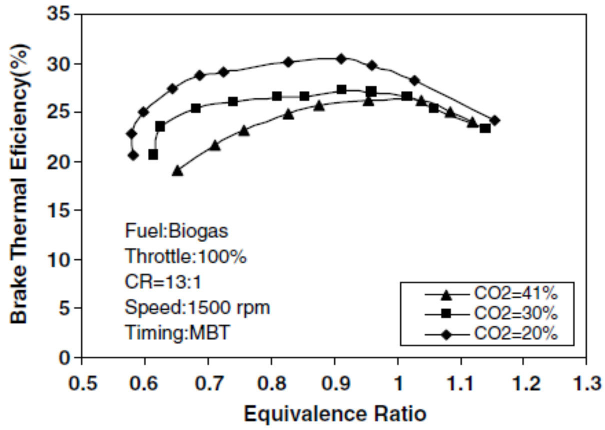


Fig.2.6 Brake thermal efficiency at full Throttle

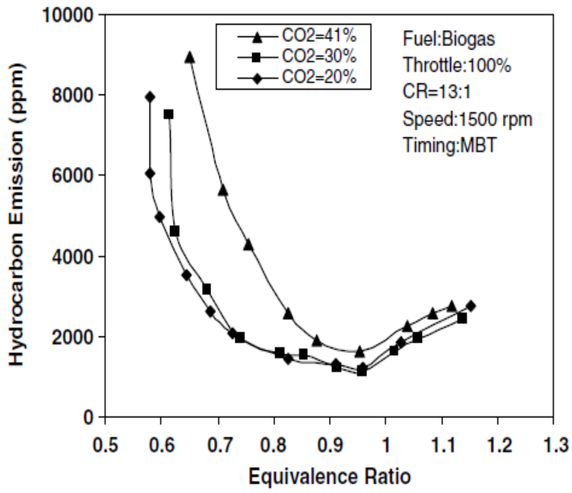


Fig.2.7Hydrocarbon emission

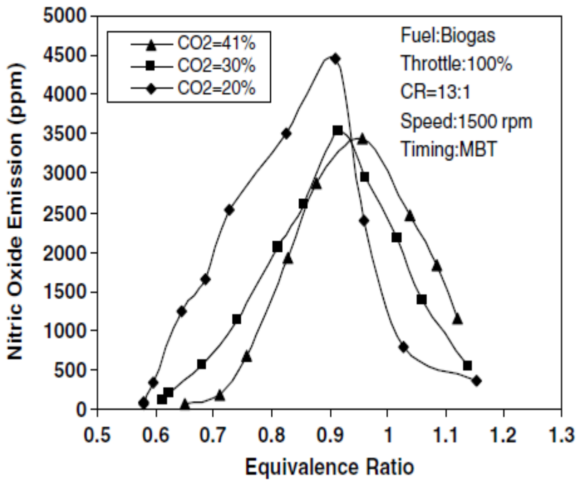


Fig.2.8Nitric oxide emission

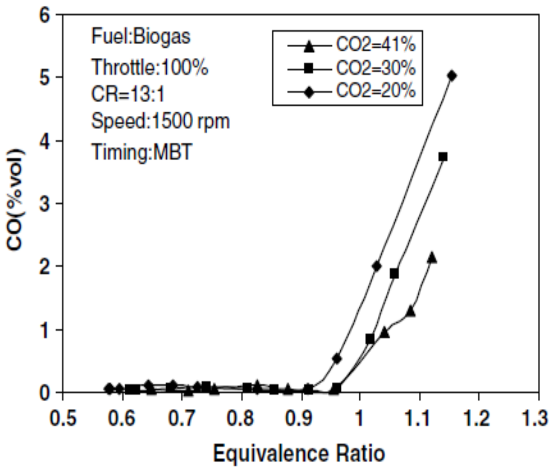


Fig.2.9CO emission

Enhanced methane concentration in the inducted biogas significantly improves performance and reduces emissions of hydrocarbons (HC). The real benefit of removal of CO2 from biogas is obtained when the engine is operated with lean fuel air mixtures in the range of equivalence ratios between (0.8 and 0.95). Removal of CO2 in biogas results in higher methane and oxygen concentrations in the charge and thus leads to faster combustion and also higher power outputs at a given equivalence ratios. In a case where reduction in HC emission is important, even a reduction in the CO2 level in the fuel from about the normal 40–30% by volume will be of significant benefit and at this condition the rise in NO level is also not very significant

Single cylinder diesel engine modified to operate as a biogas operated 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.[3]

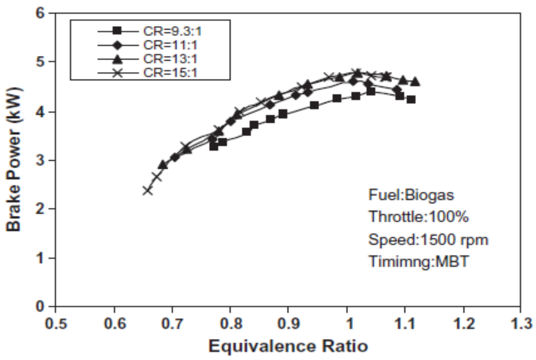


Fig.2.5 Variation of brake power with equivalence ratio

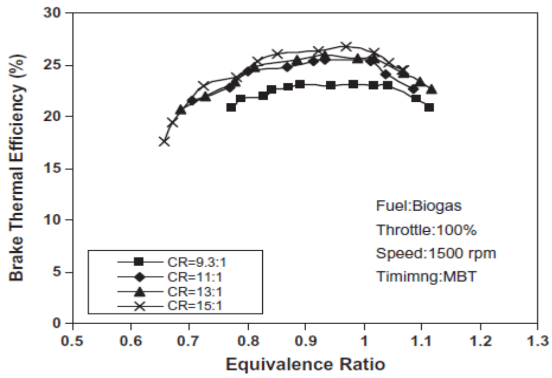


Fig.2.6 Variation of brake thermal efficiency with Equivalence ratio

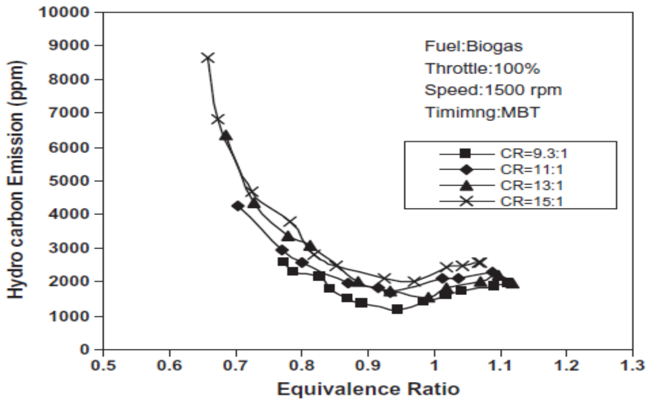


Fig.2.7 Variation of hydrocarbon emission with Equivalence ratio

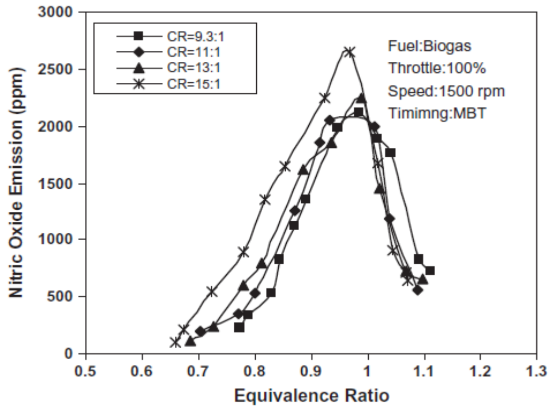


Fig. 2.8 Variation of nitric oxide emission with Equivalence ratio

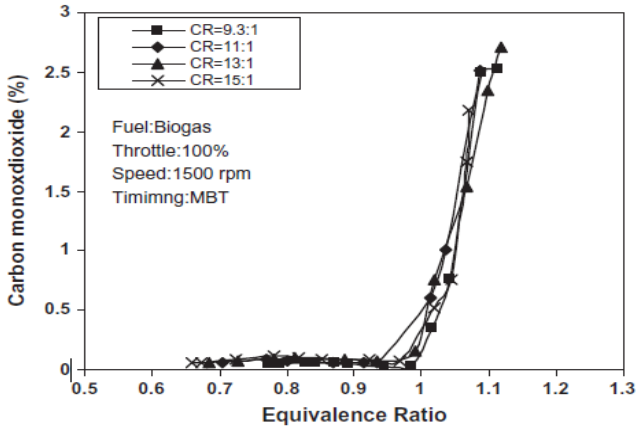
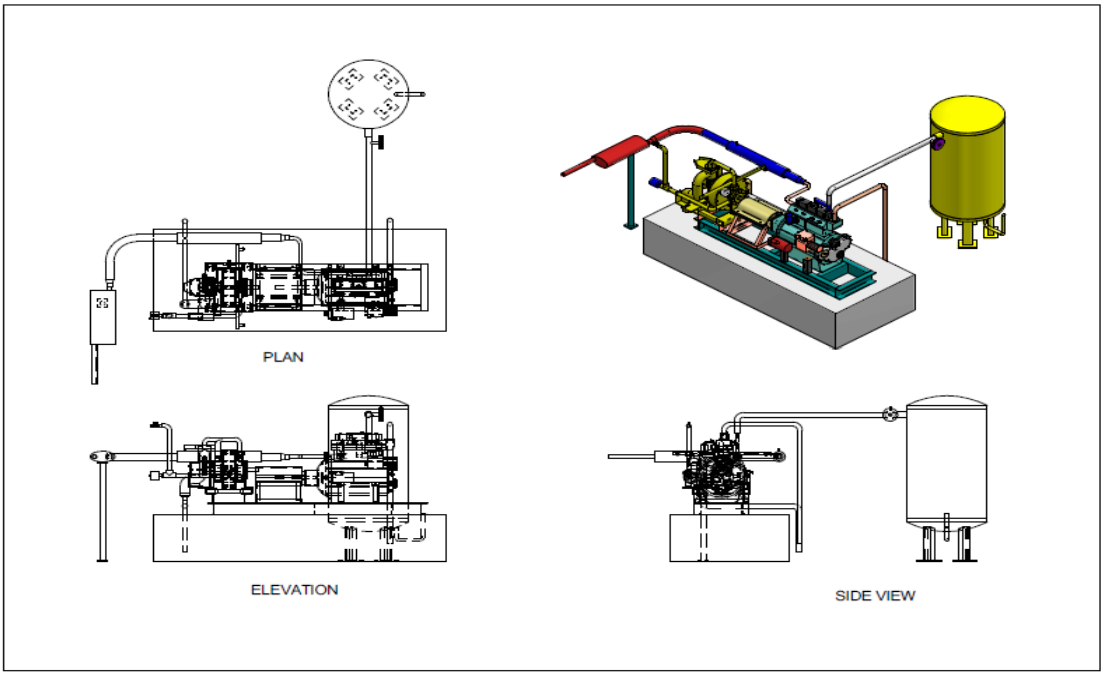


Fig. 2.9 Variation of CO emission with equivalence ratio

III. METHODOLOGY



In the present work in the first phase the engine will be assembled as per requirement to run it with bio gas and necessary instrumentation will be provided like flow measurement of bio gas, K type thermocouples for temperature measurement also electric loading system and bio gas tank, purification system etc

Table 3.1 Components Details

Sr. No.	Name of Components
1.	Auto rickshaw engine
2.	Bio gas Scrubbing system
3.	K type Thermocouples with Indicator
4.	Bio gas flow measurement System
5.	Electric loading system

IV. CONCLUSION

There is need to develop a sustainable renewable energy programme on biogas for replacing petroleum products by utilization of biogas in the country. This will help in green energy technology and reducing green house gases emissions.
Biogas is a potential renewable energy source for rural India and other developing countries. Biogas generation and subsequent bottling will cater the energy needs of vehicles by mode of bottling. This will also be helpful in supply enriched manure and maintain village sanitation. The bottling system will work as a decentralize source of power with uninterrupted supply using local resources, generate ample opportunities for employment and income of the rural people. We concluded that biogas can be used to run an I.C. Engine and is more efficient as compared to the CNG as well as it generates less pollutant as compared to other fuels.

V. REFERENCE

[1] S.S. Kapdi et al. /Renewable Energy xx (2004) 1-J.

[2] Biogas Plants, by L. Sasse, GATE/Vieweg, Braunschweig, FRG

[3] Biogas Handbuch, by G. Eggeling et al., BORDA/GTZ, Bremen, FRG (in German)

[4] Production and Utilization of Biogas in Rural Areas of Industrialized and Developing Countries, by J. Hohlfield, L. Sasse et al., GTZ, Eschborn, FRG

[5] Anonymous. Annual report of Ministry of Non-conventional Energy Sources. New Delhi: Govt. of India; 2002

[6] Rao PV, Baral SS, Ranjan Dey, Srikanth Mutnuri. Biogas generation potential by anaerobic digestion for sustainable energy development in India. Renewable and Sustainable Energy Reviews, vol. 14, pp. 2086-2094, 2010

[7] *Res. J. Recent Sci.*, Volume 5, Issue (ISC-2015)

[8] V.K. Vijay (2012)., Book on Biogas Production and Slurry Management, Narosa Publishing House, 56.

[9] Vijay V.K. (2013)., Presentation on Water scrubbingbased biogas Enrichment technology by IIT-Delhipresentation during International Disseminationworkshop on Promotion of Biogas Up gradation andBottling in India and EU' August, IIT-Delhi .