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# PERFORMANCE INVESTIGATION OF SINGLE CYLINDER TWO STROKE PETROL ENGINE WITH DIFFERENT SPARK TIMING AND SPARK PLUGS

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***Abstract:*** ***In present days an automobile engine has to satisfy the strict environmental constraints and fuel economy standards in addition to meeting the competitiveness of the world market. Today the automobile engines have synthesized the basic knowledge of many disciplines like thermodynamics, fluid flow, combustion, chemical kinetics and heat transfer. Now-a-days internal combustion engines play an important role in automobile field. There are various factors that influence the performance of engine such as compression ratio, ignition timing, quality of fuel, combustion rate, air fuel ratio, intake temperature and pressure and also based on piston design, inlet manifold, and combustion chamber designs etc. Growing demand on reduction of internal combustion engine fuel consumption with increase of its performance new designs and optimization of existing ones are introduced. Spark plug in SI engine influences the quality of spark produce for ignite the air/fuel mixture in the combustion chamber. Ignition timing plays an important role in complete combustion of air/fuel and helps to reduce pollution. In present work a single cylinder 145.45 cc petrol engine is used to investigate the performance characteristics. The main objective of this work is to study the effect of the spark plug and spark timing on performance and pollution of the single cylinder petrol engine at different loading condition.***

***Index Terms: Spark ignition (SI), Wide open throttle (WOT), Liquefied petroleum gas (LPG), Brake-specific fuel consumption (BSFC), Bottom dead center (BDC)***

## I. INTRODUCTION

A spark plug (sometimes, in British English, a sparking plug, and, colloquially, a plug) is a device for delivering electric current from an ignition system to the combustion chamber of a spark-ignition engine to ignite the compressed fuel/air mixture by an electric spark, while containing combustion pressure within the engine.

Parts of Plug

- Terminal
- Insulator
- Ribs
- Insulator tip
- Seals
- Metal case/shell
- Central electrode
- Side (ground, earth) electrode

Spark Plug Gap

Spark plugs are typically designed to have a spark gap which can be adjusted by the technician installing the spark plug, by bending the ground electrode slightly. The same plug may be specified for several different engines, requiring a different gap for each. Spark plugs in automobiles generally have a gap between 0.024"–0.070" (0.6–1.8 mm). The gap may require adjustment from the out of the box gap.

Ignition Timing

Ignition timing, in a spark ignition internal combustion engine (ICE), is the process of setting the angle relative to piston position and crankshaft angular velocity that a spark will occur in the combustion chamber near the end of the compression stroke.

## II. LITERATURE SURVEY

Indira Priyadarsini et al. [2] have worked on the importance of design variables of I.C. engine for better performance with fewer emissions. The spark timing and compression ratio are the two important design variables to deal with for effective performance of engine. This paper presents the effects of spark timing and compression ratio on the performance of a four stroke single-cylinder spark ignition engine. The study evaluated results of research in the area of spark ignition engine and is assessed by studying its performance characteristics relative to find the optimum. Experiments were conducted at different ST of 200 to 300 BTDC and CR of 3.5 to 9. The results have shown that performance parameters: brake thermal efficiency and volumetric efficiency increased for advanced timing. The peak pressure increases with increasing spark advance. The increased compression ratio results increased BTE and EGT increased and then decreased. BSFC decreased with increased compression ratio. The engine for tests used was variable compression ratio engine with adjustable dome head with wheel. The setup is running at constant speed of 3000rpm with water cooling system. The purpose of spark advance mechanism is to assure that under every condition of engine operation, ignition takes place at the most favorable instant in time. Increasing the compression ratio below detonating values to improve on the performance is another choice of variable. Increased fuel mileage, performance and reduction in emissions are just some of the benefits as the ignition timing can be advanced or retarded to prevent engine detonation. Higher compression ratios will however make gasoline engines subject to engine knocking if lower octane-

rated fuel is used, also known as detonation. the best results were obtained at 28°BTDC for compression ratio of 8:1 at 3000RPM.

## III. PROPOSED METHODOLOGY

From the literature survey, identified following parameters for my dissertation work:

1) Use of Different Spark Plugs

Different types of spark plug are available in market. we use this advance spark plug in the two stroke single cylinder spark ignition engine. We will use platinum tip spark plug, double platinum tip spark plug, iridium tip spark plug and copper tip spark plug which is in use now in two stroke spark ignition engine. It represents, increase the life of spark plug of the engine, reduce the fuel consumption and also minimization of emissions formation with good balance of cost.

2) With Varying Ignition Timing

From the literature survey it is concluded that the need for advancing the timing of the spark is because fuel does not completely burn the instant the spark fires, the combustion gasses take a period of time to expand, and the angular or rotational speed of the engine can lengthen or shorten the time frame in which the burning and expansion should occur. The ignition timing affects many variables including engine longevity, fuel economy, and engine power. So the selected different spark plugs are checked with changing the ignition timing.

3) Engine Load

From literature review we can consider engine load as parameter and measure the performance and emission characteristics for different engine speed.

Objectives of Research

Many researcher work on four stroke SI engine but only few were worked on two stroke SI engine. With high power to weight ratio, simple design, low maintenance more interest on two stroke engine deserve. The main aim of this work is improve efficiency and performance and reduce exhaust emission of two stroke petrol engine by using different spark plugs and varying ignition timing and spark gap.

## IV. EXPERIMENTAL SETUP

4.1 Experimental Setup Detail


Fig. 1 Experimental Setup

This is the experimental setup , which we are going to use for our testing. As shown in figure 4.1, the test equipment is composed of

- 2-stroke, single cylinder petrol engine with rope brake dynamometer
- Stop watch


Fig. 2 Exhaust gas analyzer

## V. RESULT AND DISCUSSION

5.1 Introduction

Experiment were performed at 20 kg, 40 kg, 60 kg, 80 kg engine load and brake power, BSFC, BTE are measured with different spark plugs at three different spark timing.

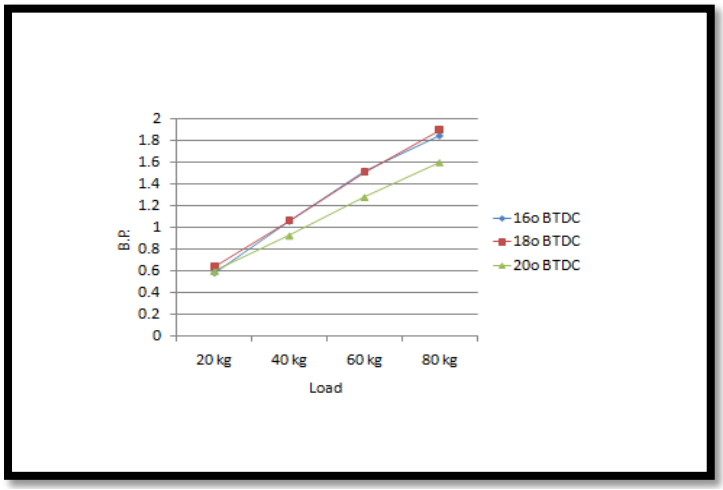
5.2 Engine Performance

In each test, the volumetric flow rate of fuel was measured and then converted into mass consumption rate based on the density of the fuel. Based on the mass consumption rate the fuel and the brake power, the brake specific fuel consumption and brake thermal efficiency can be calculated.

5.2.1 Brake Power

For better understanding of the relationship between engine load and Brake Power graphs were generated and shown as under,

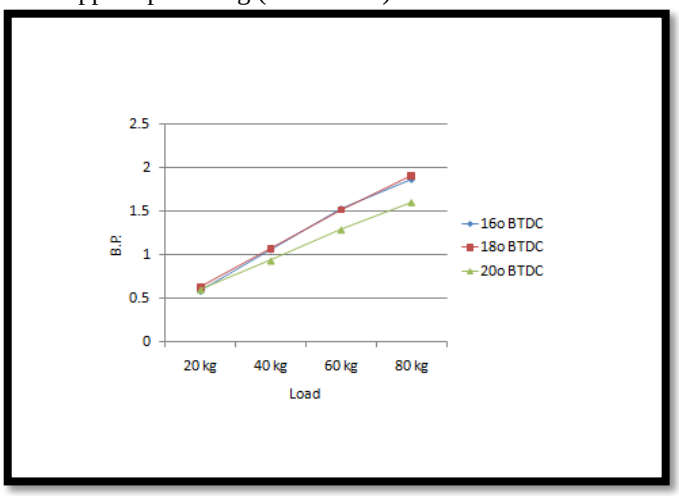
For Regular Spark Plug




Graph 1 B.P. vs Load

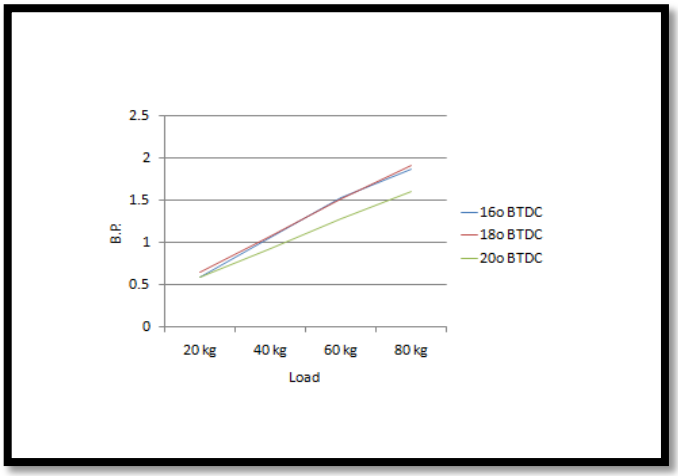
  

For Copper Spark Plug (Power TW)



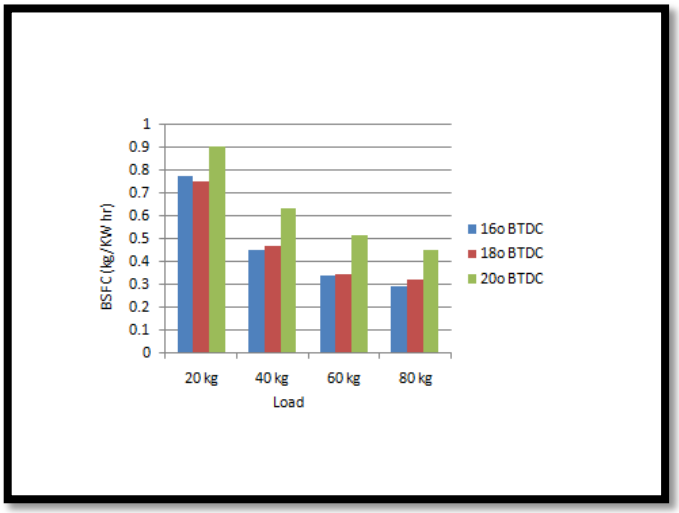

Graph 2 B.P. vs Load

For Silver Coating Spark plug (Bosch)



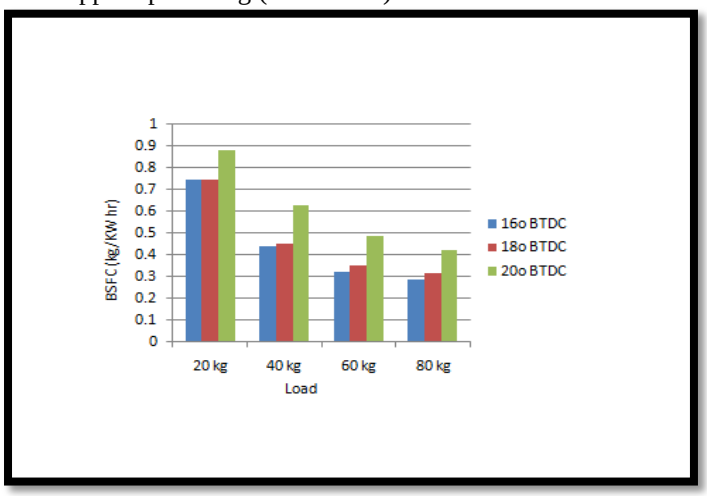

Graph 3 B.P. vs Load

6.2.2 Brake specific fuel consumption (BSFC)
For better understanding of the relationship between engine load and BSFC graphs were generated and shown as under,
For Regular Spark Plug



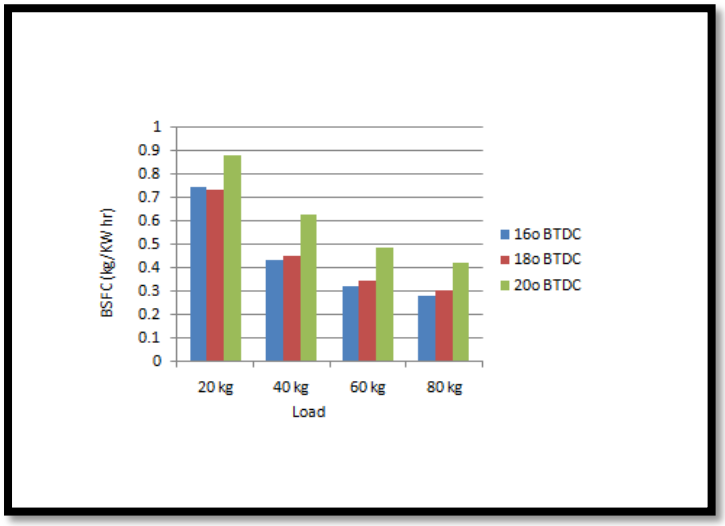

Graph 4 BSFC vs Load

For Copper Spark Plug (Power TW)



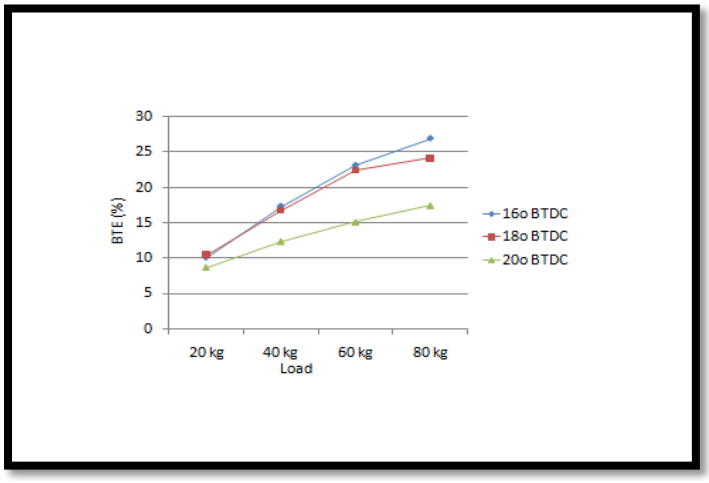

Graph 5 BSFC vs Load

For Silver Coating Spark plug (Bosch)




Graph 6 BSFC vs Load

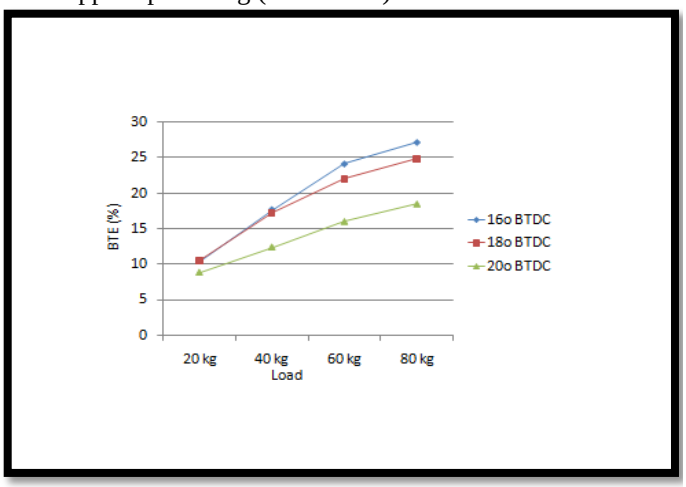
6.2.3 Brake Thermal Efficiency
Brake thermal efficiency is mainly affected by brake power, lower calorific value and fuel mass flow rate.
For Regular Spark Plug




Graph 6.7 BTE vs Load

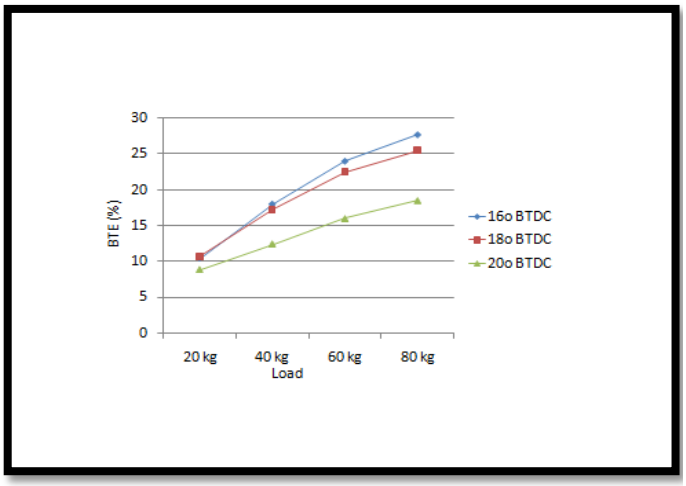
  

For Copper Spark Plug (Power TW)




Graph 6.8 BTE vs Load

For Silver Coating Spark plug (Bosch)



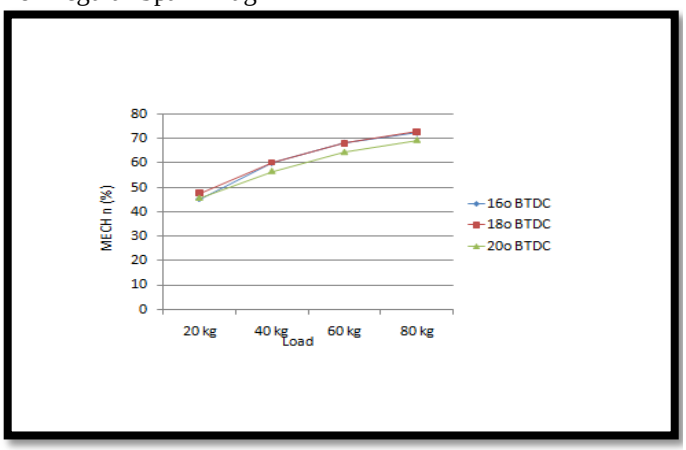

Graph 6.9 BTE vs Load

6.2.2 Mechanical efficiency

Mechanical efficiency is ration of brake power to indicated power.

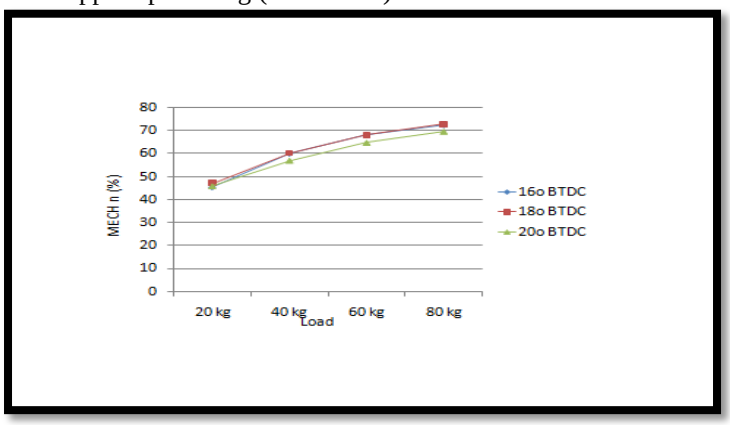
Mechanical efficiency gives the performance of engine, how much input power is transmitted to output shaft.

For Regular Spark Plug



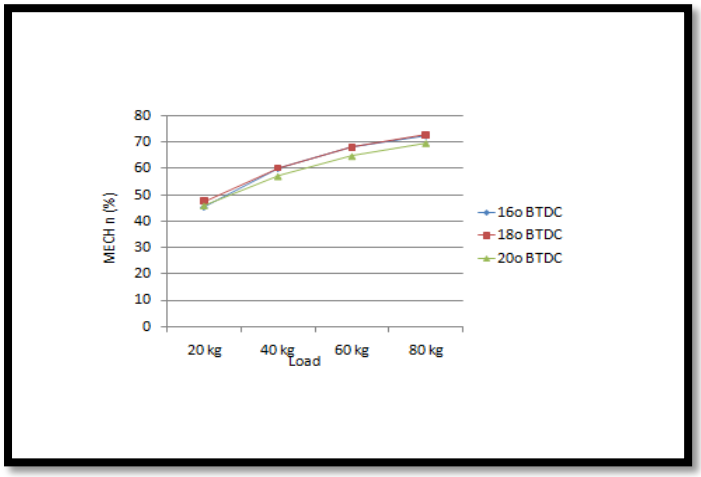

Graph 6.10 MECH n% vs Load

For Copper Spark Plug (Power TW)




Graph 6.11 MECH n% vs Load

For Silver Coating Spark plug (Bosch)




Graph 6.12 MECH n% vs Load

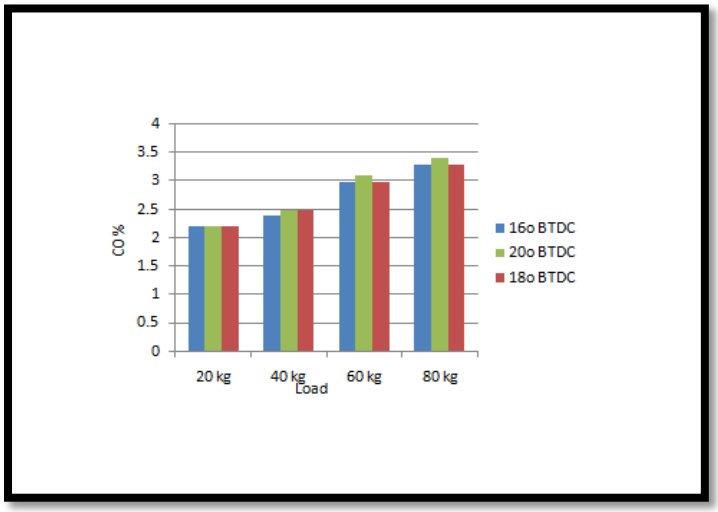
6.3 Engine Emission

6.3.1 CO

The formation of CO is mainly due to to the incomplete fuel oxidation phenomena.

CO % Volume at Different Spark Timing for Different Spark Plugs

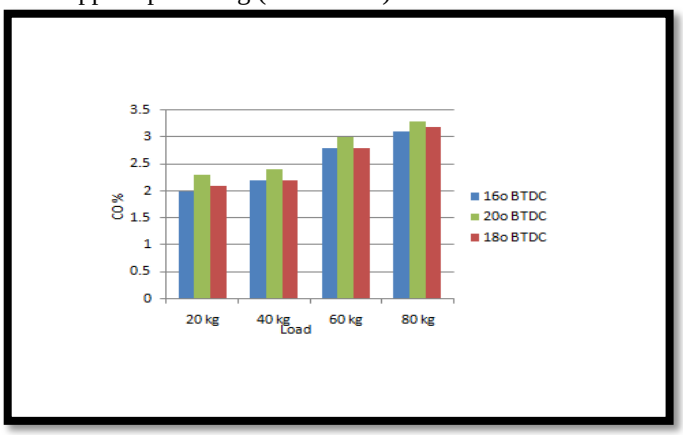
For Regular Spark Plug




Graph 6.13 CO% vs Load

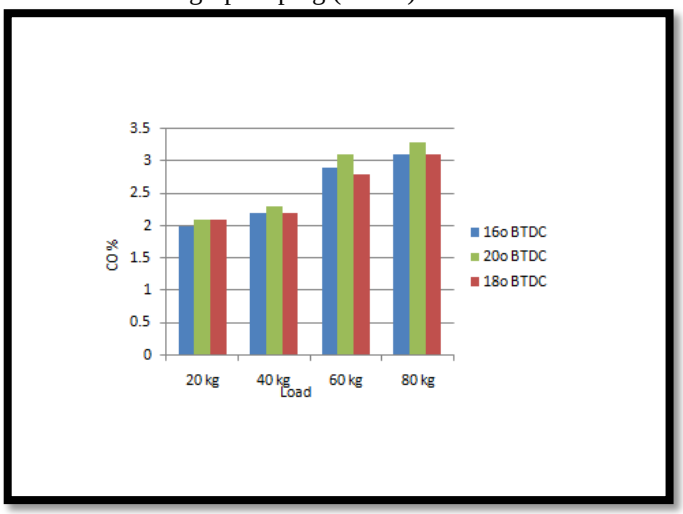
  

For Copper Spark Plug (Power TW)




Graph 6.14 CO% vs Load

For Silver Coating Spark plug (Bosch)

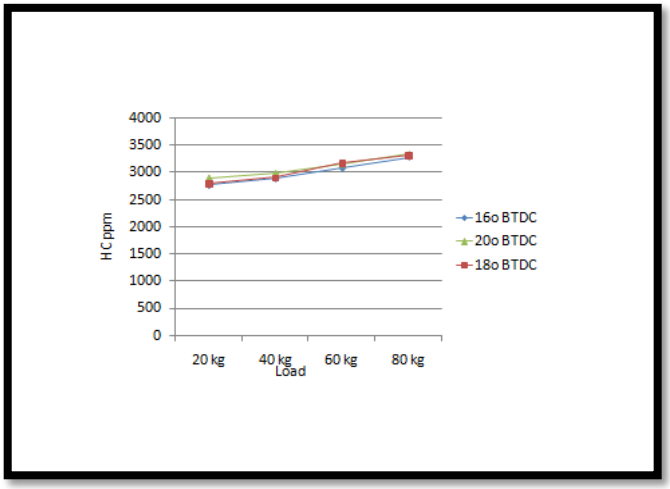



Graph 6.15 CO% vs Load

6.3.2 HC

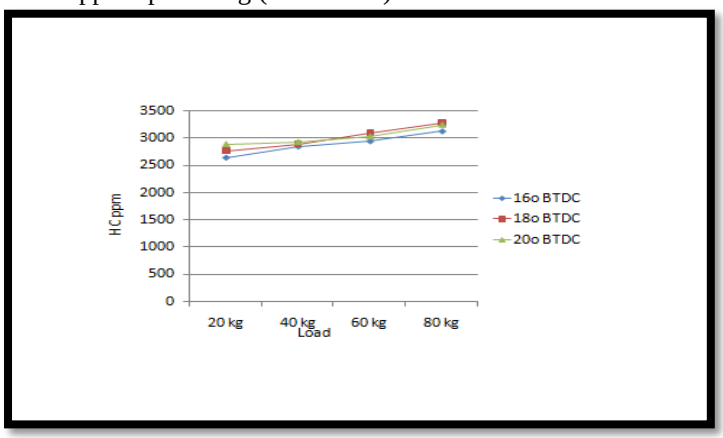
HC emissions are completely unburned or partially burned molecules those comes from heterogeneous combustion in the combustion chamber. HC can affect the human mucous membranes like the throat and eyes and the environment due to the smog-formation reaction that produces ozone.

For Regular Spark Plug



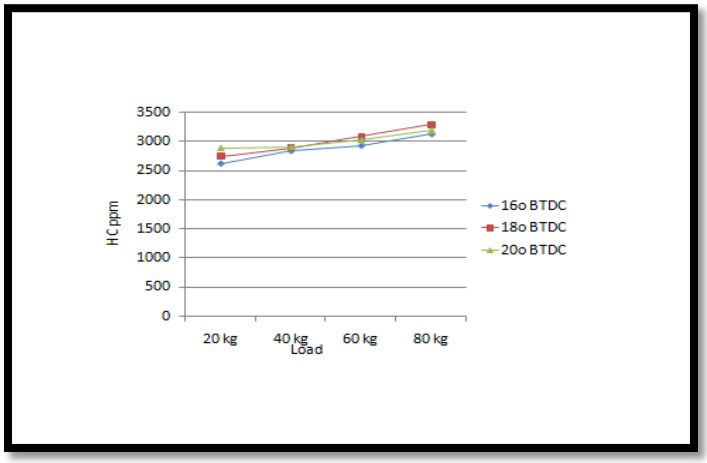

Graph 6.16 HC PPM vs Spark Timing

For Copper Spark Plug (Power TW)




Graph 17 HC PPM vs Spark Timing

For Silver Coating Spark plug (Bosch)

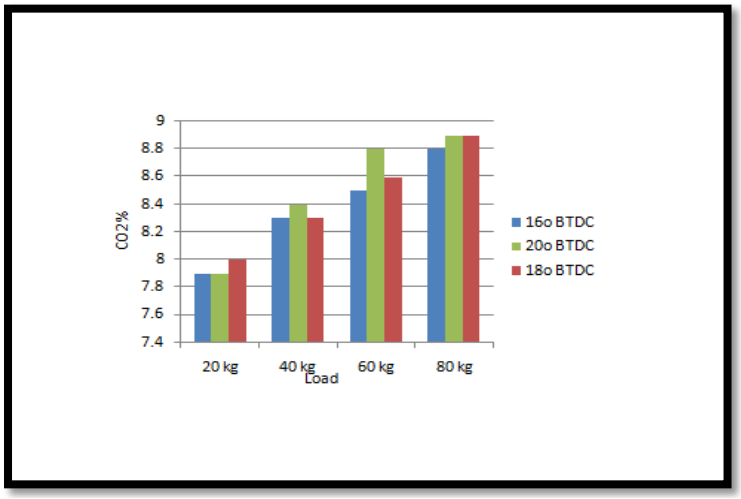



Graph 18 HC PPM vs Spark Timing

6.3.3 $CO_2$

Petrol is mixture of carbon and hydrogen, so it is called hydro carbon fuel. In complete combustion process bonded between hydrogen and carbon breaks and release heat or energy and free carbon makes bond with oxygen and it generates carbon dioxide.

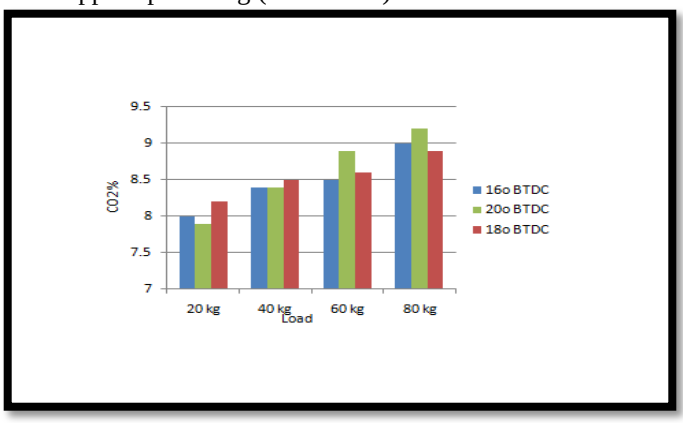
For Regular Spark Plug




Graph 6.19 CO% vs Load

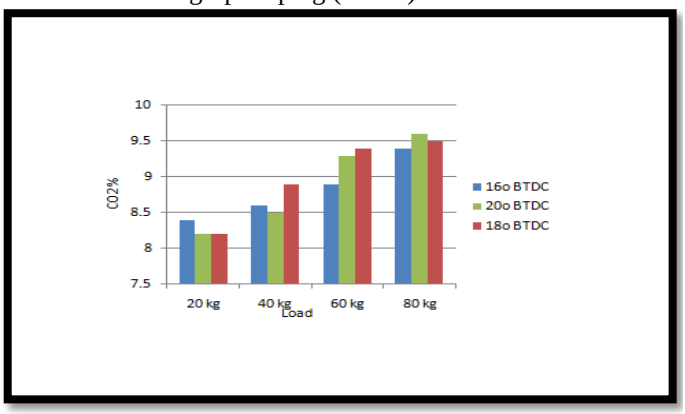
  

For Copper Spark Plug (Power TW)




Graph 6.20 $CO_2$% vs Load

For Silver Coating Spark plug (Bosch)




Graph 6.21 CO2% vs Load

## VI. CONCLUSIONS

- Fuel consumption is varying with the spark timing. As engine speed increase spark should advance for rapid combustion of fuel, but two much advancing may denote. While retarding the spark timing much cause the loss of power.
- We use different spark plug for experiment among them bosch Silver coated central electrode spark plug have the best result.
- As load on the engine increase brake power, brake thermal efficiency and mechanical efficiency increase and BSFC decrease.
- With advancing the spark ignition timing HC emission also decrease.
- Spark ignition timing has little effect on CO emission.
- As load increase percentage volume of CO2 has increases.

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