Combustion analysis of M.P.F.I. S.I. Engine

[1] **Mr. S. J. Patil**
(Asst. Prof.)
Sharad Institute of Technology,
College of Engineering, Yadrav (Ichalkaranji)
India.
   E-mail : shitalkumar_.patil@rediffmail.com

[2] **Mr. A. M. Patil**
(Associate Prof. & V. Principal)
P.V.P.I.T. Budhgaon.
India.

[3] **Mr. H. M. Dange**
 (Associate Prof.)
P.V.P.I.T. Budhgaon.
India.

Abstract—

In this era of modern civilization, transportation of goods as well as passengers is playing a very vital role. Day by day this number of vehicles plying over the roads is being increasing. Consequently this leads to tremendous consumption of non renewable conventional fossil fuels which are commonly known as gasoline (petrol) and diesel.

Moreover amount of pollutants those are being emitted through the tail pipes of cars is also tremendously increasing. Thus increased number of vehicles / cars altogether are becoming major pollution contributors of the entire globe.

For enhancing the performance of MPFI S.I. engine this work has been carried out both Combustion process analysis and Exhaust Gas analysis by varying the spark plug gap. The readings of various parameters are recorded for five different plug gaps. Moreover the trials are also carried out at various loads and speeds of the engine. All the respective calculations based on the corresponding observation tables have been performed and also tabulated the yielded results accordingly into respective result tables. The results have also been graphically interpreted.

Keywords— **S. I. Engine, Combustion analysis, Exhaust gas anbalysis, Spark plug gap variation**

I. INTRODUCTION

With increased population human beings   are experiencing the proportionate increment in transportation media known as vehicles that is goods and passenger transport vehicles. Day by day this number of vehicles plying over the roads is being increasing. Consequently this leads to tremendous consumption of nonrenewable conventional fossil fuels which are commonly known as gasoline   (petrol) and diesel. Moreover amount of

pollutants those are being emitted through the tail pipes of cars is also tremendously increasing. Thus increased number of vehicles / cars altogether are becoming major pollution contributors of the entire globe. Engineers are now bound to accept the prevailing challenge of considerable reduction of global pollution and optimum utilization of scarce fossil oil reserves by enhancing the overall performance of I. C. engines which will lead to enhancement of overall fuel economy.

Now a day Government has made it mandatory to all automobile manufacturers to reduce emission level of their vehicles to a minimum. To reduce the emission level of M.P.F.I. Petrol engine; thorough analysis of combustion process in combustion chamber can be efficiently carried out. So by varying some parameters of present engine optimum performance of the engine can be obtained.

II. METHODOLOGY.

Statement of Hypothesis : Combustion analysis of Multi Point Fuel Injection   S.I. Engine.

Method of data collection : Initially experimental evaluation of existing MPFI S.I. engine is carried out by implementing the phenomenon of combustion analysis. Entire data with regard to engine performance parameters is recorded accordingly. Eventually by varying the spark plug the combustion analysis of the said engine is be thoroughly carried out. Again all the variable data is recorded accordingly for further experimental procedure. Simultaneously exhaust gas analysis is carried out that yielded variation in the contents of exhaust gas due to variation of corresponding spark plug gap.

IV. EXPERIMENTAL SET-UP OF PROJECT

Method of data analysis : For enhancing the performance of MPFI S.I. engine the project work carried out both Combustion process analysis and Exhaust Gas analysis by varying the spark plug gap. The readings of various parameters are recorded for five different plug gaps. Moreover the trials are also carried out at various loads and speeds of the engine. All the respective calculations based on the corresponding observation tables are performed and tabulated the yielded results accordingly into respective result tables. Graphically entire results of combustion analysis and exhaust gas analysis are interpreted.


III. ACTION PLAN

The project work is carried out by implementing following steps.

1. Thorough review of relevant literature that is useful for proposed work.
2. Setting a proper procedure to test the various engine performance parameters.
3. Preparation of experimental set up with all calibrated equipments.
4. Variation of spark plug gap by filler gauge.
5. Evaluation of various performance parameters by varying operating conditions such as engine speed and load and its effect on performance of M.P.F.I. petrol engine.
6. Determination, recording and graphical representation of contribution of each individual gas element for various engine operating conditions with regard to air pollution due to exhaust gas emission.
7. Thorough Exhaust gas analysis for various engine operating conditions.
8. Comparison of existing and theoretical results.
9. Conclusion of research work.

V. RESULTS

Sr. No.	Parameters	Unit	Spark Plug Gap (m.m.)				
			0.762	0.686	0.596	0.508	0.406
1	Indicated Mean Effective Pressure	Bar	2.811	4.11	3.96	4.02	3.92
2	Time Required for 50 gm.Fuel Cons.	Sec.	76.72	78.77	80.78	77.73	71.16
3	Brake Specific Fuel Consumption	Gms / Kwh.	275.13	276.25	268.72	279.92	297.92
4	Brake Power	Kw	8.53	8.27	8.29	8.27	8.49
5	Air / fuel Ratio		20.94	22.21	21.9	21.78	20
6	Brake Thermal Efficiency	%	27.66	27.55	28.32	27.19	25.55
7	Volumetric Efficiency	%	51.61	55.5	53.24	54.74	53.38
Emission of Exhaust Gas Elements							
1	CO	%	3.064	3.134	3.139	3.397	2.706
2	HC	PPM	216	233	221	224	220
3	CO2	%	10	10.1	10.2	10	10.8
4	O2	%	4.46	4.34	4.73	4.29	4.35
5	Nox	PPM	385	392	312	365	405
6	LDA		1.22	1.111	1.131	1.098	1.124

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## VI. GRAPH AND DISCUSSION.
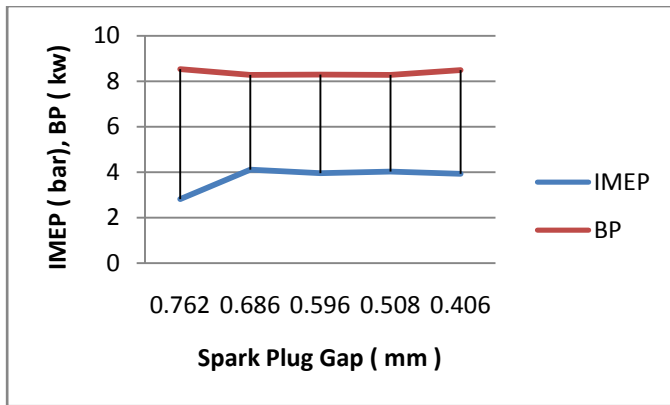
Graph : Spark plug gap Vs. IMEP, B.P.

Discussion:

a. Graph of 'Spark plug gap' Vs. 'IMEP' infers that, indicated mean effective pressure is much lower at maximum spark plug gap compared to other gaps at constant speed.

b. Graph of 'Spark plug gap' Vs. 'BP' infers that, brake power is high at maximum and minimum spark plug compared to other moderate gaps at constant speed.
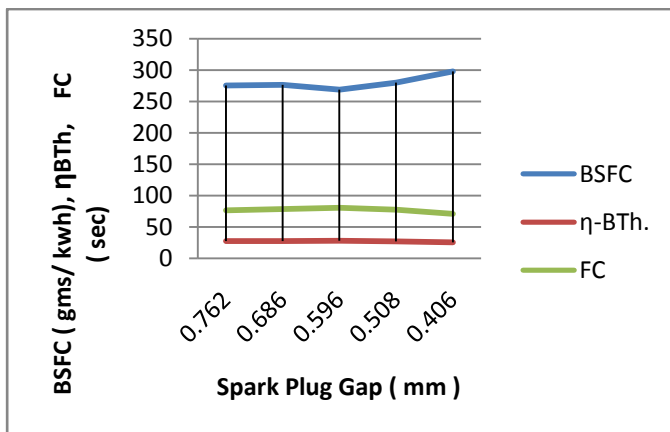
b. Graph of 'Spark plug gap' Vs. 'η BTh', infers that brake thermal efficiency gradually and very slightly goes on decreasing with decrease in spark plug gap at constant speed.

c. Graph of 'Spark plug gap' Vs. 'FC', infers that rate of fuel consumption   goes on increasing gradually with decreasing spark plug gap at constant speed.
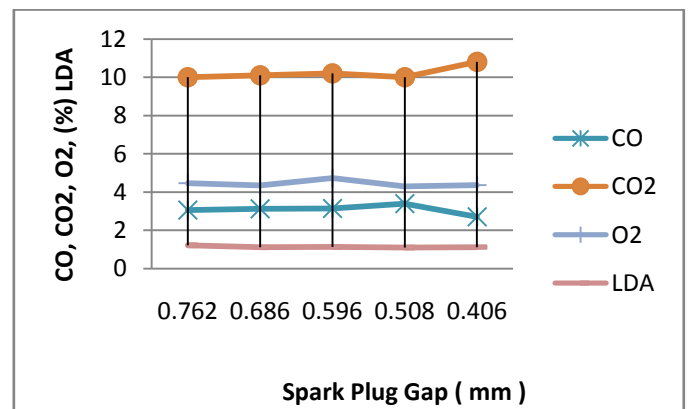
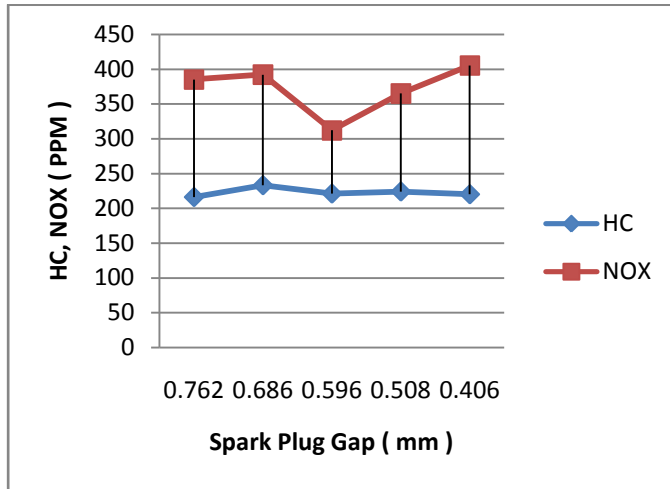**Graph: Spark plug gap Vs. CO, CO2, O2, LDA**

Discussion:

a. Graph of   'Spark plug gap' Vs 'CO' infers that, CO emission goes on decreasing gradually with decrease in plug gap at constant speed.

b. Graph of   'Spark plug gap' Vs 'CO2' infers that, CO2 emission goes on increasing gradually with decrease in plug gap at constant speed.

c. Graph of   'Spark plug gap' Vs 'O2' infers that, O2 emission is high at moderate spark plug gap compared to other gaps at constant speed.

d. Graph of   'Spark plug gap' Vs 'LDA' infers that, LDA emission fairly remains constant for all spark plug gaps at constant speed.

Graph : Spark plug gap Vs. IMEP, η BTh, FC

Discussion:

a. Graph of   'Spark plug gap' Vs. 'BSFC', infers that brake specific fuel consumption   goes on increasing   with decreasing spark plug gap at constant speed.

Graph: Spark plug gap Vs. HC, NOx

Discussion:

a. Graph of 'Spark plug gap' Vs 'HC' infers that, hydrocarbon emission goes on decreasing gradually with decrease in plug gap at constant speed.

b. Graph of 'Spark plug gap' Vs 'NOx' infers that at moderate spark plug gap NOx emission is much low and it increase gradually with maximum and minimum gaps at constant speed.

VII. CONCLUSION

Research work of combustion analysis and exhaust gas analysis of MPFI S.I.engine is helpful in determining the best optimum spark plug gap in order to achieve complete combustion of the fuel. Complete combustion of the fuel yields maximum power output thereby enhancing better fuel economy. Moreover there is considerable reduction in amount of Unburnt hydrocarbons and other hazardous pollutants of the exhaust gas emission.

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