Available online at www.elixirpublishers.com (Elixir International Journal)

Mechanical Engineering

Elixir Mech. Engg. 89 (2015) 37221-37225

ISSN: 2229-712X

Purification and Performance of Emission Characteristics on Two Stroke Petrol Engine using Bio-Gas as an Alternate Fuel

P.Lakshmanan[1], P.Velmurugan1[1], G.Mariammal[2], K.Appas mandri[1], G.Mohamedyahiya[1], .S.Vijayaraj[1] and H.Ubaidurrahuman[1]

[1]RVS School of Engineering and Technology, Dindigul, India.

[2]PSNA College of Engineering and Technology, Dindigul, India.

ARTICLE INFO

Article history:

Received: 25 April 2015;

Received in revised form:

23 December 2015;

Accepted: 28 December 2015;

Keywords

Alternate Fuels,

Purification,Bio-Gas,

Si Engines,

Engine Performance, Emission.

ABSTRACT

This project provides information about energy system by the use of bio gas... Biogas contains primarily CH4 with the balance being mostly CO2 and a small amount of trace components. Now a day's alternate fuel appears during possessions, by better understanding its components, biogas can be processed and utilized in a more efficient, cost-effective way because of reducing fuel cost, demand of fuel, and emission influence in global warming. The most important of this work is, to produce bio gas from organic waste and reduce the usage of petrol fuel. The increase in population leads to depletion of diesel fuel. Another reason is instead of disposing the organic waste in landfill, this can be converted into a useful product (bio-gas). The bio gas can be stored in a cylinder and be placed in a luggage side box of a vehicle. A regulator is fixed on the top of the cylinder. A hose tube from a vacuum kit which is placed beneath the seat is fixed to the cylinder, so that the gas can be passed to the carburetor. The needle of the carburetor is taken out and the gas would pass on the engine directly. The air filter is partially closed in the vehicle. On kicking the bio gas from the cylinder easily pass on from vacuum gas kit to engine. A spark plug which is above the engine is used to burn the biogas. In this manner, bio gas can be used run the vehicle. The pickup and efficiency is more comparing the existing system of the vehicle has not been reduced by using bio gas. A two Stroke Petrol engine is used for this project, 2 Kg Cylinder is used. It gives 110 kilo meter for one liter of bio gas. So that it can be used in the presented vehicle without any modification. So, the compression ratio of the engine is also high 15:1 Due to high compression ratio power developed by the engine is also high. By less consumption of the fuel, the power produced is more. Petrol produces more toxic gases like HC, CO etc...But we find that methane is less toxic, and emission is very less eco-friendly compare to petrol. It makes "GREEN EVOLUTION".

Introduction

Energy is a critical issue. We urgently need to develop strategies to use energy more efficiently and develop new, sustainable, renewable and alternative energy supplies.The term 'biogas' is commonly used to refer to a gas which has been produced by the biological breakdown of organic matter in the absence of oxygen. The gases methane, hydrogen and carbon monoxide can be combusted or oxidized with oxygen and the resultant energy release allows biogas to be used as a fuel. It is primarily a mixture of methane (CH4) and inert carbonic gas (CO2). One of the main environmental problem is increasing the productionoforganicwaste.Insteadofdisposingthewasteintoopenatmosphere,energyrecoveryandrecyclingnutrientsoforganicmatterisaimed. Production of biogas by anaerobicdigestionofanimalwasteandorganicwasteintoarenewableenergy. The fossil resources of oil, gas and coalareavailablein limited level. Actually the biogas which is produced by the fermentation of animal dungs, humansewageoragriculturalresiduesisrichinmethaneandhasthesamecharacteristicsas the natural gas(anaerobicdigestion). This alternatesourceshouldnotproducepollutionproblem,aswellasshouldnot have badsmell, while running the engine. Also should not create noise in the engine. Biogas not alone used in the engine. It is combined with diesel fuel(50%,75%,100%)atvaryingload condition. M.Kubaská*, S.Sedláček, I.Bodík, B.Kissová in Bratislava at May 24 – 28, 2010 the presented contribution deals with laboratory testing of biodegradable municipal organic substrates for biogas production. The anaerobic fermentation and biogas production from biodegradable organic substrates such as expired wine, beer, bread, meat and dairy products, food oils and fats, were tested in the laboratory anaerobic models [1]. M.Saev, B.Koumanova, IV.Simeonovat 12 January 2009 Anaerobic co-digestion of wasted tomatoes (WT) and cattle dung (CD) was investigated in semi-continuous mode at mesophilic conditions [2]. Stefan MIHIC at serbia in 2004 the problems of biogas use for powering internal combustion engines. Modification of internal combustion engines for tractors and light duty trucks is reviewed [3].D.Deepa, T.Mythili at 2013 The main objective of this work is, to produce bio gas from organic waste and reduce the usage of diesel fuel. The increase in population leads to depletion of diesel fuel. Another reason is instead of disposing the organic waste in landfill, this can be converted into a useful product (bio-gas). So that it can be used in the existing engine without any

Tele:

E-mail addresses: lakshkok@gmail.com

modification. The dual fuel engine is a combination of diesel and biogas. By varying the amount of biogas and varying load conditions the engine was tested. This fuel can be used in the engine without any modification [4].Venkata Ramesh Mamilla, V.Gopinath, C.V.SubbaRao at 2008 this paper deals with the study and performance of 4-stroke petrol engine fueled with Bio gas /L.P.G blends. 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 [5]. The objectives of this study: (i) Evaluate the performance and variability an extensive monitoring of biogas composition (ii) Determine and assess the performance of biogas processing systems best suited for in these operations. (ii) Bio-gas is used as a fuel in four wheeled diesel engine carried out on petrol engine.

Experimental methodology

The specification of the vehicle shown in table.1 in this testisdonetoensurethereliabilityofusing biogas in a running vehicle. Vehicle is made to run with petrol and biogas change in mileage is found out.

Table 1. Specification of the vehicle

Name of vehicle	Two stroke petrol engine
Number of cylinder	1
Number of strokes	2
Fuel	Petrol
Oil	Used
Engine Displacement	98.20cc
Maximum Power	7.8 bhp @ 5500 rpm
Transmission	4-speed constant mesh
Front Brake & Rear Brake	130mm
Front Suspension	Telescopic oil damped
Rear Suspension	Swing arm and hydraulic absorber
Wheel Base	1217mm

The gas kit is shown in Fig.1. It is made up of Aluminum (Al). There are three gas tubes used. One tube is connected between regulator and gas kit. Another tube is connected between gas kit and carburetor. The third tube is connected between gas kit and vacuum.

Fig 1. gas kit

The gas cylinder is shown in fig.2. The gas Cylinder is made up of Iron. The capacity of cylinder is 2kg that means 3litre

Fig 2. gas cylinder

The carburetor connector is shown in fig3. The connection from petrol tank is closed off and them ileage testeris connected to the carburetorinletconnectionfor petrol. Thev ehicleis made torun with petrol and biogas the presence ofbiogas supply to carburetor. At thesametime the distance covered in a specific consumption of petrol. Itis observed that while the biogas generating unit active the distance covered for the specified amount of petrol is increased.

Fig.3

Properties of Biogas used as Fuel in S.I.Engines

Biogascontains50%to70%ofCH_4,5-10%ofH_2andupto30-40%ofCO_2.Table-1After being cleaned of carbondioxide, this gas becomes a fairly homogeneous fuel containing upto 80% of methane with the calorific capacity of over25MJ/m³. The most important component of biogas, from the calorific point of view, is methane. Table-2 The other components are not involved in combustion process, and rather absorb energy from combustion of CH_4 as they leave the process at higher temperature than the one they had before the process.

Table 1. omposition of biogas

S.no	Components	Amount(%)
1	Methane(CH4)	50-70
2	CarbonDioxide(CO2)	30-40
3	Hydrogen(H2)	5-10
4	Nitrogen(N2)	1-2
5	WaterVapour(H2O)	0.3
	HydrogenSulphide (H2S)	Traces

Properties of Biogas for engine performance

The actual calorific value of biogas is function of the CH4 percentage, the temperature and the absolute pressure, all of which differ from case to case. The actual calorific value of biogas is a vital parameter for the performance of an engine. The consumption of biogas in actual volume will differ from these data according to the actual conditions of biogas fed to the engine in terms of temperature, pressure and CH_4 content.

Technical parameters of biogas

Technical parameters of biogas are very important because of their effect on the combustion process in an engine. Those properties are: -Ignitability of CH4 in mixture with air: CH4: 5...15 Vol. %, Air: 95...85 Vol. %Mixtures with less than 5 Vol. % and

mixtures with more than 15 Vol. % of CH4 are not properly ignitable with spark ignition. Combustion velocity in a mixture with air at p = 1 bar: cc = 0.20 m/s at 7% CH4, cc = 0.38 m/s at 10% CH4. The combustion velocity is a function of the volume percentage of the burnable component, here CH4. The highest value of cc is near stoichiometric air/fuel ratio, mostly at an excess air ratio of 0. 8 to 0.9. It increases drastically at higher temperatures and pressures. Temperature at which CH_4 ignites in a mixture with air Ti = 918K ... 1023 K Compression ratio of an engine, at which temperatures reach values high enough for self-ignition in mixture with air (CO4 content increases possible compression ratio) e = 15...20 Methane number, which is a standard value to specify fuel's tendency to knocking (uneven combustion and pressure development between TDC and BDC). Methane and biogas are very stable against knocking and therefore can be used in engines of higher compression ratios than petrol engines. Stoichiometric air/fuel ratio on a mass basis at which the combustion of CH4 with air is complete but without unutilized excess air.

Table 2. Thermodynamic properties

S.no	ThermodynamicpropertiesofCH4at273Kand101325Pa	
1	Specificheat (Cp)	Cp=2.165kJ/kgK
2	Molarmass(M)	M = 16.04 kg/kmol
3	Density (ρ)	ρ = 0.72 kg/m³
4	Individualgasconstant R	R = 0.518 kJ/kgK
5	LowercalorificvalueHv	Hv = 50000 kJ/kg,
		Hv, n = 36000 kJ/ m³n

Problemstouse Biogas in S.I. Engines

High CO_2 content reduces the power output, making it uneconomical as a transportfuel. It is possible to remove the CO_2 by washing the gas with water. The solution produced from washing out the CO_2 is acidic and needs careful disposal. H_2S is acidicandifnotremovedcancausecorrosionofengineparts withinam atterof hours. It is easy to remove H_2S, by passing the gas through ironoxide(Fe_20_3-rustynails area good source) orzincoxide (ZnO). These materials can be re-generated on exposure to the air, although the smell of H_2S is unpleasant. There is high residual moisture which can cause starting problems. The gas can vary in quality and pressure.

Fuels used in S.I.Engines& Limitations

There are so many fuels used in S.I. Engines, but they have certain physical and chemical properties. In Other words, fuels used in S.I. Engine re-designed to satisfy performance requirements of engine system, in which they are used. The limitations of fuels that are used presently are as follows. Gasoline contains many impurities. It has high octane number. All petroleum fuels oxidize slowly in presence of air. The oxidation of unsaturated hydrocarbons result in formation of resinous materials called gum and reduces its lubricating quality and tends to form sludge and warmish on piston and rings. It has less knock resistance as well as energy per unit mass. It has less efficiency compared to other fuels. In alcohol, higher latent heat of vaporization reduced charge temperatures before combustion. Alcohols suffer disadvantages of water absorption, corrosive and lubricant incompatibility. In LPG, it reduces volumetric efficiency due to its high heat of vaporization. The road sensitivity is very high. It is very corrosive. Response to blending is very poor. It has higher cost of transportation. It has higher cost for conversion kit, installation of extensive. In electricity, they use in initially generated power stations that use fossil fuel of nuclear power. There are other problems too. The problem is with batteries in these vehicles. These batteries are quite heavy and life of these is also low. Cost of replacing these batteries is high.

Performance & function parameters

The performance of S.I engines in dual fuel mode has been foundal most equal to the Performance of using diesel fuel alone as long as the calorific value of biogas is not too low. The inlet channel and manifold of petrol engine are dimensioned in such a way that at the maximum speed and power output of the enginesufficientaircanbesuckedintoobtainanair/gasfuelratio,whic hisoptimal for operation at this point. When the petrol fuel is reducedandanair/biogasmixtureissuckedinsteadofairalone,partoft heairis replaced by biogas. With less air fed to the engine an excess air ratio necessarily maintained. This decrease is less significant than in modified petrol engines. For operation in medium and low speeds the air inlet is larger than necessaryandallowsarelativelylargeramountofair/fuelmixturetobe suckedin.Hencethe power output will not be significantly lower than inbio-gas operation.

Exhaust emission

The exhaust emission contains three specific substances which contribute the air pollution, hydrocarbon, carbon monoxide &oxides of nitrogen. Hydrocarbons are the unburned fuel vapour coming out with the exhaust due to incomplete combustion. Hydrocarbon also occurring in crankcase by fuel evaporation. The emission of hydrocarbon is closely related to many design &operating factors like induction system, combustion chamber design, air fuel ratio, speed, load. Lean mixture lower hydrocarbon emission. Carbon monoxide occurs only in engine exhaust. It is the product of incomplete combustion due to insufficient amount of air in air- fuel mixture. Some amount of CO is always present in the exhaust even at lean mixture. When the throttle is closed to reduce air supply at the time of starting the vehicle, maximum amount of CO is produced. Oxides of nitrogen are the combination of nitric oxide & nitrogen oxide &availability of oxygen are the two main reasons for the formation of oxides of nitrogen. With biogas, co emission levels are low than that of petrol and diesel engine.

Results And Discussions

Test. 1 [using test rig]

Experiment on two stroke petrol engine with bio gas and petrol. At first gear the torque produced is high so the fuel consumed will be higher as compared to other gears TFC vs. BP curve without bio gas lies above the curve with hydrogen. This indicates that fuel consumed in kg per hour is reduced when bio gas is mixed with petrol when rpm is held constant. From this graph it is clear that at constant fuel consumption the brake power is more when biogas is added also at constant brake power the fuel consumed is reduced.

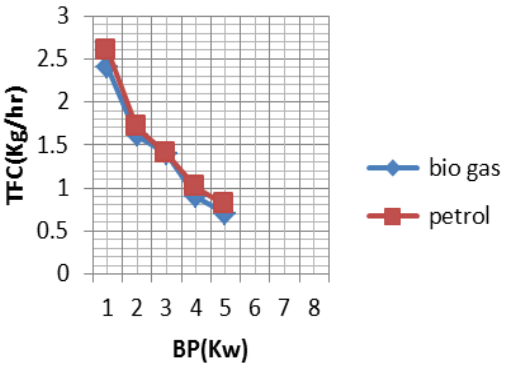

Fig.TFC Vs BP (rpm 105)

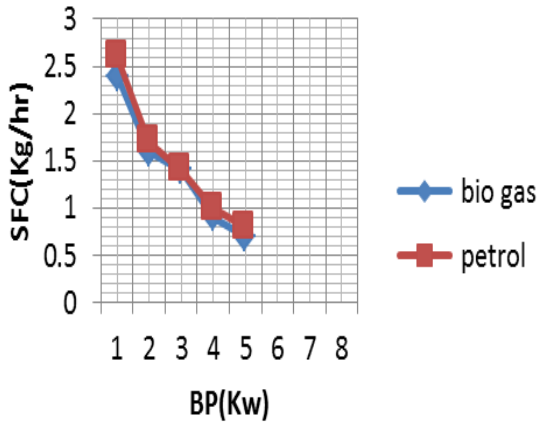

Fig.SFC Vs BP

TFC Vs. BP curve and SFC Vs BP with petrol lie above the curve with bio gas. This indicates that fuel consumed in kg per hour is reduced when bio gas and petrol rpm is held constant. From this graph it is clear that at constant fuel consumption the brake power is more when bio gas is added also at constant brake power the fuel consumed is reduced. This is because when bio gas burns more .heat energy is produced. Specific fuel consumption is plotted vs. Brake power. At second gear the fuel consumed is lower than that consumed in first gear.

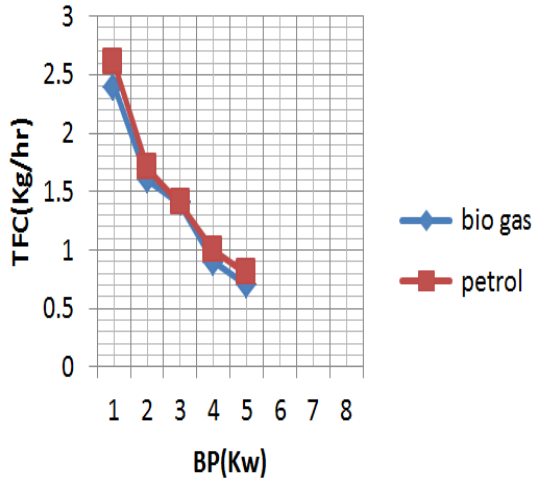

Fig.TFC Vs BP (rpm 190)

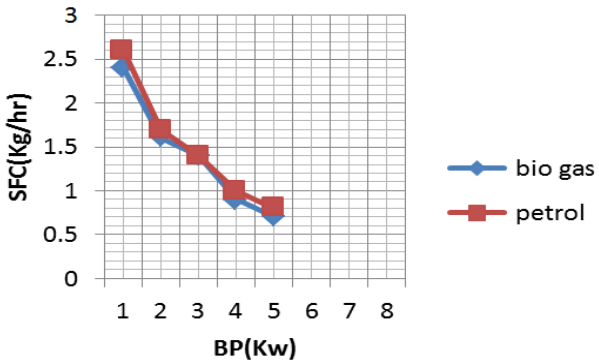

Fig.SFC Vs BP

At third gear fuel consumed is lower than that of first and second gear due to lower torque produced. This indicates that fuel consumed in kg per hour is reduced when bio gas and petrol rpm is held constant. From this graph it is clear that at constant fuel consumption the brake power is more when bio gas is added also at constant brake power the fuel consumed is reduced. This is because when bio gas burns more heat energy is produced. Specific fuel consumption is plotted vs. Brake power. At second gear the fuel consumed is lower than that consumed in third gear.

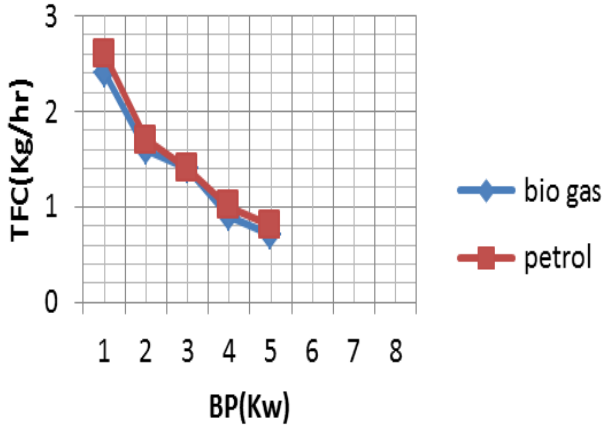

Fig.TFC Vs BP (rpm 250)

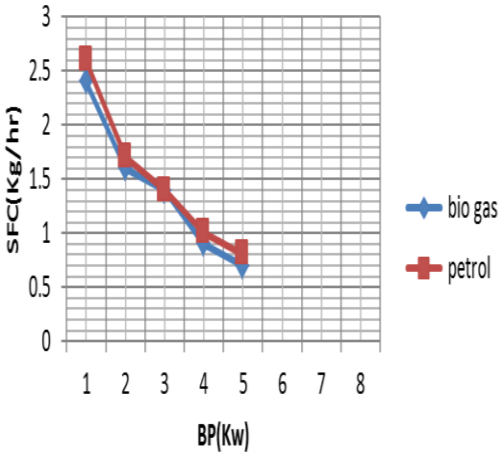

Fig.SFC Vs BP

TFC vs. BP curve with petrol lies above the curve with bio gas. This indicates that fuel consumed in kg per hour is reduced when biogas and petrol when rpm is held constant. From this graph it is clear that at constant fuel consumption the brake power is more when biogas is added also at constant brake power the fuel consumed is reduced. This is because when biogas burns more heat energy is produced. Specific fuel consumption is plotted vs. Brake power. From the above observations we observe that mileage of vehicle is increased in second case i.e. when vehicle is made to run with biogas mixture. We can observe than on an average the mileage of vehicle is increased by 11 km/liter of petrol.

Conclusions

Biogas is a fuel with heat content nearly three times that of petrol engine. From our work we experimentally found out at the efficiency of an S.I engine can be rapidly increased by bio gas. We conducted two tests. Experiment with test rig and a road test with two wheeler. In both cases we observed reduction in fuel consumption. It is clear evidence that addition of biogas can results in increase in the power of the engine or increase in mileage. Moreover the various emissions normally produced from S.I engines can be reduced. Thus use of biogas in S.I engines as a fuel can be considered a huge leap in the field of automobile engineering. The study concludes the biogas production from organic wastes, its 'composition and properties for use In S.I.Engines. In this research study, Investigation of engine performance was found by operating on biogas in a two wheeler SI engine at constant speed and varying load condition were carried out. Different techniques for CO_2, H_2S

scrubbing are discussed, among which water scrubbing is a simple continuous and cost effective method for purification. Attention is also focused for making biogas as alternate fuel in petrol Engines and dual fueling is recommended to be the best one for biogas S.I operation. Drop of CO_2 in biogas for dual fueling increases the thermal efficiency. Therefore it is recommended to use biogas as alternate fuel in petrol engines. Fuel consumption was saved by 90% by using biogas at varying load condition. The study and analysis can be extended to the following levels. Next we are going to or its planned to implement biogas petrol engine in light duty and heavy duty petrol engine vehicles. It acts as a fuel (Biogas). It's going to be used in petrol engine as fuel with some composition. Afterwards it may be proposed to a government project through our institution. It's possible the filling station of bio fuel can be implemented by the use available resources of our intuitions. Exhaust gas analysis which includes variations in the quantities of the various combustion products including nitrogen oxides, carbon monoxides, sulfur dioxides etc. When biogas is employed the harmful emissions can be reduced.

References

[1] M.Kubaská*, S.Sedláček, I.Bodík, B.Kissová. Food Waste as Biodegradable Substrates for Biogas Production at 37th International Conference of Slovak Society of Chemical Engineering in Bratislava in May 24 – 28, 2010.

[2] M.Saev, B. Koumanova, IV. Simeonov.Anaerobic co-digestion of wasted tomatoes cattle dung for bio-gas production at Journal of the University of Chemical Technology and Metallurgy in 12 January 2009.

[3] Stefan MIHIC. Biogas fuel for internal combustion engines at university of novi sad faculty of engineering serbia in 2004.

[4] D.Deepa, T.Mythili Performance of dual fuel engine (diesel and biogas) at Department of Mechanical Engineering, Muthayammal Engineering College, Rasipuram.

[5] Venkata Ramesh Mamilla, V.Gopinath, C.V.SubbaRao performance and emission characteristics of 4 stroke petrol engine fueled with biogas / l.P.G blends in Department of mechanical engineering, QIS College of engineering & technology ongole, andhrapradesh, india.

[6] Jiang Yao-hua1,2, XiongShu-sheng*1, Shi Wei1, HE Wen-hua1, Zhang Tian1, LIN Xian-kegu yun1,2, LV Yin-ding1, Qian Xiao-Jun1, Ye Zong-Yin1, WANG Chong-ming1, Research of biogas as fuel for internal combustion engine at 2009 college of Mechanical and energy engineering, zejiang university, hangzhou 310027 at china.

[7] DebabrataBarik, SudhirSah, S. Murugan biogas production and storage for fueling internal combustion engines at Department of mechanical engineering, national institute of technology at rourkela in india.

[8] Md. Ehsan and N. Naznin Performance of a biogas run petrol engine for Small scale power generation at Department of Mechanical Engineering Bangladesh University of Engineering and Technology at Dhaka in 18 Oct 2004

[9] SUYOG VIJ Biogas production from kitchen waste & to test the Quality and Quantity of biogas produced from kitchen waste under suitable conditions Department of biotechnology and medical engineering national institute of technology, Rourkela in 2011.

[10] N.H.S.Ray, M.K.Mohanty, R.C.Mohanty Biogas as alternate fuel in diesel engines at dept of mechengg. GEC, Bijupatnaik university of technology, odisha, india in april 2007.