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Experimental investigation of various Spark Plug gap on Four Stroke Single Cylinder S.I. Engine.

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Abstract— The SI engines are the most common for passenger cars and their development is therefore very important. It is believed that not only the spark energy, but also the spark location may play an important role in the interaction with mixture composition and charge motion; moreover the spatial distribution, between the spark electrodes gap, of the energy supplied by the discharge can also play a role in the development of Engines and performance and emissions, in this study experiments were carried out on a single cylinder petrol engine to understand the effect of spark plug gap on SI engine.

Keywords— Spark plug, Spark plug gap, Spark plug Electrode, SI engine, Electrode Geometry.

I. INTRODUCTION

In a SI engine combustion is initiated by spark plug, the various design parameter associated with the spark plug can affect the combustion of mixture inside the engine. The Spark plug geometry, electrode type, size , number of electrodes etc are undergoing research to understand the effect of all this parameter on actual combustion, performance and emission. With this an spark plug gap plays an important factor in combustion process of an SI engine.

II. REVIEW OF LITERATURE

Worm, Jeremy Jet al. (2013).In this experiment the alternative geometry Spark plug was evaluated with a conventional spark plug in an Two different test methods were used during the study steady state testing was employed to be able to examine the crank angle resolved burn rate, while transient testing was conducted to assess the impact of the alternative spark plug electrode geometry on overall engine output including both brake and indicated parameters. Transient testing was chosen over steady state for the performance evaluations since it better represents engine operation in its intended application.

It was found that although early burn rate has a profound impact on part-load operation under both transient and steady state operation, the alternative geometry spark plug resulted in a slightly increased flame kernel development and early burn rate. The changes in burn rates are slight compared to test to test variation, yet are consistent, and therefore are considered to be statistically significant. [1]

Teng Su et al.(2017)[2] In this study the effect of spark timing on performance of a hydrogen-gasoline dual-fuel rotary engine. For this aim, a modified rotary engine equipped with a dual-fuel port injection system was carried out,engine was operated at 4500 rpm with a manifold absolute pressure (MAP) of 35 kPa. Results showed that Advancing spark timing caused the increased flame development period, the decreased flame propagation period and exhaust temperature. Also HC and NOx emissions were reduced after retarding spark timing. Spark timing had little effect on CO emission.

Derek Johnson et al.(2016)[3] In this study this work was to investigate the effects of various spark plug configurations along with spark timing,Spark plugs with varied electrode diameter, number of ground electrodes, and heat ranges were evaluated against efficiency and exhaust emissions also combustion analysis was also conducted to understand effect of various parameters. Each spark plug configuration was examined at ignition timings of 17, 14, 11, 8, and 5 crank angle degrees TDC. Five spark plug configurations were examined during this program to elucidate the effects of penetration depth, electrode diameter, number of ground electrodes, they concluded that for different spark timing and electrode design combustion varied and effect on emission and performance was seen.

From the literature review spark plug gap was found to be one of the important parameter which affect the performance of a SI Engine

III. EXPERIMENTAL SETUP

The setup consist of a single cylinder four stroke SI engine air cooled and used with rope brake dynamoter for loading and measurent of brake power,fuel measurement consumption was measured using a burette along with an air box for measurement of air flow, thermocouple were used with digital multi channel temperature indicator to measure exhaust and intake temperatures.

Fig 1: Experimental setup

Parameter	Specification
Make	Bajaj
H.P. of engine	10.84 @8000 rpm
Cooling	Air Cooled
Dynamometer	Rope brake Dynamometer
No. Of cylinder	Single cylinder engine
Cubic capacity	134.6 cc

Table 1:Technical Specification of test engine

In this experiment engine was tested on five different engine speed 1500 rpm, 2000rpm, 2500 rpm ,3000rpm and 3500 rpm for three different spark plug gaps which were set as 0.35mm , 0.6mm and 0.8 mm. A rope brake dynamometer was used for measurement of brake power and loading was applied to investigate the effect of spark plug gap on performance of engine,brake power, brake torque and volumetric efficiency,brake specific fuel consumption etc were measured and results were compared in the experimental work.

IV. RESULTS AND DISCUSSIONS

Result obtained from the experiment which was conducted for different spark gaps are shown below. The relationship between different variables were shown in figures and discussed in following sections. Investigation was done or Spark plug gap 0.35, 0.6mm and 0.8 mm, here performance parameter were considered for five different engine speed and loading was applied.

A. *Brake specific fuel consumption*

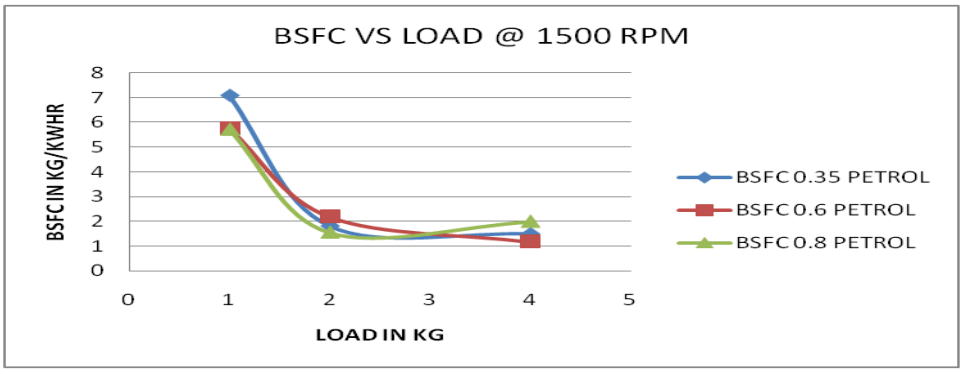

Fig 2 : BSFC VS LOAD @ 1500 rpm

Fig 3 : BSFC VS LOAD @ 2500 rpm

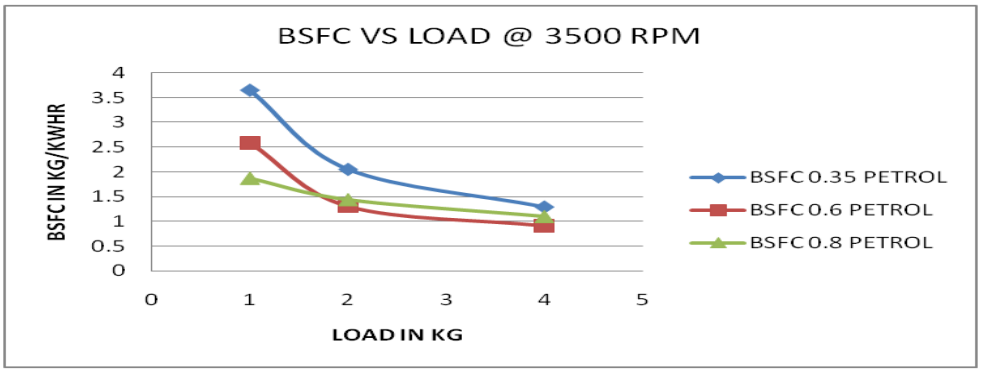

Fig 4: BSFC VS LOAD @ 3500 rpm

Bsfc in Kg/Kwhr are shown for three different engine speed vs load are plotted, result shows that Bsfc for spark plug gap 0.35 mm is comparatively higher for all engine speeds with load. Bsfc for 0.6 mm spark plug gap is lower in both cases and with spark plug gap 0.8mm Bsfc is slightly higher in 2500 rpm and is comparable with 0.6 mm Bsfc less than 0.35 mm spark plug gap.

So for lower spark plg gap fuel consumption increases and Bsfc is lowest for spark plug gap 0.6mm and then followed by 0.8 mm and higher for 0.35 mm due to less ignition energy at lower spark plug gap.

B. Brake Thermal Efficiency

Brake thermal efficiency is one of the most important engine performance parameter which indicates the percentage of fuel energy converted to useful power output. Fig 6 shows variation of brake thermal efficiency (BTHE) with different load and at different spark plug gaps.

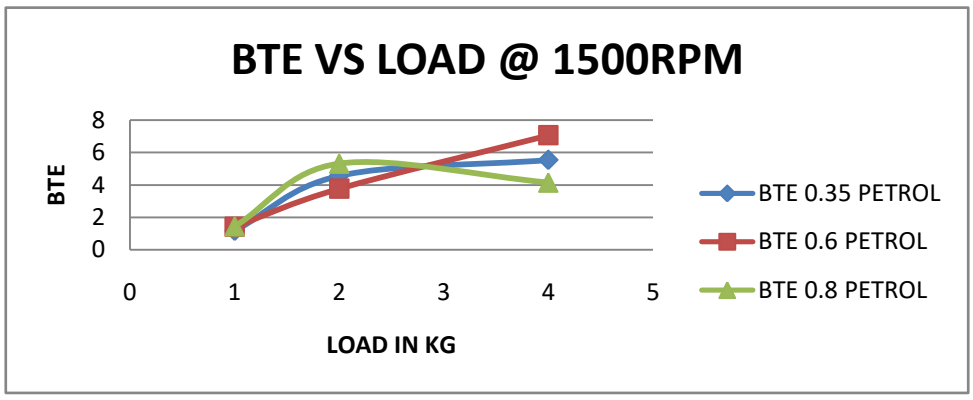

Fig 5: BTE VS LOAD @ 1500 rpm

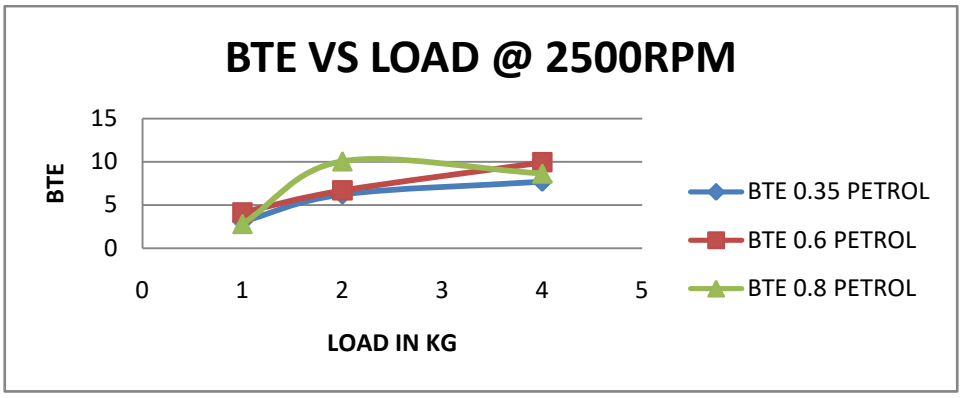

Fig 6: BTE VS LOAD @ 2500 rpm

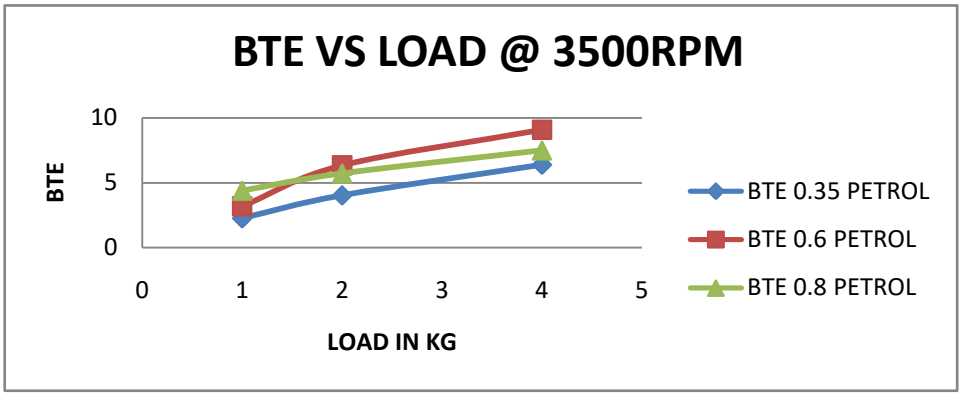

Fig 7: BTE VS LOAD @ 2500 rpm

Brake thermal efficiency (BTE) in percentage are shown for three different engine speed vs load are plotted, result shows that BTE of Spark gap 0.6mm is Higher for 3500 rpm and at 2500 rpm BTE increases for point 0.6mm spark gap to maximum value and followed by BTE at spark gap 0.8 mm and spark gap 0.35 results in lower BTE in all three engine speed vs load condition due to less required iginition energy for combustion and hence affect BTE.

C. Brake power

Brake power (BP) is another important factor for engine performance analysis , BP for three different spark plug gaps and engine speed in RPM are as shown below.

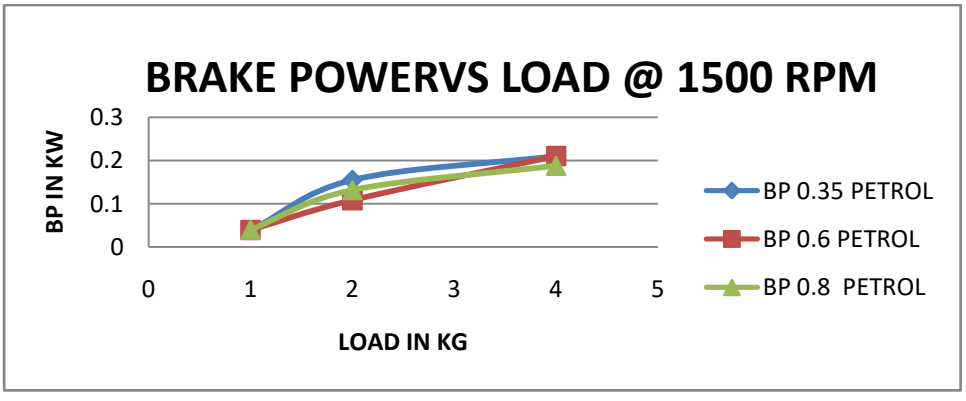

Fig 8: BP VS LOAD @ 1500 rpm

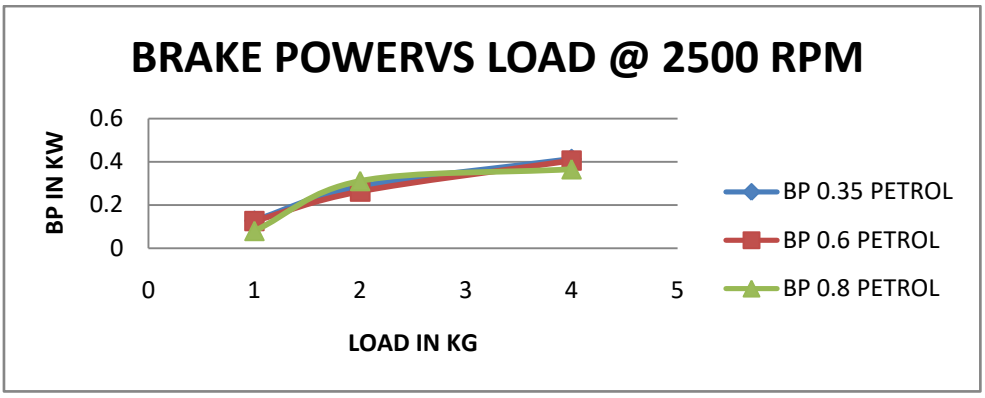

Fig 9: BP VS LOAD @ 2500 rpm

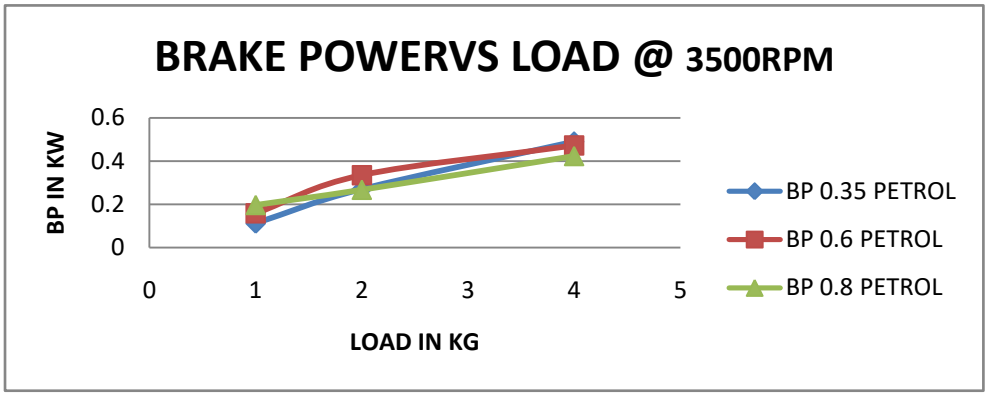

Fig 10 : BP VS LOAD @ 3500 rpm

Brake Power (BP) in Kw for various spark plug gap indicate that at 1500 rpm BP for spark plug gap0.35mm is higher compare to BP at spark plug gap 0.8 mm and Lowest Bp is for spark plug gap 0.6 mm with increase in engine speed to 2500 rpm BP for Spark plug gap 0.35 mm shows results similar to spark plug gap 0.6 mm and lowest for Spark plug gap 0.8 mm.

At higher speed BP for spark plug gap 0.6mm is higher compared to spark plug gap 0.35mm and then followed by spark plug gap 0.8mm. With lower speed spark energy smaller in magnitude is enough to jump electrode gap 0.35 mm and at electrode gap 0.8 mm engine BP reduces due to more energy requirement and difficult in combustion.

V. CONCLUSION

Since spark plug gap affect the combustion and performance of a petrol engine also affects the fuel efficiency. At lower spark plug gap higher brake power is obtained with increase in fuel consumption and at higher spark plug gap reduction in BP is obtained along with higher Fuel consumption so an optimum Spark plug gap for a given fuel is outmost factor which affects the performance and fuel efficiency and in this case spark gap between 0.6 mm can be considered as optimum value.

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