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EFFECT OF INJECTION TIMING AND GASEOUS FLOW RATE ON LPG BIODIESEL FUEL ENGINE PERFORMANCE

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***Abstract*—**
Bio-fuels are very friendly with environment and also renewable energy sources. Bio-fuels are produced by west materials like animal west, using seeds, plants west, and industry west, but Bio-fuels cannot be used directly fuels like petroleum product. We have to combine with petroleum product to minimize the environment pollution, increase the efficiency and reducing their price of the fuel. To find out the test facilities for dual fuel engine on LPG-HOME fuels with different engine parameters. Examine the effect of different injection timing on the performance of dual fuel engine operated on biodiesel and liquefied petroleum gas (LPG).
Keywords— LPG, Bio fuel, injection timing

INTRODUCTION

TIn the present world growing the need of fossil fuel. The developing countries like India fuels are more important parameter which gives the economic growing of country, because changing the generation year by year the vehicles, automobile industry, transportation company, power production plant and military. These all sectors need the fuels to run the sector to perform this destination. Also in India there are no petroleum resources to fulfill the fuel to run the entire sector. The country should buy the fuel from other country it will effects the country economic growth and also increasing the petroleum application it will affect the environment condition by increasing CO, CO2 and SO4. The increasing environment pollution it will effect on human health and also country as to pay Tax to the world environment tax department. Because of all the above reason we have to search for alternate fuel which will fulfill requirement and it is friendly with environment. It should give more efficiency, cast price should be low. Also provide imbalance for the fuel in the country.

LITERATURE SURVEY

Abhishek Paul et al (2014) have conducted experiment and investigated effect compressed natural gas duel fuel operation with diesel and panama pinnate methyl ester (PPME) study conducted here provides a systematic comparison between diesel-CNG and PPME-CNG dual fuel operations. Diesel CNG strategies reduce the break thermal efficiency of the engine and BSFC also decreased and NO_x and smoke opacity are decreased. However, there is an increase in co end unburned hydrocarbon emission (1). Vivek and Gupta (2004) investigated the feasibility of Karajan oil for the production of biodiesel and determined the optimum conditions for high yield of Karanja oil to biodiesel. They concluded that engine performance with Karanja oil was similar to that of diesel while emissions were lesser in case of biodiesel (2). H.S .Tiro,J.M.herreros,A.Tsolakis et al(2012) Studied the LPG in diesel dual fuelled combustion engine .they carried characteristics of the direct injection diesel fuels such as rapeseed methyl ester and gas to liquid (GTL), from the experiment 60% liquid fuel is replaced with LPG and get better emission of NO_x, HC, CO.they also carried performance of LPG-RME showed better result compared LPG-diesel of emission CO, NO_X and HC(3). Yuwei zho, yingwang, dongchang Li (2014) et al. studied characteristics of testing the combustion and emission of DME (dimethyl-ether) diesel parameter combustion ignition engine with EGR. As the DME ratio increases the reduction of smoke and NO_Xemission.Also changing crank angle and increasing EGR the NO_X emission reduces but increase in smoke,HC and CO emission(4).

EXPERIMENTAL SETUP AND METHEDOLOGY

The CI engine examine were conducted on a 4-stroke single cylinder water cooled direct injection compression ignition engine with a compression ratio of 17.5:1 and displacement volume of 622cc,devolping 3.7 kw at 1500 rpm. The photographic fig 4.1(a) and fig 4.1 (b) shows the overall view of the test rig modified to operate on dual fuel mode. The specification of the engine are given in the Table 4.1.The engine always operated at a rated constant speed of 1500 rpm and constant LPG flow rate is 0.6 kg/hr. and 80% load and 100% load. The engine had a conventional fuel injection system. The injector hole diameter each is 0.27 mm and injector had three holes. The injector opening pressure and the static injection timing as specified by the manufacture were 230 bar and 23^0BTDC respectively. The governor of the engine was used to control the engine speed. The engine was provided with a hemispherical combustion chamber with overhead valves operated through push rod. The engine cooling was consummate by circulating water through the jackets on the engine block and cylinder head.

Fig 1(a) LPG-HOME dual fuel Test Rig

The proposed work involves studies of the effects of injection timing, compression ratio, on the dual fuel engine performance and emissions operated on LPG-HOME .To study the effects of injection timing and compression ratio at 80% load and 100% load on the engine performance suitable arrangements were provided in the test rig.

Fig 1 (b) LPG-HOME dual fuel test rig

Set up with orifice meter caused to measure LPG flow rate connected to U- tube manometer.

DESIGN OF LPG GAS CARBURETTOR:

STEP I: Determination of the Volumetric Intake of Engine

Determine the volumetric intake V_1 (in m^3/s) of the engine as a function of engine cubic capacity either at rated or maximum operational speed N (in rev/min).
Engine Bore D: 87.5 mm
Engine Stroke S: 110 mm
Rated Speed N: 1500 rev/min.
Maximum Speed (120% of rated speed) N': 1800 rev/min.
Displacement Volume = 661cc/cycle

Maximum (air + Biogas) intake under extreme conditions $= \dfrac{V_s \times N'}{10^6 \times 2 \times 60}$

(Assuming 100% volumetric efficiency) $= \dfrac{661 \times 1800}{10^6 \times 2 \times 60}$

= 0.009915 m^3/s
= 35.694 m^3/h

STEP II: Determination of mean intake velocity
Let Di = Intake manifold diameter in m,
= 0.029m, and
Ai = Cross sectional area of intake manifold in m^2
= $0.6605198 * 10^{-3}$ m^2

Therefore mean intake velocity
Ci = Volume flow in m^3 / s / Cross sectional area m^2
= $0.009915 / 0.6605198 * 10^{-3}$
= **15.0109 m/s**

STEP III: Determination of the air and gas quantities
Efficiency if the diesel engine in general = 0.3
Specific fuel consumption of diesel engine = 3.3kwh/ kWh
So volume flow rate of fuel into the cylinder is given by
Efficiency= Brake power/ (m_f * calorific value)
0.3 = 5.42 / (M_f * 50257)
m_f = 5.42 / (0.3*50257)
$m_{f\,=\,3.59}*10^{-4}$ m^3/s or 1.29 m^3/hr

Percentage of BIOGAS in total fuel is 80% so volume flow rate of Biogas is
$m_{f\,=}$ 1.29*0.8
$m_{f\,=}$ 1.0353016 m^3/hr or $2.8726*10^{-4} m^3/s$
OR
This can be solved even by considering specific fuel consumption
I.e. sfc = (M_f *CV)/BP
M_f = (3.3*5.42*3600)/50257
M_f = 1.29 m^3/hr
For 80% biogas
$m_{f\,=}$ 1.0245752 $m^{3/}hr$ or $2.847533*10^{-4}$ m^3/s

Volume flow rate of air is given by
Total volume intake to engine = volume of gas + volume of air
Volume of air = total volume- volume of gas
Volume of air $v_{a\,=}$ ((0.009915-0.000359)/1.2)
$v_{a=}$ $7.96*10^{-3}$ m^3/s or 28.6636m^3/hr

Stoichiometric air to fuel ratio at 15 ºC and 710 mm of Hg (at Hubli)
Density of LPG at 15^0C and 760 mm of Hg =1.75 kg/m^3

Density of air at 30^0C and 710 mm of Hg = 1.092 kg/m^3
Mass flow rate of LPG (m_g)= 1.035*1.75
= 1.8131 kg/hr
Mass flow rate of air m_a= 7.961*10^{-3}*1.092
= 0**.008690kg/s**
=29.52**kg/hr**
Stoichiometric ratio of air and bio gas
$M_a/ m_f = v_a / v_f = F/A$
29.52/1.81 = 15.87:1

RESULTS AND DISCUSSIONS

The experimental examine were carried out on a single cylinder four stroke CI engine test rig to operate in dual fuel mode. The engine tests were conducted with dual fuel using LPG-HOME 80% and 100% load conditions. Further the tests were conducted on dual fuel engine operation with varying injection timings and compression ratios. The injection timing is varied from 19^0,23^0 and 27^0 BTDC. As the maximum compression ratio of the engine was limited to 17.5 and LPG flow rate is 0.6 kg/hr, it was not possible to study the engine performance beyond this compression ratio.

Fig 2. indicates that for LPG-HOME fuel combinations .At 100 % load the BTE is higher compared with 80% engine operation. An improvement in BTE was achieved by advancing the injection timing. The value of BTE at 100% load and 27^0 BTDC advanced injection timing is slightly high for 100% load for IT 19^0,23^0,and 27^0 BTE values are 19.1%,22.15 and24.2% respectively

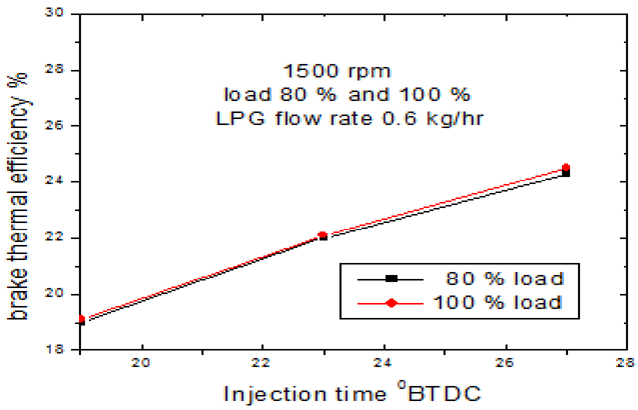

Fig 5.1.1: Variation of BTE V/S injection timing for 80% and 100 % load

Smoke Opacity:

Figure 5.1.2 Illustrates that variant of burn cloudiness with different injection time for both 80% load and 100% load respectively Smoke cloudiness decreases with injection time increase. For 100% load the smoke opacities are 73, 72 and 64 with respect to 19^0,23^0 and 27^0 injection timing.

NOx emissions:

Figure 5.1.3 shows variant of NOx emission with injection timings for HOME – LPG fuel combinations respectively. As the injection timing increases the emission of NO_x increases considerably with the dual fuel combinations at both (a) 80% and (b) 100% load respectively the reason for increased NO_x emissions with increased injection timing could be due to better combustion prevailing inside the engine cylinder and more heat released during premixed combustion. The higher NO_x emissions for 27^0 BTDC are later controlled by appropriate use of EGR method. The variations in NOx emissions follow changes in adiabatic flame temperature. These effects also vary with injection timing, suggesting that reaction zone stoichiometry and post combustion mixing are also influenced by fuel composition.NO_X emissions increases with injection timing is increases for 100% load the NO_X are 885,980 and 1025 with respect to 19^0,$23^0$and 27^0 injection timing.

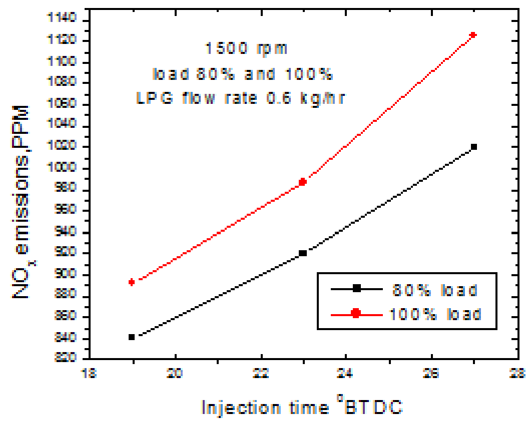

Fig 5.1.3: Variation of NO_x emissions v/s injection timing for 80% and 100% load.

HC emissions:

Figure 5.1.4 shows variation of HC emissions with injection timings for HOME – LPG dual fuel combination operation. As the injection timing increases the emission decreases considerably as seen in the figure for both 80% and 100% loads. The reason for decreased HC emissions with increased injection timing could be due to better combustion with increased BTE and more heat released during premixed combustion. However other researchers reported that advancing injection timing showed low and high HC emissions at low and high loading conditions compared to the standard injection timing operation, respectively.HC emissions decreases with injection timing increases for 100% load the HC emissions are 83, 79 and 74 with respect to 19^0,23^0 and 27^0 injection timing.

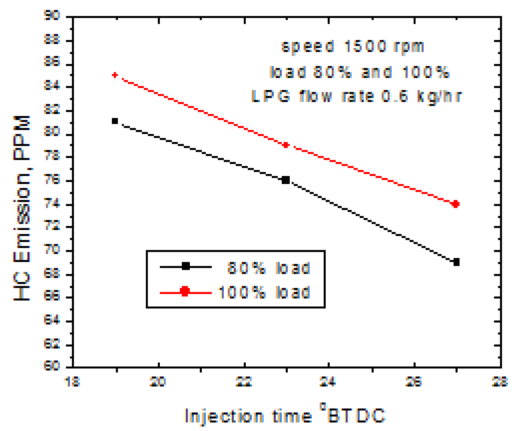

Fig5.1.4: Variation of HC emissions v/s injection timing for 80% and 100%.

CO emissions:

Figure 5.1.5 shows variation of CO emissions with injection timings for HOME – LPG dual fuel operation for both 80% and 100% loads respectively. As the injection timing is advanced from 19^0 BTDC to 27^0 BTDC the CO emission also decreased considerably as seen in the figure. The emission of CO results from incomplete combustion of HC fuel. The emission of CO greatly depends on the air-fuel ratio relative to stoichiometric proportions. The reason for decreased CO emissions with increased injection timing could be due to better combustion with increased brake thermal efficiency. The advanced injection timing showed a significant reduction in CO emissions compared to standard dual-fuel operation.CO emissions decreases with injection timing is increases for 100% load the CO emissions are 0.241%, 0.164% and 0.152% with respect to 19^0,23^0, and 27^0 injection timing.

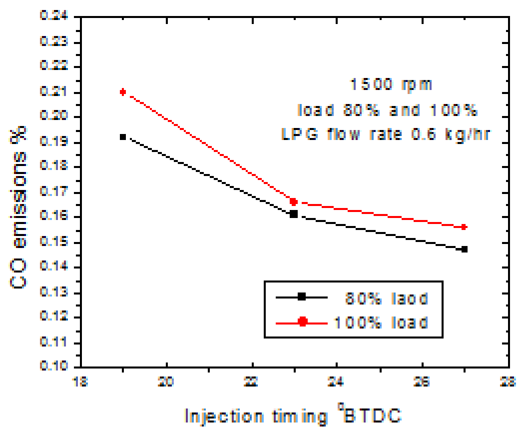

Fig 5.1.5: Variation of CO emissions v/s injection timing for 80% and 100% load

CONCLUSIONS

Based on the present work on the exhaustive experimentation on LPG-HOME duel fuel engine operation with optimized engine parameters that resulted in better brake thermal efficiency and acceptable emissions levels are determined. The following conclusions were made references to each of the above engine parameters that were considered for the study.

- Effects of injection timing suggest that with the advanced from 19^0,23^0 and 27^0 BTDC. The brake thermal efficiency increased and found to be maxim at 27^0 BTDC.
- Effects of addition time propose with progression from 19^0 to 27^0 BTDC, the smoke opacity, HC and co emissions are decreased and found to be maxim at 27^0 BTDC.
- Effect of injection timing suggests that with advancement from 19^0 BTDC to 27^0 BTDC NO_X emissions increased and found to be maxim at 27^0 BTDC.

Reference

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