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Comparative Performance Analysis on Newly Design CI to SI Single Cylinder Engine

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Abstract*— This paper presents a modified design of single cylinder CI engine to a SI mode. Most of the modification required pilot fuel to start the engine. After modify the design analysis has to be done on the modified engine then the comparative analysis of result show that newly design engine perform well in petrol as well as gas (LPG) mode and also found that the conversion also very easy and quickly without need any expert and slightly change make engine work on SI mode. Result Show that the performance analysis is carried out for various engine parameters like total fuel consumption (TFC), Brake specific fuel consumption (BSFC) and Brake thermal efficiency (BTE) for various load conditions. The experimental analysis is performed and comparative result show that efficiency was increases in both the case gasoline as well as LPG.

***Index Terms*— LPG, BTE, Modified, CI, SI, bsfc**

I. INTRODUCTION

Diesel engine is a heart of modern transport system due to their greater performance and combustion quality it give high fuel economy and power as compare to SI Engine. Various Engineers and Researcher work in this field to achieve better performance with less emission of CI Engine. It is well known that diesel vehicles emit a lot of emission as compare to SI Engine due to this various euro norms are implement regularly to maintain emission standard.

Nikolaos Cristian Uute et al 2017 investigate LPG fuel in diesel engine with compression ratio 17 and conclude that BSFC decreases by 20% as well as the emission NOx also reduce to 25%.

Syed Yaser Hussaini et al 2016 HCCI () and carried a performance and emission analysis on the Diesel engine and compare result with spark ignition engine applying HCCI experiment result show that the performance with lower size fuel jet is comparatively higher than large size jet which shows that lean burn occur in HCCI. Compression ratio also effect the knocking tendency with increasing compression ration knocking also increases. Performance of HCCI mode SI engine is lower than the SI mode and it can be increases by controlling by air fuel ratio.NOx emission by using HCCI will reducer 78 %.

Tien Duy Nguyen et al 2020 perform experiment reactivity controlled compression ignition (RCCI) technology and evaluate performance and emissions of modified diesel engine. Result show that RCCI mode engine give a remarkable effect in the medium load condition. Homogeneous mixture supporting the combustion process of diesel fuel. Increasing the injection timing Contributes to homogenizing the mixture of gasoline, diesel and air that will reduce the NOx and shoot emission. But HC and CO emission is higher then existing diesel engine and that can be depending on injection timing at low load.

Arnold Taremwa et al (2016) work on the modification of single syliner 4 stroke diesel engine to work on dual fuel bio gas use as a primary fuel. and investigate the result at various different compression ratio ie 14:1, 16:1, 18:1.Result conclude that increasing the compression ratio increase the BTE of dual fuel engine due to increasing the combustion. Due to the presence of CO2 in bio gas bsfc is higher than that of diesel engine. Also conclude that at higher compression ratio NOx and CO2 increases and HC, CO reduces in dual fuel engine.

Vipul Patil et al (2020) work on a desigle engine and modified it to work in dual fuel mode i.e diesel and CNG. Result conclude that efficiency of the engine will improve when working on dual fuel mode and bsfc reduced.This research also show that CNG also used as the secondary fuel and they are available abundant in nature.

Himsar Ambarita et al modified CI engine experiment perform in two model one is without modifying and second one after modifying in second model nozzle is replace by spark plug and gas mixture fitted at the top to mix the fresh air .Result shown that bsfc of CI engine with LPG fuel about 17.53% is higher. It also suggested that engine is further modified by reducing the compression ratio and fuel injection system.

Kaleemuddin S et al the conversion of a diesel engine car to run on natural gas has been studied. In the engine, spark plugs, the electronic ignition system and gas cylinder equipment are installed instead of spray nozzles. For the combustion compression ratio was reduced from 21 to 13.

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II. CONVERSION TECHNIQUE

With the above literature reviews no one work to convert CI engine completely in to SI mode most of the researcher convert CI engine in to SI mode but they need to required pilot fuel no one directly start the engine without pilot fuel. In this paper modification made in the kirlosker single cylinder diesel engine to work directly in SI mode and comparative performance analysis done.

To convert CI engine in to SI mode one of the major thing is that to reduced the compression ratio because we know very well compression ratio of CI engine 15-21 and compression ratio of SI engine 6-12. Therefore to reduce the compression ratio modification is done in head and to reduce the compression ratio use aluminum plate to reduce the compression ratio due to their good thermal resistance property. To create the spark in SI engine mode we remove the fuel injector and in this place make suitable chance and fitted spark plug. Spark distributor and bottle coil also used and also need carburetor for the proper mixing of air fuel while mixture is use in case of LPG.

III. BLOCK DIAGRAM AND EXPERIMENTAL SETUP

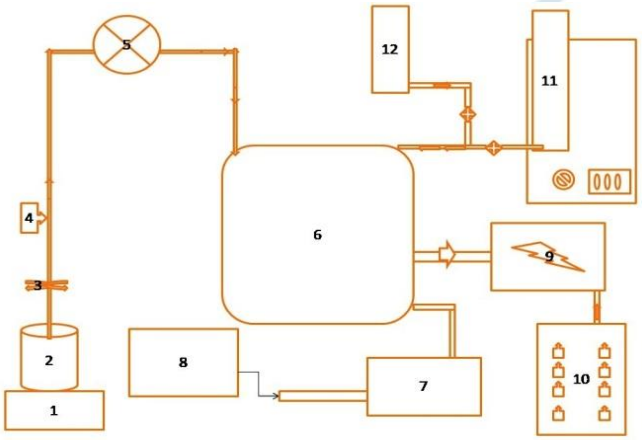

Figure 1: Block Diagram of Setup

1 Weight machine 2 LPG Cylinder
3 Regulator 4 Vaporizer
5 Mixture 6 Modified engine
7 Calorimeter 8 Gas analyzer
9 Generator 10 Load panel
11 Display panel 12 Fuel tanks

Figure 2 Experimental setup

Specifications of test engine

Table 1.1 specification of engine

S.No	Engine Parameters	Specificatios
1	Model	Kirloskar AV1
2	Type	Spark ignition water cooled engine
4	Displacement	148 cm^3
5	Compression ratio	7.5
6	Cooling system	Water cooled
7	Bore and stroke	80mm, and 110mm
8	Speed	1500rpm
9	Rotation while locking flywheel	Clockwise
10	Starting	Hand start

IV. RESULT AND ANALYSIS

Experimental has to be done on the set up on the engine keeping speed of the engine constant 1500 rpm in CI and SI mode. Diesel fuel use without modifying engine and after that the analysis is done on SI mode that is petrol and LPG after conversing and comparative study has to be done on the performance i.e bsfc, bte, and also investigate than HC and CO emissions.

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1. BRAKE THERMAL EFFICIENCY

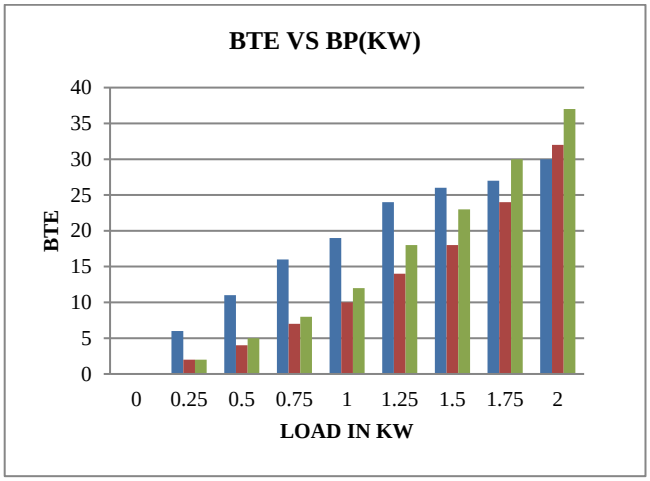

Figure 3: Brake thermal efficiency Vs Load

2. BRAKE SPECIFIC FUEL CONSUMPTIO

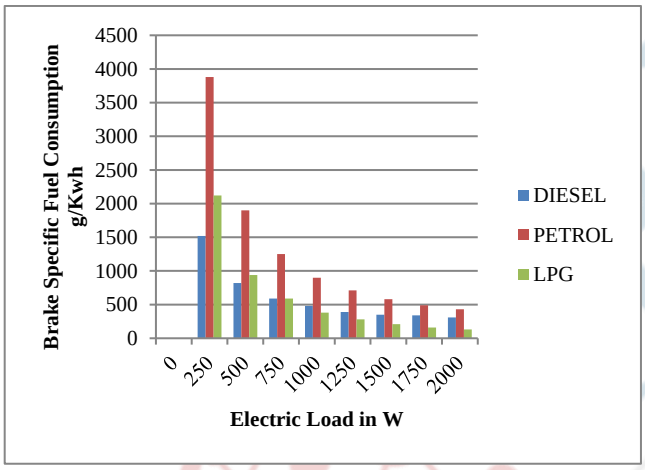

Figure 4: Brake Specific Fuel Consumption Vs Load

3. CO EMISSION WITH LOAD

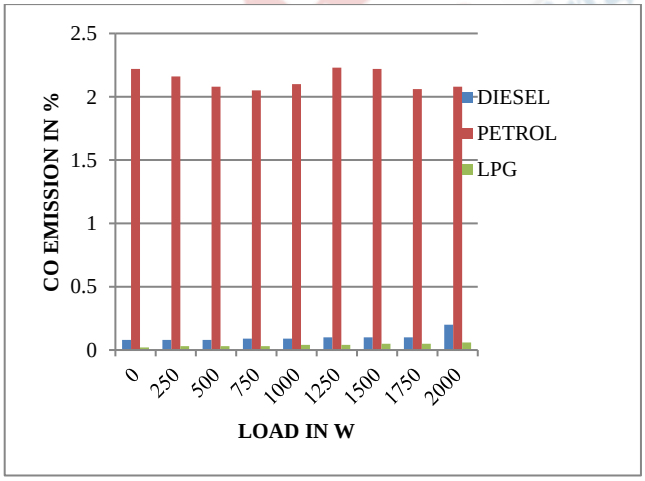

Figure 5: Brake Specific Fuel Consumption Vs Load

4. HYDROCARBON (HC) EMISSION

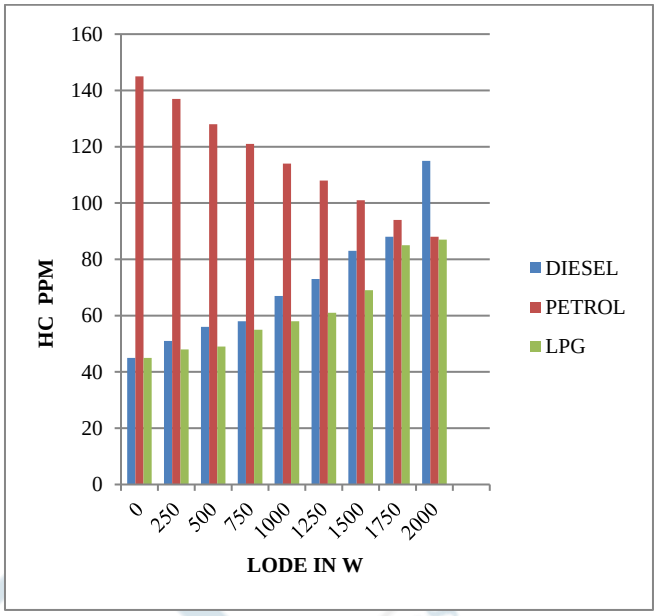

Figure 6 HC Emission Vs load

V. CONCLUSION

Above comparative result show that at a constant speed 1500rmp modified CI engine Run on a SI mode using petrol and lpg give better result as compare to diesel mode after conversion both, bsfc on all the tree mode has been compared the both and bsfc in LPG mode give higher thermal 37% but at the no load and low load condition thermal efficiency and bsfc is lowered but with increasing the load the both of them increase in LPG mode. While comparing the emission lpg give less HC,CO emission as compare to petrol and diesel but emission is higher is obtain in case of petrol due to the incomplete combustion.

Over all comparative analysis show that the modified newly design CI to SI engine give good performance in LPG mode as compare to the Diesel, Petrol mode.

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